Lecture Notes in Networks and Systems 103

Harvinder Singh Saini
Rishi Sayal
Rajkumar Buyya
Govardhan Aliseri *Editors*

Innovations in Computer Science and Engineering

Proceedings of 7th ICICSE

Springer

Lecture Notes in Networks and Systems

Volume 103

The series "Lecture Notes in Networks and Systems" publishes the latest developments in Networks and Systems—quickly, informally and with high quality. Original research reported in proceedings and post-proceedings represents the core of LNNS.

Volumes published in LNNS embrace all aspects and subfields of, as well as new challenges in, Networks and Systems.

The series contains proceedings and edited volumes in systems and networks, spanning the areas of Cyber-Physical Systems, Autonomous Systems, Sensor Networks, Control Systems, Energy Systems, Automotive Systems, Biological Systems, Vehicular Networking and Connected Vehicles, Aerospace Systems, Automation, Manufacturing, Smart Grids, Nonlinear Systems, Power Systems, Robotics, Social Systems, Economic Systems and other. Of particular value to both the contributors and the readership are the short publication timeframe and the world-wide distribution and exposure which enable both a wide and rapid dissemination of research output.

The series covers the theory, applications, and perspectives on the state of the art and future developments relevant to systems and networks, decision making, control, complex processes and related areas, as embedded in the fields of interdisciplinary and applied sciences, engineering, computer science, physics, economics, social, and life sciences, as well as the paradigms and methodologies behind them.

**** Indexing: The books of this series are submitted to ISI Proceedings, SCOPUS, Google Scholar and Springerlink ****

More information about this series at http://www.springer.com/series/15179

Harvinder Singh Saini · Rishi Sayal ·
Rajkumar Buyya · Govardhan Aliseri
Editors

Innovations in Computer Science and Engineering

Proceedings of 7th ICICSE

Springer

Editors
Harvinder Singh Saini
Guru Nanak Institutions
Hyderabad, Telangana, India

Rishi Sayal
Guru Nanak Institutions
Hyderabad, Telangana, India

Rajkumar Buyya
School of Computing
and Information Systems
The University of Melbourne
Melbourne, VIC, Australia

Govardhan Aliseri
Department of Computer Science
and Engineering
Jawaharlal Nehru Technological
University Hyderabad
Hyderabad, Telangana, India

ISSN 2367-3370 ISSN 2367-3389 (electronic)
Lecture Notes in Networks and Systems
ISBN 978-981-15-2042-6 ISBN 978-981-15-2043-3 (eBook)
https://doi.org/10.1007/978-981-15-2043-3

This Springer imprint is published by the registered company Springer Nature Singapore Pte Ltd.
The registered company address is: 152 Beach Road, #21-01/04 Gateway East, Singapore 189721, Singapore

Organizing Committee

Patrons

Sardar Tavinder Singh Kohli
Sardar Gagandeep Singh Kohli

Conference Chair

Dr. Harvinder Singh Saini

Conference Co-chairs

Dr. S. Sreenatha Reddy
Dr. M. Ramalinga Reddy
Dr. Rishi Sayal

Conveners

Dr. S. Deepajothi
Dr. D. Stalin Alex
Dr. J. Rajeshwar
Prof. V. Deva Sekhar
Dr. M. I. Thariq Hussan
Dr. S. Jayanthi
Dr. Ch. Subbalakshmi

Co-conveners

Dr. E. Madhusudhana Reddy
Dr. M. Venkata Narayana
Dr. S. Madhu
Mr. Devi Prasad Mishra
Mr. D. Saidulu
Mr. A. Ravi

Committees

Conference Committee: Dr. Rishi Sayal

Mrs. B. Ranjitha
Mr. Mohammed Miskeen Ali
Ms. Rajashree Sutrawe
Mr. S. Sreekanth

Publicity Chair International: Dr. D. Stalin Alex/Dr. M. I. Thariq Hussan

Mr. Mohammed Imran Sheikh
Mr. M. Naresh Kumar
Mr. Manik Rao Patil

Publicity Chair National: Dr. S. Deepajothi/Dr. J. Rajeshwar/ Prof. V. Devasekhar

Mrs. R. Sravani
Mr. M. Ajay Kumar
Mr. Farooq Mohammed
Mr. Ravindra

Programme and Publication Chair: Dr. S. Jayanthi/Dr. Ch. Subbalakshmi

Mr. D. S. S. Veeresh
Ms. B. Mamatha
Ms. Ch. Pushya
Mr. I. Phani Raja

Accommodation Chair: Dr. M. Venkata Narayana

Mr. M. Mahesh
Mr. Arun Singh
Mr. Kiran Jeevi

Advisory Board International

Dr. San Murugesan, Australia
Prof. Rajkumar Buyya, Australia
Dr. Hemant Pendharkar, USA
Dr. Anuj Sharma, USA
Dr. Chandrashekar Commuri, California
Mr. Maliyanath Sundaramurthy, USA
Dr. Sitalakshmi Venkataraman, Australia
Mr. Kannan Govindaraj, USA
Dr. Hamid R. Arbania, USA
Dr. Anitha Thangasamy, Ethiopia
Dr. K. M. Sharavana Raju, Saudi Arabia
Dr. Lipo Wang, Singapore
Dr. Vitaliy Mezhuyew, Malaysia
Dr. Gopala Karunakaran, South Korea

Advisory Board National

Dr. Raj Kamal, India
Dr. R. Markandeya, India
Dr. A. Govardhan, India
Dr. D. V. L. N. Somayajulu, India
Dr. A. K. Nayak, India
Dr. K. Shahu Chatrapati, India
Dr. Uday Bhaskar Vemulapati, India
Dr. R. B. V. Subramanyam, India
Dr. G. Narsimha, India
Dr. L. Sumalatha, India
Dr. P. Premchand, India
Dr. D. D. Sarma, India
Dr. Nicholas Savarimuthu, India
Mr. Mohamed Kasim Khan, India
Dr. N. Krishnan, India
Dr. N. Parthiban, India
Dr. Bhramaramba Ravi, India
Dr. K. V. Ramana, India
Dr. Shivamurthy, India
Dr. M. P. Vani, India

Dr. Ramakanth Kumar P., India
Dr. Sasikala R., India
Dr. Amitabh Wahi, India
Dr. Aruna Malapadi, India
Dr. T. Venugopal, India
Dr. P. Natarajan, India

Preface

This volume contains 70 papers that were presented at the Seventh International Conference on Innovations in Computer Science and Engineering (ICICSE-2019) held during 16–17 August 2019 at Guru Nanak Institutions, Hyderabad, India, in collaboration with Computer Society of India (CSI) and funding from Council of Scientific and Industrial Research (CSIR).

The aim of this conference is to provide an international forum that hubs together the researchers, scientists, academicians, corporate professionals and technically sound students from all over the world under a roof to make it as a phenomenal, informative and interactive session which is acutely needed to pave the way to promote research advancements in the field of computer science and engineering.

ICICSE-2019 received more than five hundred research papers from various sub-fields of computer science and engineering. Each submitted paper was meticulously reviewed by our review committee consisting of senior academicians, industry professionals and professors from premier institutions and universities.

This conference was inaugurated and attended by top dignitaries such as Dr. A. K. Nayak, Fellow and President, CSI, India; Dr. Govardhan Aliseri, Professor and Rector JNTUCEH, Hyderabad; Dr. Vijanth Sagayan Asirvadam, Director of Institute of Autonomous System, Universiti Teknologi, Petronas, Malaysia; Mr. G. Rama Seshagiri, Senior Principal Scientist, Head—IT Group, CSIR–NGRI, Hyderabad; Mr. Meka Venkata Chalapathy, Senior Director and Talent Management Head, Virtusa, Hyderabad; Mr. Dhrumil Sorathia, COO, Multiplier Solutions, Hyderabad; Mr. K. Mohan Raidu, Chairman, Div VIII, CSI; Dr. D. D. Sarma, Fellow CSI, Recipient LTA Award, CSI, Fellow A.P. and Telangana Academics of Sciences; Mr. Suresh Babu, Vice President, Information Technology and International Cooperation, Linyi Top Network Company, Shandong, China; and Mr. Huang Liming, Manager and Co-Interpreter of International Cooperation, Linyi Top Network Company, Shandong, China.

The technical sessions of this conference were chaired by eminent professors, Dr. P. Swetha, Department of Computer Science and Engineering, JNTUH College of Engineering Jagtial, Telangana; Dr. T. Arumuga Maria Devi, Centre for

Information Technology and Engineering, Manonmaniam Sundaranar University, Tamil Nadu; and Dr. C. N. S. Vinoth Kumar, School of Computing, SRM Institute of Science and Technology, Kattankulathur, Chennai.

Pre-conference tutorial sessions were conducted for two days during 9–10 August 2019 on cutting-edge technologies such as knowledge representation and expert systems, social network analysis, development of smart grid towards smart city perspective, and augmented reality, and the invited speakers were Dr. Parthiban Natarajan, Professor, Department of CSE, SRM Institute of Science and Technology, Chennai, India; Dr. Srinivas Padmanabhuni, Co-Founder, Tarah Technologies, Associate Vice President Research at Infosys, India, Dr. Albert Alexander, Associate Professor, Department of EEE, Kongu Engineering College, India; and Dr. Vigneshwaran T., Founder and CEO, Nanda Infotech, Coimbatore, India, respectively.

The organizing committee of ICICSE-2019 takes the opportunity to thank the invited speakers, session chairs and reviewers for their excellent support in making this ICICSE-2019 a grand success.

The quality of the research papers is a courtesy from respective authors and reviewers to come up with the desired level of excellence. We are indebted to the programme committee members and external reviewers in producing the best-quality research papers in a short span of time. We also thank CSI delegates and CSIR, for their valuable suggestions and funding in making this event a grand success.

Hyderabad, India — Harvinder Singh Saini
Hyderabad, India — Rishi Sayal
Hyderabad, India — Govardhan Aliseri
Melbourne, Australia — Rajkumar Buyya

Contents

Editors and Contributors

About the Editors

Dr. Harvinder Singh Saini is the Managing Director of Guru Nanak Institutions. He holds a Ph.D. in Computer Science, and has over 29 years of teaching experience at university/college level. He has published/presented several high-quality research papers in international and national journals and the proceedings of international conferences. He has published six books with Springer. He is a lover of innovation and is an advisor on NBA/NAAC accreditation process to many institutions in India and abroad. He is chief editor of a number of innovative journals and chairs various international conferences.

Dr. Rishi Sayal is an Associate Director of Guru Nanak Institutions Technical Campus. He holds a B.E. (CSE), and M.Tech. (IT), and received his Ph.D. (CSE). in Computer Science and Engineering in the field of data mining from the prestigious Mysore University of Karnataka State. He has over 27 years of experience in training, consultancy, teaching, and placements. His current areas of research interest include data mining, network security, and databases. He has published a wide number of research papers in international conferences and journals, and has received several research grants from government funding agencies. He is co-editor of various innovative journals and has convened international conferences.

Dr. Rajkumar Buyya is a Redmond Barry Distinguished Professor and Director of the Cloud Computing and Distributed Systems (CLOUDS) Laboratory at the University of Melbourne, Australia. He is also serving as the founding CEO of Manjrasoft Pvt. Ltd, a spin-off company of the University, commercializing its innovations in cloud computing. He served as a Future Fellow of the Australian Research Council from 2012 to 2016. He received a Doctor of Philosophy (Ph.D.) in Computer Science and Software Engineering from Monash University,

Melbourne, Australia, in 2002. Dr. Buyya has authored/co-authored over 625 publications. He has co-authored five textbooks and edited the proceedings of over 26 international conferences.

Dr. Govardhan Aliseri is currently a Professor of Computer Science & Engineering, Rector of JNTUH, and a member of the executive council at Jawaharlal Nehru Technological University Hyderabad (JNTUH), India, where he also completed his Ph.D. He is a member of the editorial boards of twelve international journals. He is a member of the advisory & academic boards and technical program committees of more than 65 international and national conferences. He has published two monographs and ten book chapters.

Contributors

Sheikh Abujar Department of Computer Science and Engineering, Daffodil International University, Dhaka, Bangladesh

T. Aditya Sai Srinivas SCOPE, VIT University, Vellore, Tamil Nadu, India

Manisha Agarwal Banasthali Vidyapith, Computer Science and Engineering, Jaipur, Rajasthan, India

Ram Bhushan Agnihotri Amity University Noida, Noida, India

Laxmi Ahuja Amity Institute of Information Technology, Amity University, Noida, Uttar Pradesh, India

V. Aishwarya CSE, SOC, SASTRA University, Thanjavur, India

Jwalin Arora Delhi Technological University, New Delhi, India

R. Arya Department of Computer Science & IT, Amrita Vishwa Vidyapeetham University, Kochi, India

Khalid Been Md. Badruzzaman Department of Software Engineering, Daffodil International University, Dhaka, Bangladesh

N. Balaji SOCE, University of Missouri-Kansas City, Kansas City, MO, USA

Bhavan Kumar Basavaraju Computer Science and Engineering, Panimalar Engineering College, Chennai, India

K. R. Bhargav Computer Science and Engineering, Panimalar Engineering College, Chennai, India

Koyela Chakrabarti Department of Computer Science and Engineering, West Bengal University of Technology, Kolkata, India

Navoneel Chakrabarty Jalpaiguri Government Engineering College, Jalpaiguri, West Bengal, India

Sri Venkata Divya Madhuri Challa University of Texas at Dallas, Texas, USA

Santanu Chatterjee Department of Computer Science and Engineering, West Bengal University of Technology, Kolkata, India

Anamika Chauhan Delhi Technological University, New Delhi, India

Akhil Chitreddy School of Computer Science and Engineering, Vellore Institute of Technology, Vellore, Tamil Nadu, India

Harshit Choubey Vellore Institute of Technology, Vellore, Tamil Nadu, India

Siddhartha Chowdhury Jalpaiguri Government Engineering College, Jalpaiguri, West Bengal, India

Jabez Christopher Department of Computer Science and Information Systems, BITS-Pilani, Hyderabad Campus, Hyderabad, Telangana, India

Aarti Chugh Amity University Haryana, Gurgaon, India

Padma Dandannavar Department of Computer Science, KLS Gogte Institute of Technology, Belagavi, India

P. Darwin Centre for Information Technology and Engineering, Manonmaniam Sundaranar University, Tirunelveli, Tamil Nadu, India

Rinkle Das Amity Institute of Information Technology, Amity University, Noida, Uttar Pradesh, India

Yogesh Deo Mercedes Benz Research and Development India Pvt. Ltd., Pune, Maharashtra, India

T. Arumuga Maria Devi Centre for Information Technology and Engineering, Manonmaniam Sundaranar University, Tirunelveli, Tamil Nadu, India

Kritika Dutta National Institute of Technology Calicut, Kozhikode, India

Steve Abraham Eapen National Institute of Technology Calicut, Kozhikode, India

Ebinezar TCS, Edison, NJ, USA

Fahad Faisal Department of Computer Science and Engineering, Daffodil International University, Dhaka, Bangladesh

Mohd Umar Farooq Muffakham Jah College of Engineering and Technology, Hyderabad, India

Armaan Farshori Amity Institute of Information Technology, Amity University Uttar Pradesh, Noida, India

Dherya Gandhi Amity Institute of Information Technology, Amity University, Noida, India

Chintakani Sai Gireesh Computer Science and Engineering, Panimalar Engineering College, Chennai, India

Kailash Gogineni School of Computer Science and Engineering, Vellore Institute of Technology, Vellore, Tamil Nadu, India

K. Govinda SCOPE, VIT University, Vellore, Tamil Nadu, India

Neetu Gupta Amity Institute of Information Technology, Amity University, Noida, Uttra Pradesh, India

Sharmi Dev Gupta AIG PPS AVM, Cognizant Technology Solutions Private Limited, Kolkata, India

Balaji Hariharan Amrita School of Engineering, Amrita Center for Wireless Networks & Applications (AmritaWNA), Amrita Vishwa Vidyapeetham, Amritapuri, India

Fuad Hasan Department of Computer Science and Engineering, Daffodil International University, Dhaka, Bangladesh

Mehedi Hasan Department of Computer Science and Engineering, Daffodil International University, Dhaka, Bangladesh

Animesh Hazra Department of Computer Science and Engineering, Jalpaiguri Government Engineering College, Jalpaiguri, West Bengal, India

Veena N. Hegde BMS College of Engineering, Bengaluru, India

R. Hepzibai Centre for Information Technology and Engineering, Manonmaniam Sundaranar University, Tirunelveli, Tamil Nadu, India

Takamichi Hirata Department of Biomedical Engineering, Tokyo City University, Tokyo, Japan

S. M. Mazharul Hoque Chowdhury Department of Computer Science and Engineering, Daffodil International University, Dhaka, Bangladesh

Syed Akhter Hossain Department of Computer Science and Engineering, Daffodil International University, Dhaka, Bangladesh

Rakibul Islam Department of Computer Science and Engineering, Daffodil International University, Dhaka, Bangladesh

Jeevamma Jacob National Institute of Technology Calicut, Kozhikode, India

Naveen Jaglan Department of Electronic and Communication Engineering, Jaypee University of Information Technology, Solan, HP, India

Charu Jain Amity University Haryana, Gurgaon, India

Priyansh Jain Vellore Institute of Technology, Vellore, Tamil Nadu, India

Roshan Raj Jajware Amity University Noida, Noida, India

S. Jayanthi Department of CSE, Guru Nanak Institute of Technology, Hyderabad, India

Mamata Jenamani Indian Institute of Technology, Kharagpur, India

S. Jerald Nirmal Kumar Anna University, Chennai, India

Alok Nath Jha Amity Institute of Information Technology, Amity University, Noida, Uttar Pradesh, India

Anand Jha Department of Information Technology, Jalpaiguri Government Engineering College, Jalpaiguri, West Bengal, India

Jibrael Jos Christ University, Bengaluru, India

Alpana Kakkar Amity Institute of Information Technology, Amity University, Noida, Uttar Pradesh, India

Anant Kakrania Vellore Institute of Technology, Vellore, Tamil Nadu, India

Vijay A. Kanade Intellectual Property Research, Pune, India

R. Kannan Department of Computer Science, Rathinam College of Arts and Science, Coimbatore, India

Naresh Kumar Kar Department of Computer Science and Engineering, Rungta College of Engineering and Technology, Bhilai, Chhattisgarh, India

Khaleel Ur Rahman Khan ACE Engineering College, Hyderabad, India

Kiran G. Krishnan National Institute of Technology Calicut, Kozhikode, India

Srinidhi Kulkarni Department of Computer Science, KLS Gogte Institute of Technology, Belagavi, India

Alok Kumar Computer Science and Engineering Department, Motilal Nehru National Institute of Technology Allahabad, Allahabad, India

Anoj Kumar Computer Science and Engineering Department, Motilal Nehru National Institute of Technology Allahabad, Allahabad, India

Kanduru Phani Kumar Research Scholar, Department of Computer Science, Dravidian University, Kuppam, Andhra Pradesh, India

K. Lavanya Vellore Institute of Technology, Vellore, Tamil Nadu, India

Chinmoy Lenka Department of Information Technology, Jalpaiguri Government Engineering College, Jalpaiguri, West Bengal, India

Praveen Likhar Centre for Artificial Intelligence and Robotics (CAIR), Defence Research and Development Organisation (DRDO), Bengaluru, India

Lingraj ACS College of Engineering, VTU Affiliation, Bengaluru, India

Santhosh Maddila Information Technology, GVPCEW, Visakhapatnam, Andhra Pradesh, India

E. Madhusudhana Reddy Department of CSE, Guru Nanak Institutions Technical Campus, Hyderabad, India

Koushik Majumder Department of Computer Science and Engineering, West Bengal University of Technology, Kolkata, India

Aditya Malhotra Delhi Technological University, New Delhi, India

Rezaul Karim Mamun Department of Computer Science and Engineering, Daffodil International University, Dhaka, Bangladesh

Pratima Manhas FET, ECE, Manav Rachna International Institute of Research and Studies (MRIIRS), Faridabad, India

S. S. Manivannan SCOPE, VIT University, Vellore, Tamil Nadu, India

V. Mareeswari ACS College of Engineering, VTU Affiliation, Bengaluru, India

Mathew Martin National Institute of Technology Calicut, Kozhikode, India

Abu Kaisar Mohammad Masum Department of Computer Science and Engineering, Daffodil International University, Dhaka, Bangladesh

Megha Mishra Department of Computer Science and Engineering, Rungta College of Engineering and Technology, Bhilai, Chhattisgarh, India

Ved P. Mishra Amity University Dubai, Dubai, United Arab Emirates

Satanik Mitra Indian Institute of Technology, Kharagpur, India

Neetu Mittal Amity University Uttar Pradesh, Noida, India

S. Mohana Kumar Department of Computer Science and Engineering, Ramaiah Institute of Technology, Bengaluru, India

Md. Mohibullah Department of Computer Science and Engineering, Comilla University, Comilla, Bangladesh

Rambabu Mukkamala Research Scholar, Dravidian University, NICMAR, Hyderabad, India

U. Nanditha BMS College of Engineering, Bengaluru, India

P. Natarajan School of Computer Science and Engineering, Vellore Institute of Technology, Vellore, Tamil Nadu, India

Ohidujjaman Department of Computer Science and Engineering, Daffodil International University, Dhaka, Bangladesh

Maya L. Pai Department of Computer Science & IT, Amrita Vishwa Vidyapeetham University, Kochi, India

P. Dhruv BMS College of Engineering, Bengaluru, India

Astitva Narayan Pandey Amity Institute of Information Technology, Amity University, Noida, Uttar Pradesh, India

Mohammad Pasha Muffakham Jah College of Engineering and Technology, Hyderabad, India

Soumyajit Pathak Amity Institute of Information Technology, Amity University, Noida, Uttar Pradesh, India

Sunita S. Patil ACS College of Engineering, VTU Affiliation, Bengaluru, India

Rekha Prabha Amrita School of Engineering, Amrita Center for Wireless Networks & Applications (AmritaWNA), Amrita Vishwa Vidyapeetham, Amritapuri, India

V. Purna Chandra Rao CSE, MLR Institute of Technology, Hyderabad, India

J. Rajeshwar Department of CSE, Guru Nanak Institutions Technical Campus, Hyderabad, India

Kosaraju Rakshitha CSE, VNRVJIET, Hyderabad, Telangana, India

Somula Ramasubbareddy IT, VNRVJIET, Hyderabad, Telangana, India

Srinibas Rana Jalpaiguri Government Engineering College, Jalpaiguri, West Bengal, India

P. Ranjana Professor, Department of Computer Science and Engineering, Hindustan Institute of Technology and Science, Chennai, India

E. SenthilKumar Centre for Information Technology and Engineering, Manonmaniam Sundaranar University, Tirunelveli, Tamil Nadu, India

A. Sreenivasa Rao IT, VNRVJIET, Hyderabad, Telangana, India

Geetanjali Rathee Department of Computer Science and Engineering, Jaypee University of Information Technology, Solan, HP, India

S. Ravimaran M.A.M College of Engineering, Trichy, India

G. B. Regulwar Principal, Shankarprasad Agnihotri College of Engineering, Wardha, Maharashtra, India

M. N. Renuka Devi PESIT South Campus, Bengaluru, Karnataka, India

Rishabh Department of Computer Science and Engineering, National Institute of Technology Hamirpur, Hamirpur, Himachal Pradesh, India

Y. Sagar CSE, VNRVJIET, Hyderabad, Telangana, India

Sonia Saini Amity Institute of Information Technology, Amity University, Noida, Uttar Pradesh, India

Anil Kumar Sajnani Amity Institute of Information Technology, Amity University, Noida, India

Md. Sanzidul Islam Department of Computer Science and Engineering, Daffodil International University, Dhaka, Bangladesh

Subhanjan Sarkar Department of Computer Science and Engineering, West Bengal University of Technology, Kolkata, India

A. Sathish Anna University, Chennai, India

R. M. Savithramma Department of CSE, SIT, Tumkur, India

Rishi Sayal Guru Nanak Institute of Technical Campus, Hyderabad, India

A. S. Sayee Shruthi CSE, SOC, SASTRA University, Thanjavur, India

Deepa D. Shankar Abu Dhabi University, Abu Dhabi, UAE

Ravi Shankar Yadav Centre for Artificial Intelligence and Robotics (CAIR), Defence Research and Development Organisation (DRDO), Bengaluru, India

Agrim Sharma Amity University Uttar Pradesh, Noida, India

Mahima Sharma Inderprastha Engineering College, Ghaziabad, Uttar Pradesh, India

Manasvi Sharma Amity Institute of Information Technology, Amity University, Noida, Uttar Pradesh, India

Mayukh Sharma Vellore Institute of Technology, Vellore, Tamil Nadu, India

Monika Sharma Amity Institute of Information Technology, Amity University, Noida, Uttar Pradesh, India

T. P. Sharma Department of Computer Science and Engineering, National Institute of Technology Hamirpur, Hamirpur, Himachal Pradesh, India

Chetan Shetty Department of Computer Science and Engineering, Ramaiah Institute of Technology, Bengaluru, India

Amit Shinde Mercedes Benz Research and Development India Pvt. Ltd., Pune, Maharashtra, India

Subhash Chandra Shrivastava Department of Computer Science and Engineering, Rungta College of Engineering and Technology, Bhilai, Chhattisgarh, India

Shubham Shukla Delhi Technological University, New Delhi, India

Shifat Nayme Shuvo Department of Computer Science and Engineering, Daffodil International University, Dhaka, Bangladesh

M. K. Sinchana Department of CSE, SIT, Tumkur, India

Mihir Sing Department of Computer Science and Engineering, West Bengal University of Technology, Kolkata, India

Ajay Vikram Singh Amity Institute of Information Technology, Amity University, Noida, Uttar Pradesh, India

Anushka Singh Delhi Technological University, New Delhi, India

Paramveer Singh Amity Institute of Information Technology, Amity University, Noida, Uttar Pradesh, India

Siddarth Pratap Singh Amity Institute of Information Technology, Amity University, Noida, Uttar Pradesh, India

Akula V. S. Siva Rama Rao Research Scholar, Department of Computer Science and Engineering, Hindustan Institute of Technology and Science, Chennai, India; Department of CSE, SITE, Tadepalligudem, Andhra Pradesh, India

Roshan Sivakumar Department of Electrical and Electronics Engineering, BITS-Pilani, Hyderabad Campus, Hyderabad, Telangana, India

M. K. Soni FET, ECE, Manav Rachna International Institute of Research and Studies (MRIIRS), Faridabad, India

P. Sreenivasulu ECE Department, ASCET, Gudur, Nellore, Andhra Pradesh, India

B. Sri Gurubaran CSE, SOC, SASTRA University, Thanjavur, India

K. Srinivas Department of CSE, Guru Nanak Institutions Technical Campus, Hyderabad, India

Gowri Srinivasa PESIT South Campus, Bengaluru, Karnataka, India

J. Srishtishree Department of Computer Science and Engineering, Ramaiah Institute of Technology, Bengaluru, India

Anurag Srivastav Amity Institute of Information Technology, Amity University, Noida, Uttar Pradesh, India

Gaurav Srivastav Inderprastha Engineering College, Ghaziabad, Uttar Pradesh, India

D. Stalin Alex Guru Nanak Institute of Technology, Hyderabad, Telangana, India

S. Subashini Sethu Institute of Technology, Madurai, Tamil Nadu, India

E. R. S. Subramanian CSE, SOC, SASTRA University, Thanjavur, India

P. Subramanian Sri Indu College of Engineering, Hyderabad, Telangana, India

N. Suresh Kumar Department of CSE, Galgotias University, Greater Noida, India

R. M. Tugnayat Principal, Shankarprasad Agnihotri College of Engineering, Wardha, Maharashtra, India

Akshay Tyagi Amity Institute of Information Technology, Amity University, Noida, Uttar Pradesh, India

B. K. Uday School of Computer Science and Engineering, Vellore Institute of Technology, Vellore, Tamil Nadu, India

A. Umamakeswari CSE, SOC, SASTRA University, Thanjavur, India

Prabhat Kumar Upadhyay Department of Electrical and Electronics, Birla Institute of Technology, Mesra, India

Prakash Upadhyaya ACS College of Engineering, VTU Affiliation, Bengaluru, India

M. S. Urmila Amrita School of Engineering, Amrita Center for Wireless Networks & Applications (AmritaWNA), Amrita Vishwa Vidyapeetham, Amritapuri, India

Hemendra Kumar Vaishnav Barefoot Lightning India Pvt Ltd, Jaipur, India

S. Varadharajan Sree Venkateswara University College of Engineering, Tirupati, India

K. S. Varsha Department of Computer Science & IT, Amrita Vishwa Vidyapeetham University, Kochi, India

V. Vasanthi Department of ICT, Sri Krishna Adithya College of Arts and Science, Coimbatore, India

K. A. Venkatesh Myanmar Institute of Information Technology, Chanmyathazi, Myanmar

Shivangi Verma Amity Institute of Information Technology, Amity University, Noida, Uttra Pradesh, India

Vidushi Banasthali Vidyapith, Computer Science and Engineering, Jaipur, Rajasthan, India

E. R. Vimina Department of Computer Science & IT, Amrita Vishwa Vidyapeetham University, Kochi, India

B. L. S. R. K. Vishal Computer Science and Engineering, Panimalar Engineering College, Chennai, India

Revanth Voleti Computer Science and Engineering, Panimalar Engineering College, Chennai, India

Tahniyat Yasmeen Muffakham Jah College of Engineering and Technology, Hyderabad, India

Lakshmi Prasanna Yeluri Department of CSE, JNTUH, Hyderabad, India

Mohammad Younus Department of Information Technology, Jalpaiguri Government Engineering College, Jalpaiguri, West Bengal, India

A. V. Zade Research Scholar, SGBA, University, Amravati, India

Survey on Cloud Computing Security

M. K. Sinchana and R. M. Savithramma

Abstract Cloud computing is considered as one of the renowned computing methods for pooling and providing various computing resources on demand basis. Cloud computing has grabbed its roots in the IT industry and has become a useful choice for small budget business and organizations. As multiple customers are sharing the same cloud, it will have many security challenges such as malicious user attack, user identity management, auditing, resource management, and integrity control. The main aim here is to provide security to the data by protecting it by unauthorized users during the time of information transmission by using different encrypting techniques such as Blowfish algorithm, RSA algorithm, secure hash algorithm 2, and message digest, on the user data in the cloud. In this paper, we present very recent techniques and algorithms proposed by various authors to secure the stored cloud data.

Keywords Cloud computing · Information security · Blowfish algorithm · Hash algorithm

1 Introduction

Cloud computing is a standard method that is found and suitable everywhere because it provides access to the collection of resources on request of the users which can be used with less interaction with the service provider and with the minimum cost. It is considered as a dominant technology because it can manage the large amount of information. Cloud computing is consistent and reliable, due to which the organizations use this infrastructure and need no necessary to build their own. It is a best method for any sized organization or business because of its cost-saving technology. It is a platform which provides computing resources as a service. The services that are based on cloud include software as a service, platform as a service, and infrastructure as a service [1]. Some of the examples of cloud computing infrastructure are Microsoft Windows Azure storage services, IBM's Blue Cloud, Amazon's EC2, Google app engine and S3, etc. [2].

M. K. Sinchana (✉) · R. M. Savithramma
Department of CSE, SIT, Tumkur, India

H. S. Saini et al. (eds.), *Innovations in Computer Science and Engineering*,
Lecture Notes in Networks and Systems 103,
https://doi.org/10.1007/978-981-15-2043-3_1

Although cloud computing has many uses, it also has some disadvantages too, and the most important is security issue. It has many security-related issues such as identity management, resource management, and integrity control and so on. In cloud computing, if any organization or user wants to store their important data, they should provide it to the utility provider. Therefore, the risk of important information going into the evil hands is high because cloud services are available and accessible by all its users. Hence, there is the most probability of misusage of confidential data or the user data may be altered intentionally by hackers or accidentally by other users. This leads to confidentiality and consistency breach.

By considering all these issues regarding the security of the data, it is considered an important concern in cloud computing. Cryptography is widely approved method for ensuring the information security. This mechanism will secure the information by changing it to the unreadable form.

There are two types of cryptographic algorithm. They are symmetric key algorithm and asymmetric key algorithm. In symmetric key algorithm, one key is used for both encryption and decryption of the data known as private key, and in asymmetric key cryptographic algorithm, two keys are used, namely private key and public key [3]. Here, public key is used for encrypting the information, and private key is used for decrypting the user information. As compared to symmetric key cryptography, asymmetric key cryptography is considered as more secure because here we use two different keys and if in case one key gets leaked cannot cause any harm to the encrypted data.

2 Related Works

Soman and Natarajan [1] proposed an enhanced hybrid data security algorithm for the cloud in order to protect the information that is present in the cloud by using the combination of SHA256, ECDSA, and AES. These methods are used for securely sending and receiving the information or data on the cloud.

Timothy and Santra [4] have proposed a new hybrid cryptography method for security by using RSA, Blowfish, and SHA-2 algorithms. Here, by combining the symmetric and asymmetric algorithm, the efficiency of the proposed system is increased, and by using SHA-2 algorithm, high security is provided to the data transmission.

Kanna and Vasudevan [2] proposed a novel identity-based hybrid encryption (RSA with ECC) to increase the security of the information. Here, the information is encrypted by sender by using the identity-based hybrid encryption algorithm.

Singh and Malhotra [3] have proposed a hybrid two-tier agent-based framework which deploys symmetric and asymmetric key algorithms in combination to provide robust security to user data in the cloud environment.

Chauhan and Gupta [5] proposed a novel parallel cryptographic algorithm where MD5 and Blowfish encryption algorithms are used in order to overcome the problems of symmetric block cryptography and hash function algorithm, which can upgrade the security.

Bhandari et al. [6] used various cryptography concepts: RSA, hybrid encryption-RSA, and AES in cloud computing during communication along with its application in order to increase the security.

3 Methodology

In the hybrid cryptography method, they combined the combination of symmetric and asymmetric algorithms in order to provide high security. Different cryptographic methods use different encryption and decryption processes. The original information is transformed into cipher data in the encryption process, which will not be in a readable form. In the decryption process, the ciphertext is converted into plaintext. The different methods and algorithms used in order to provide data securities are given below:

In paper [1], they have combined SHA256, ECDSA, and AES in order to send and receive the data on the cloud. In message file, upload hybrid data encryption process; at first, digital signatures are generated in the client machine correspondingly along ECDSA with SHA256 message digest. Next by using AES encryption algorithm, the message or information along with the public key is encrypted, and then, the encrypted data or file is sent to the cloud service provider, and this file will be stored in the cloud server.

During message, download hybrid data security process, and the cloud user has to request the cloud service provider to provide their data that is securely stored in the cloud. The hash value of the requested file is checked by the cloud server, and if the hash values match, then the cloud server will perform the AES data decryption algorithm with private key using the private key of the requested cloud user, and the decrypted message or file is sent to the requested cloud user.

In paper [4], encryption and decryption processes are used twice as it uses both symmetric and asymmetric algorithms. In the encryption process, in order to encrypt the selected file a secret key is selected and Blowfish algorithm is used. Later, this secret key is encrypted by using RSA algorithm which is an asymmetric key cryptographic algorithm where two keys are used. Later, SHA2 is applied on the encrypted file in order to generate the message digest or hash code. Then, digital signature algorithm is applied in order to generate digital signature from message digest.

In the decryption process, the encrypted secret key is used to get the secret key, which needs to be decrypted using RSA decryption algorithm. Then, using this secret key, original information is obtained by applying Blowfish decryption algorithm on the encrypted file. Verification is done on the digital signature to get the expected message digest or hash code. Later, this message digest is compared with SHA2 generated message digest in order to check integrity.

In paper [2], enhancing technique for the security of user information is proposed by using hybrid cryptographic algorithm and keyword encryption. Here, a novel identity-based hybrid cryptographic algorithm, i.e., RSA with ECC, is proposed, and it can be achieved by hybrid encryption and proxy re-encryption techniques.

Here, receiver identity uses an identity-based encryption (IBE) to cover the output of the public key encryption, and it can be achieved by hybrid encryption and proxy re-encryption techniques.

The receiver identity is added to the encrypted data in order to encrypt the receiver identity, and a keyword is generated to create ciphertext. Later, proxy re-encryption techniques are applied to encrypt the identity of the receiver and keyword. The keywords can be ordinary or top secret tags. Ciphertext can be decrypted by the user anytime by using decryption key provided according to the identity.

In paper [3], they proposed a hybrid two-tier security engine for the cloud environment, whose goal is to provide a strong security to the cloud which cannot be breached even by the cloud service provider. Due to the increase in the encryption process, security of the system increases, but the efficiency of the system decreases. So, in order to avoid this problem, they have combined the work of two encryption algorithms which uses a smaller key size to provide higher security as compared to other encryption algorithms.

Here, the proposed mechanism called a hybrid two-tier security engine (HT2SE) is used. It is an agent-based framework which uses both symmetric and asymmetric processes together on the data before sending it to the receiver. At first, it uses Blowfish algorithm and this key will be known by user only, and the output of this layer is given to the second layer which will encrypt the data again by using asymmetric key ECC, where, here, the user needs to obtain two keys from the standard authorities, whenever he needs to store his data on the cloud. Similarly, CSP will also acquire the above set of keys which needs to be used at the end, i.e., whenever user needs to save his data from CSP.

At client end, an agent called Crypto Agent (CA) is used for encryption and decryption of the data. It contains the user's set of keys, and another agent called cloud service provider agent is used interact with CA of the user. It receives the encrypted data from the user and keeps that in the cloud.

In paper [5], a novel technique of cloud security is used which is based on hybrid encryption by Blowfish and MD-5 is proposed. Here, to overcome the shortcomings of the symmetric block cryptography and hash function, a hybrid MD5–Blowfish cryptographic calculation is done.

In the Blowfish algorithm, it has a key of variable length and a block cipher. Here, two procedures occur, that is, initializing the key and the phase in which data is encrypted. Hence, the user variable key is expanded in the first phase to sub-key arrays. Here, the sub-key arrays' generation process is a user key dependent. Hence by increasing the complexity enhancement of the sub-key and user key relation, the security level is increased.

In the MD5 hashing algorithm, the information is separated into the pieces of 512-bit blocks, and after that, MD5 produces a 128 bots message process with four 32-bit hinders to check the honesty of the document.

In paper [6], they use three-tier processes as shown in Fig. 1 of cryptography in which three main process occurs. They are generating the keys, followed by encryption and decryption process.

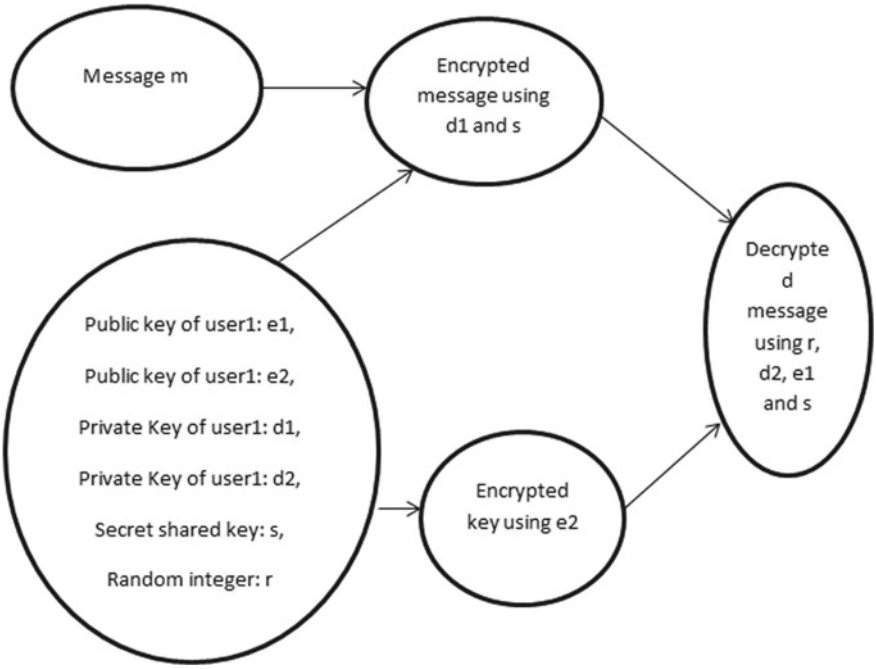


Fig. 1 Three-tier process

In the key generation process, two large numbers p and q are chosen and the product of these numbers is stored in n. A function called Euler's Totient denoted by z is computed, and after computing it, public key e is computed which is given in the efficient RSA. Both private and public keys are generated during the process, and a random integer r is used so that different keys can be used at the time of decryption.

During encryption, the first message m is checked whether it is less than the product of two numbers or not. To encrypt the data, a secret key is shared before encryption and this secret key is encrypted by using public key.

During decryption process, in order to make sure that the information is safe from the attacker, different keys are used. Hence as compared to RSA, this method is better in terms of different attacks (Table 1).

4 Conclusion

After analyzing all the proposed papers, we will come to the conclusion that data security is the main concern in cloud computing which can be enhanced by using various hybrid data security cryptographic algorithms like AES, ECC, RSA, Blowfish, MD5, and SHA. Here, the aggregation of symmetric and asymmetric algorithms

Table 1 Comparative analysis

Paper no.	Algorithms used	Advantages
1.	SHA-256 and AES	Data security is increased by hybrid data security algorithm
2.	Blowfish, RSA, and SHA-2	Provides efficiency to the system Provides high security on data transmission
3.	RSA and ECC	Security is increased by efficient hybrid encryption and proxy re-encryption
4.	ECC and Blowfish	A hybrid two-tier security engine is used for security Encryption in high speed and done by using less time
5.	Blowfish, MD5 hashing	Execution time is less in hybrid Blowfish–MD5 Better than hybrid RSA and MD5
6.	RSA and AES	Minimize the consumption of time, cost, and memory

provides efficiency to the system. The algorithm provides lesser time and better speed of encryption. All proposed mechanism has been simulated, encouraging result has been obtained, and the future work can be done.

References

1. Soman VK, Natarajan V (2017) An enhanced hybrid data security algorithm for the cloud. In: 2017 International conference on networks & advances in computational technologies (NetACT), 20–22 July 2017
2. Kanna GP, Vasudevan V (2016) Enhancing the security of user data using the keyword encryption and hybrid cryptographic algorithm in cloud. In: International conference on electrical, electronics, and optimization techniques (ICEEOT)
3. Singh A, Malhotra M (2016) Hybrid two-tier framework for improved security in cloud environment. IEEE Trans Cloud Comput
4. Timothy DP, Santra AK (2017) A hybrid cryptography algorithm for cloud computing security. IEEE Trans Cloud Comput
5. Chauhan A, Gupta J (2017) A novel technique of cloud security based on hybrid encryption by blowfish and MD5. In: 4th IEEE international conference on signal processing computing and control (ISPCC 2k17), 21–23 Sept 2017
6. Bhandari A, Gupta A, Das D (2016) Secure algorithm for cloud computing and its applications. Trans Cloud Comput

Implementation of OFDM System Using Image Input for AWGN Channel

Pratima Manhas and M. K. Soni

Abstract OFDM stands for orthogonal frequency division multiplexing and is a form of multicarrier modulation (MCM) technique which divides the whole bandwidth into huge number of small sub-carriers. After this, each subcarrier is transmitted in parallel to attain increased data rates. Real data implementation of the proposed OFDM model has been simulated for image signal under AWGN channel. BER is calculated under different SNR values. The proposed work is done using MATLAB–Simulink tool.

Keywords Digital audio broadcasting · SNR · Simulink · Multicarrier modulation · AWGN

1 Introduction

Due to the advances in communication technology, there is a requirement for huge data rate, and for this, an efficient modulation approach is used which is known as OFDM. OFDM is a multicarrier modulation (MCM) technique and has efficient use of bandwidth (Edfors et al. 1996). The orthogonal frequency division multiplexing (OFDM) system was suggested for the first time during the Second World War and gradually was studied for use as a high-speed modem and for digital mobile communication (Debbah 2004). Approximately 55 years ago, Doelz et al. (1957) published the idea of dividing the transmitting data into the number of interleaved bit streams and modulated numerous carriers. In the late 60s, OFDM technique was used in high frequency military radios. OFDM did not become popular at that time because it was too extravagant [1]. Currently, OFDM systems apply inverse fast Fourier transform (IFFT) and fast Fourier transform (FFT) to perform modulation and demodulation of the data.

P. Manhas (✉) · M. K. Soni
FET, ECE, Manav Rachna International Institute of Research and Studies (MRIIRS), Faridabad, India

M. K. Soni
e-mail: pvc@mriu.edu.in

H. S. Saini et al. (eds.), *Innovations in Computer Science and Engineering*,
Lecture Notes in Networks and Systems 103,
https://doi.org/10.1007/978-981-15-2043-3_2

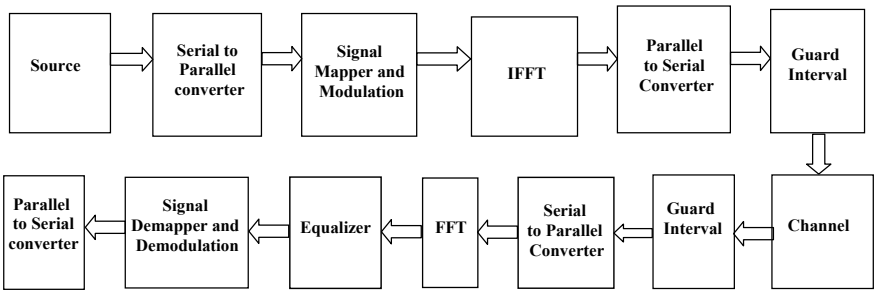


Fig. 1 OFDM model

Figure 1 indicates the diagram of OFDM model. The data source is used to generate the serial data, and then, it is converted into parallel form, and after performing the mapping (modulation), the signal is modulated by digital modulation (such as QPSK, QAM) [2]. Inverse fast Fourier transform (IFFT) is performed on modulated signal. After this, the output of IFFT is passed through channel, and then at the receiver end, the fast Fourier transform (FFT) operation is performed. After this FFT, output signal is demodulated. The recovered signal is determined later passing it to parallel to serial converter [3].

2 Proposed OFDM Model with Real Data Image Signal

The real-time implementation of OFDM system using image signal as an input has been shown below in Fig. 2. The Simulink model for real-time processing of image signal using OFDM system has been shown in Fig. 2.

The following steps are used to model:

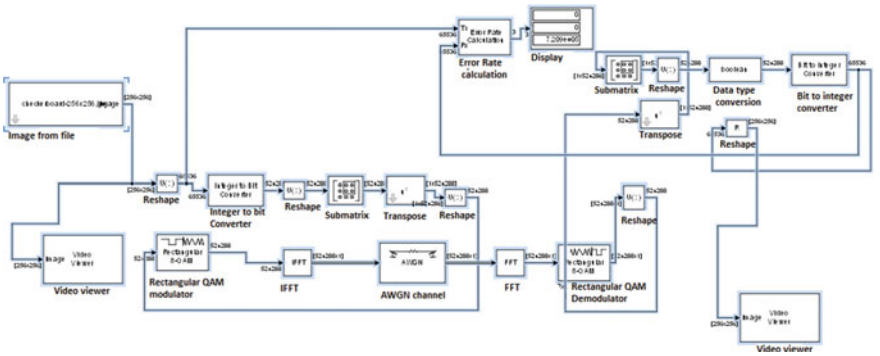


Fig. 2 Real data implementation of the proposed OFDM for image signal using Simulink for AWGN channel

1. The image is loaded from the file, and then, it is reshaped to convert into one-dimensional array.
2. The output of reshaped image is passed through integer to bit converter, and then, its output is further passed to reshape block. After doing the reshaping, the image is passed through sub-matrix block which extracts the sub-matrix from m by n array. Sub-matrix output is transposed and reshaped again.
3. Reshaped output is further mapped by using digital modulation technique, and then, the modulated output has been passed through IFFT. AWGN channel is used to pass the IFFT output, and then, the FFT operation has been done.
4. The output of FFT is further demodulated by the demodulator, and then, the reverse process is performed to get the image back at the receiver side. BER is calculated by using error rate calculation block.

3 Simulation Results

The simulation results for the proposed OFDM model shown in Fig. 2 have been obtained for different values of SNR which are shown in Figs. 3, 4, 5, 6, 7, 8, 9 and 10.

The BER results for the image input under different SNR have been shown in Table 1. The BER value is more in case of SNR = 10 dB, and it keeps on decreasing as the SNR increases.

From Table 1, the result shows that the image is worst in case of SNR = 10 dB, and the BER value is reduced to zero in case of SNR = 70 dB. For this case, the real and the simulated results are same. The graph for BER value has been shown in Fig. 11.

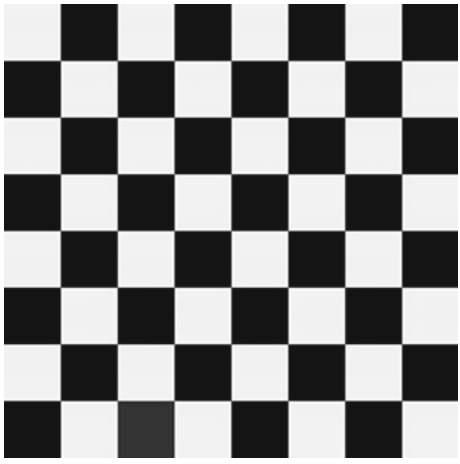


Fig. 3 Real image of size 256 × 256

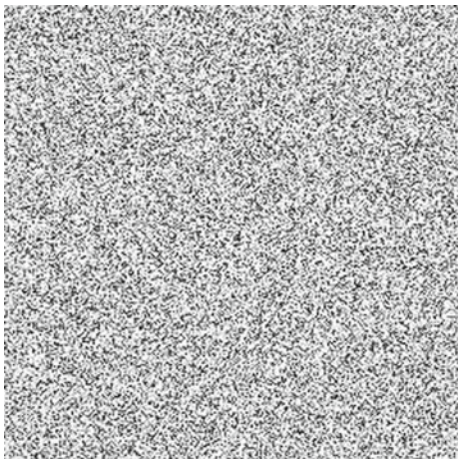


Fig. 4 Simulated image for SNR = 10 dB

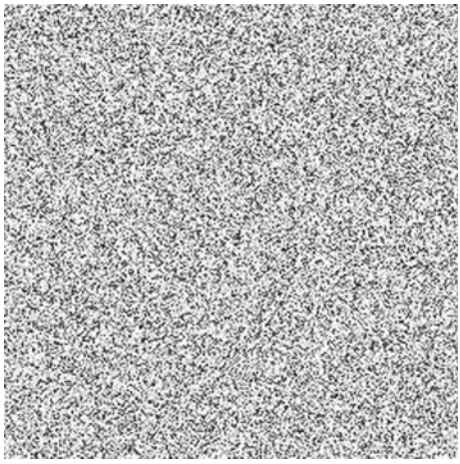


Fig. 5 Simulated image for SNR = 20 dB

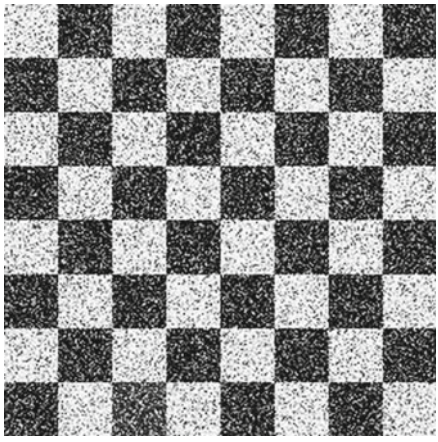


Fig. 6 Simulated image for SNR = 50 dB

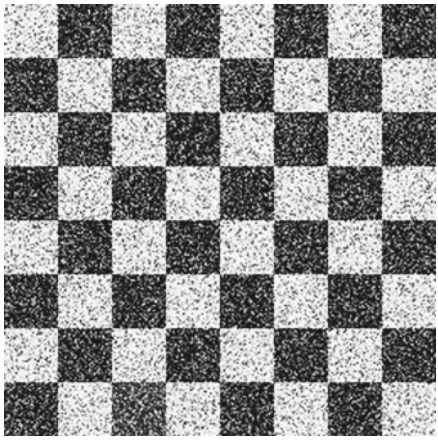


Fig. 7 Simulated image for SNR = 55 dB

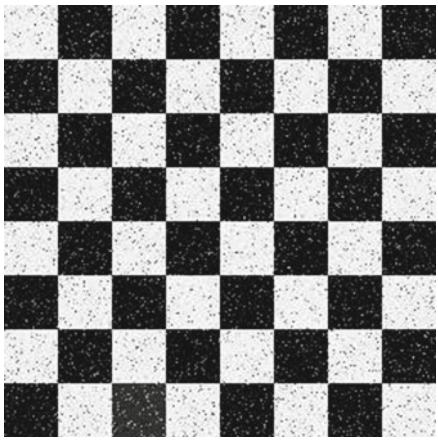


Fig. 8 Simulated image for SNR = 60 dB

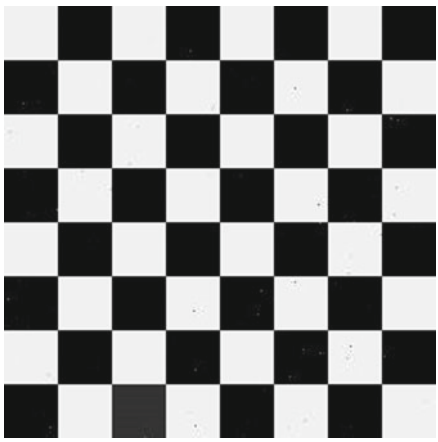


Fig. 9 Simulated image for SNR = 65 dB

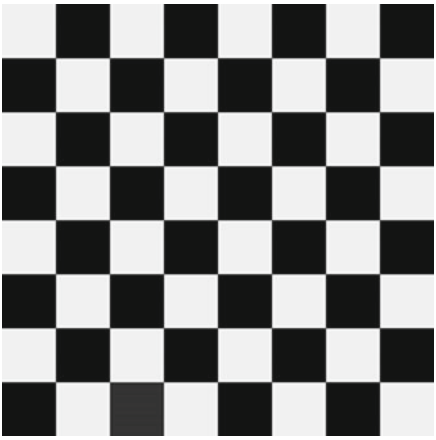


Fig. 10 Simulated image for SNR = 70 dB

Table 1 BER outcome of image signal for FFT-based OFDM system

SNR (dB)	BER
10	0.9943
20	0.9941
50	0.9577
55	0.8193
60	0.2794
65	0.0033
70	0

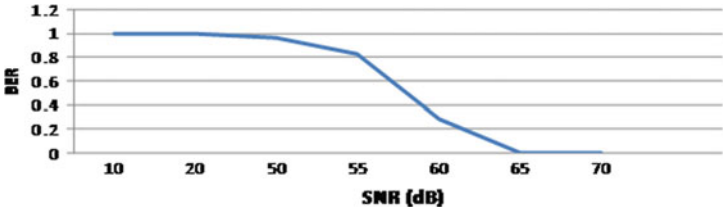


Fig. 11 BER results of image signal under different SNRs

The value of BER decreases as the value of SNR increases, and it reduces for SNR = 70 dB. At this value, the value of error is reduced to zero, and the received image is same as that of transmitted image.

4 Conclusion

The real data implementation of the proposed OFDM system using image has been done. The result shows that the AWGN channel results in minimum BER. The BER plot versus SNR is shown in Fig. 11 which shows that the BER value keeps on decreasing as the SNR value increases. When the SNR value reaches 70 dB, the real image is same as the received image.

References

1. Manhas P, Soni MK (2016) Comparison of BER analysis in OFDM using linear and cyclic block codes for different digital modulation techniques. In: Proceeding of the second IEEE based international conference on computational intelligence & communication technology, pp 199–204
2. Rahmatallah Y, Mohan S (2013) Peak-to-average power ratio reduction in OFDM systems: a survey and taxonomy'. IEEE Commun Surv Tutor 15(4):1567–1592
3. Manhas, P, Soni, MK (2015) PAPR reduction of OFDM using recurring SLM with cyclic block codes schemes. In: Proceeding of the fourth IEEE based international conference on reliability, Infocom technologies and optimization (Trends and future directions) pp 1–5
4. Manhas P, Soni MK (2015) OFDM PAPR reduction using recurring SLM with cyclic and linear block codes schemes. Telkomnika Indones J Electr Eng 16(1):1–6
5. Pandharipande A (2002) Principles of OFDM. IEEE Potentials 21(2):16–19
6. Prasad R (2004) Basics of OFDM and synchronization. In: OFDM for wireless communications systems. Artech House, London, pp 117–122
7. Tan P, Beaulieu NC (2002) A comparison of DCT-based OFDM and DFT-based OFDM in frequency offset and fading channels. IEEE Transa Commun 54(11):2113–2125
8. Manhas P, Soni MK (2014) A review of PAPR reduction techniques for OFDM systems. MR Int J Eng Technol 6(2):49–53
9. Manhas P, Soni K (2015) BER analysis of BPSK, QPSK & QAM based OFDM system using simulink. Int J Electr Electron Eng 7(2):54–60
10. Manhas P, Soni MK (2015) Performance analysis of DWT-OFDM and FFT-OFDM using various digital modulation techniques and channel coding. Int J Comput Appl 128(11):34–39
11. Manhas P, Soni MK (2016) Comparison of OFDM system in terms of BER using different transform and channel coding. Int J Eng Manuf 1:28–34
12. Manhas P, Soni MK (2016) Comparison of various channel equalization techniques in OFDM system using different digital modulations. Indones J Electr Eng Comput Sci 3(3):634–638
13. Marchetti N, Rahman MI, Kumar S, Prasad R (2009) OFDM: Principles and challenges. In: New directions in wireless communications research. Springer, Boston, pp 29–62
14. Nee RV, Prasad R (2000) OFDM for wireless multimedia communications. Artech House, USA
15. Park M, Jun H, Cho J, Cho N, Hong D, Kang C (2000) PAPR reduction in OFDM transmission using Hadamard transform. In: Proceeding of the IEEE based international conference on communications, vol 1, pp 430–433

Distributed Secure File Storage System Using Cryptography

Mayukh Sharma, Priyansh Jain, Anant Kakrania, Harshit Choubey and K. Lavanya

Abstract In recent times, cloud storage and distributed system have risen to great success owing to their easy use and availability to users. These have helped users to gain access to their data anywhere, anytime solely with the help of internet. But all these features come with greater risks and security threats. Traditional data security methods cannot be considered fully reliable given the advancements in cryptanalysis techniques and sophistication of cyber-attacks. Encryption alone is insufficient to ensure data security and integrity. In this paper, we provide an approach to create a secure distributed file system. We propose a two-layer architecture where the data will first involve interaction with the server. Once we ensure authenticity and integrity of the data, the next step involves storing it securely on the cloud which involves interaction of server with the distributed system which will be completely abstract for the user. The first layer makes the use of digital signature for client authentication and data integrity. The second layer will make use of attribute-based distributed storage of data in encrypted form with hashing techniques to remove redundancy in the data stored in the system.

Keywords Digital signature · Hashing · Cloud storage · Public-key cryptography · Secure hash algorithm · Information dispersal algorithm

1 Introduction

Distributed file systems are not only meant for computational role, but also useful to store and share data. The users can work with this data anywhere owing to the cloud computing paradigm. The client–server architecture stores the data at a single location from where it is fetched. In the distributed file system, data can be stored on several systems which are referred to as nodes. This is known as replication. It helps in increasing the performance and improves the reliability of the services.

M. Sharma (✉) · P. Jain · A. Kakrania · H. Choubey · K. Lavanya
Vellore Institute of Technology, Vellore, Tamil Nadu, India

K. Lavanya
e-mail: lavanya.k@vit.ac.in

H. S. Saini et al. (eds.), *Innovations in Computer Science and Engineering*,
Lecture Notes in Networks and Systems 103,
https://doi.org/10.1007/978-981-15-2043-3_3

If replication is used for enhancing the performance, the data is usually copied to different nodes in the distributed system to be closer to the client. This enables the client to get the data from the nearest node which is available at the time of request. If the replication is done for achieving reliability, the data is copied to systems which are more protected against failure and store the data in a redundant way.

The role of secure communication is providing a safe channel for the transfer of data. The data is usually encrypted using a symmetric key cipher. It uses a private key for data encryption. The same key is used for data decrypting. Digital signature is used for maintaining data integrity. It is used to identify the authenticity of the user. This enables trust between the user and the server.

This paper discusses the recent works followed by the methodology. The following section deals with the proposed system architecture, and finally, we have the results and advantages of our proposed system. We aim to use digital signatures and hashing using concepts of distributed file systems to create a secure system which ensures data security and integrity.

2 Literature Survey

ZhengQing Hu, Meifen Wang, Kheng Kok Mar, and Chee Yong Law proposed secure and resilient file system that supports transparent deployment in public and hybrid multi-cloud environment [1].

There are two fundamental design approaches among various IDA-based storage systems: using IDA to achieve both secrecy (e.g., POTSHARDS [2]) and fault tolerance or using erasure coding ensuring fault tolerance but for secrecy rely on encryption (e.g., SSMS [3] and Cleversafe [4]).

Seker along with Bian [5] elaborated a system that uses IDA for distributing and recursively slicing file data into peer-to-peer nodes hierarchically. Layered encryption is used as a technique to ensure security. A generalized issue of secure storage and retrieval of information (SSRI) was addressed in paper [6].

Michael O. Rabin developed an information dispersal algorithm (IDA) [7] with computationally efficient dispersal and reconstruction of data.

A survey report [8] mentioned xxhash as emerging hashing algorithm with the speed of processing being extremely fast, using RAM limits.

In paper [9], different hashing algorithms were tested on different input data. Time taken to produce a hash value is comparatively less for murmur hash and xxhash. For large data size, xxhash outperforms murmurhash.

Xxhash [10] efficiently passes the SMHasher test suite in which collision, randomness, and dispersion qualities of hash functions are evaluated. On all platforms, hashes are identical and portability of code is ensured.

Bernstein analyzes Curve25519 [11] based on Diffie-Hellman's elliptic curve function supporting large types of applications of cryptography. For Diffie-Hellman computations requiring high security, it has obtained new speed records. Breaking the Curve25519 function seems to be extremely difficult.

Padmavathi and Kumari in their paper [12] analyzed the present encryption algorithms like DES, AES, and RSA together with the technique of LSB substitution. The survey resulted in a conclusion that least encryption and decryption times are consumed by AES algorithm.

3 Methodology and Algorithm

The first step involves sending the uploaded data to the server via a secure channel. The data is sent over the secure HTTPS protocol. The reliability and authenticity are maintained using the digital signature. We are using the Edwards-curve digital signature algorithm (EdDSA) for signing the data and sending it in encrypted form to the server. It is a highly optimized algorithm for digital signature verification. It uses a public–private key pair for validating the signature. The data is encrypted using the private key. The public key is sent along with the data which is used at server to authenticate it.

The next step involves checking for redundant files on the system. When millions of people use the same storage services, there are high chances that the data they upload may be redundant. This leads to huge amount of wastage of storage. We therefore propose a secure method for overcoming this problem. We first hash the given data and compress it on client side. It is sent to the server where its presence is checked on the server. We maintain a table of hashes on the server to check if the file has been already uploaded or not. If already present a pointer is mapped to the already existing file which saves excessive upload times and memory storage. Otherwise, we upload the new file and save its hash on the server.

Once we receive a new file on the server, we need to upload it to the database. We have used information dispersal algorithm (IDA) for storing the file on a distributed server. The data is transformed using a transformation matrix which is invertible. Once a new matrix is obtained, its elements are split randomly and stored on the N nodes. The data stored is encrypted by using block cipher.

The transformation we are carrying on the data matrix is nothing but a simple matrix multiplication. The data matrix is a vector matrix. The transformation matrix is nothing but an invertible matrix. We multiply it with the data matrix in order to get new values which are difficult to interpret as data. For regaining the data, we can just multiply the result with the inverse of the transformation matrix. If the matrix dimensions do not match, we use zero padding. The advantage of using this transformation is that it adds randomization. Only the server with the transformation matrix is capable of recreating the original data.

The above steps will be instrumental in securing the data and prevent the cyber-attacks. The whole system is divided into a two-layered architecture. The first is the interaction with the client and the server which ensures data integrity by making the use of the digital signature. The next layer involves the server and distributed database interaction which involves a secure and distributed way to store the files on the database.

4 System Architecture

Our proposed model has a two-layer hierarchical architecture which helps us in providing additional security as well as data integrity to our model. Here, we shall provide a detailed overview of our proposed model.

Layer 1: At client side, the user is allowed to upload any sort of data or files. The client is considered as a registered user of our system and is thus possesses his own private and public keys which is being used for digital signature. The other role that is being carried out at the client side is the data hashing. We hash the contents of the file and send it to the server to make sure that the file does not exist. Thus, as per the response of the server we send the file if not present else we point to the already existing file in the database to reduce the upload time and save data redundancy on the system (Fig. 1).

In the first layer, the role of the server is mainly checking the digital signature that is being sent by the client and ensures the integrity of the data being sent. The public key of client is used to verify the signature. Once the user and data are authorized, we check for the file if it already exists on the server. If it is not present, we request the client to send the file, else we just add a pointer to the already existing file.

Layer 2: The server enters this state only when the client is verified. At this stage when a file is uploaded which is not already present in the database, the server uses the IDA transformation we defined to transform the data. Once a linear transformation

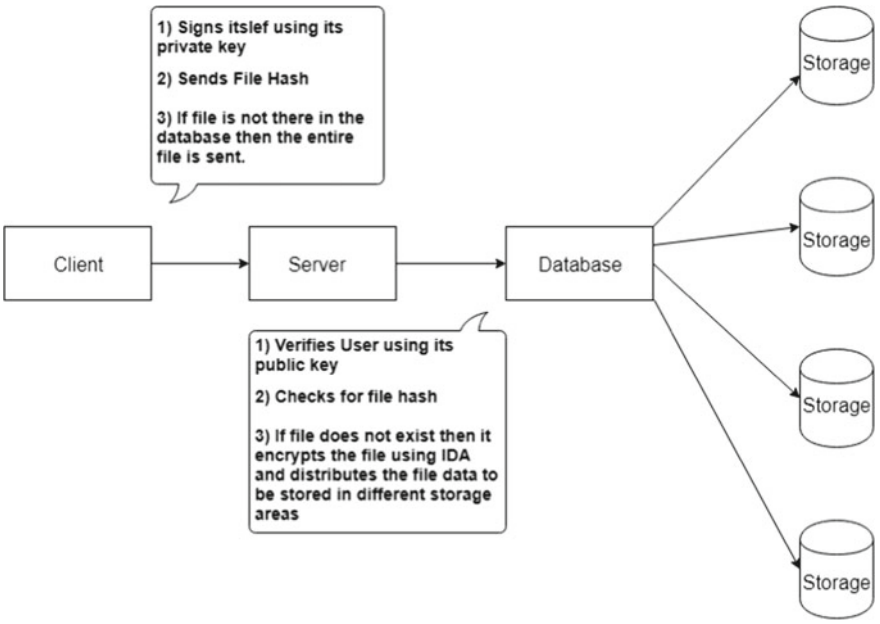


Fig. 1 System architecture

is performed, only the person with the invertible transformation matrix will be able to retrieve the data. Once the data is passed through the transformation, we divide the resultant matrix into different blocks. These blocks are then distributed into the different databases of our distributed system for storage. The data is again sent with digital signature to the database. The main role of the server is to segregate the received data after applying the matrix transformation.

The linear transformation mentioned helps us to add a degree of randomness only known to the server. The attacker has no means to know this information, and hence, it makes information retrieval an extremely complex and difficult task. It has been proved that the data is secure given the attacker is unaware of the matrix. The main role of using this is the result obtained from generator matrix which can be split and sent to different databases in a redundant manner. Hashing enables us to remove redundancy.

The distributed databases act as normal database and are completely unaware of the nature of the data being stored. The main role of them is to receive the data and encrypt it using block cipher and store it. They store fragments of a larger data file. In order to retrieve the valid data, only a valid user can use the server to request all the chunks of fragmented data to be retrieved. Only the server knows the distribution of data into the database which it stores in a table in encrypted format.

5 Results

We conducted the tests based on the number of cores in our system, i.e., 8. The algorithms specified above, hashing via xxHash, encryption of the file content via AES, transforming and dispersing the file data using IDA, were used in an 8-core, Intel i7 processor.

The file sizes ranged from 17 KB to 5 GB, and the time of processing after the file was sent to the server is measured. The results have been tabulated in Table 1 and visualized as a line graph. We observed that up to a certain file size, the performance

Table 1 File sizes and time taken (approximated) for processing and storing in the storage area

File size (KB)	Time (s)
17	0.000217
100	0.00128
500	0.00523
1000	0.00896
17,000	0.16
100,000	1.12
500,000	6.34
1,000,000	11.23
5,000,000	67.23

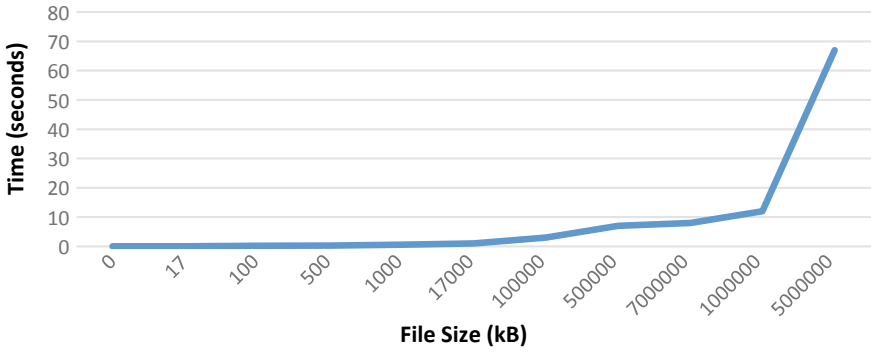


Fig. 2 A curved-plot based on our input data

increases (100 MB in our case), followed by a significant increase in the time taken to process the larger files. This is because of the increased communication overhead and hardware limitations (Fig. 2).

We used EdDSA for digital signature because of its high efficiency in comparison to RSA. It contains only 68 characters in contrast to RSA which may have keys as long as 544 characters. The key generation process is as fast as the signing process. It is built to be collision resistant. The system would not break due to hash function collision. Thus, the overall system uses various paradigms of cryptography to make the transmission secure and efficient.

6 Conclusion

The paper proposes a distributed two-layer architecture for securely storing the files on multiple databases. The two-layer architecture caters to the modern security needs and is not easily breakable. The system is highly reliable due to distributed file system architecture of the database where redundancy is used to store files in a secure and encrypted way. The IDA helps us transform data and store chunks of it in different locations. This makes the system highly secure because even if there is a breach in certain system, only partial data will be compromised which is itself encrypted. The use of digital signature and hashing adds reliability and integrity to the communication between client and server. The proposed system hierarchical model can help improve the security, reliability, and integrity of modern distributed systems.

References

1. Mar KK, Hu ZQ, Law CY, Wang M (2016) Secure Cloud Distributed File System. In: The 11th international conference for internet technology and secured transactions (ICITST)
2. Storer MW, Greenan KM, Miller EL, Voruganti K (2008) POTSHARDS: secure long-term storage without encryption. In: 2007 USENIX annual technical conference
3. Krawczyk H (1993) Secret sharing made short. In: Annual international cryptology conference, pp 136–146
4. The process behind Cleversafe's object storage platform, Cleversafe. https://www.cleversafe.com/platform/how-itworks
5. Bian J Seker R (2009) Jigdfs: a secure distributed file system. In: IEEE symposium on computational intelligence in cyber security (CICS'09), pp 76–82
6. Garay JA, Gennaro R, Jutla C, Rabin T (2000) Secure distributed storage and retrieval. Theor Comput Sci 243(1–2):363–389
7. Rabin MO (1989) Efficient dispersal of information for security, load balancing, and fault tolerance. J ACM 36(2):335–348
8. Chi L, Zhu X (2017) Hashing techniques. ACM Comput Surv 50(1):1–36
9. Thejaswi S, Westrup C (2016) Approximate computation of frequency moments, Aalto University, 1 Jan 2016
10. Yann Collet. https://github.com/Cyan4973/xxHash
11. Bernstein DJ Curve25519: New Diffie-Hellman speed records. Lecture Notes in Computer Science, pp 207–228
12. Padmavathi B, Kumari SR (2013) A survey on performance analysis of DES, AES and RSA algorithm along with LSB substitution technique. Int J Sci Res (IJSR), India

Vehicular Collision Avoidance at Intersection Using V2I Communications for Road Safety

Mohammad Pasha, Mohd Umar Farooq, Tahniyat Yasmeen and Khaleel Ur Rahman Khan

Abstract In the present paper, a crash avoiding at cross roads warning scheme laid on car-to-infrastructure messaging using realistic vehicular dataset is proposed. This meant to avoid collision between the vehicles at intersection and, thus, enhance safety at cross roads. The aim of this paper is to develop an advanced collision avoidance model for connected vehicles which integrates network-level and vehicle-level collision risk. We study the performance of the proposed protocol with an aim to understand the factors that affect successful collision avoidance schemes for cross roads. Through this study, we identified the communication distance as an important factor that influences both the network-level and application-level traffic.

Keywords V2I · Road safety · Vehicular collision · VANETs · RSU

1 Introduction

Vehicles moving toward cross roads have high probability of meeting with accidents as it is ascertained from the data by Federal freeway management statistics (FHWA) [1]. In a new direction to augment cross roads wellbeing and collision avoidance at cross roads, allied cars-based modules are prevalently brought-up to supervise cross roads using wireless messaging. VANET generally is made of car-to-car (V2V) and car-to-infrastructure (V2I) communication [2]. The studied schemes are intended to control cross roads travel efficient and safe by distribution of information among vehicles and road side units. RSUs possibly will be placed at cross roads and other prominent positions on condition that they connect with cars surrounded by their scope [3]. Generally, RSUs can be poised of wireless devices for messaging called transceivers, characteristically, the wireless access in vehicular environment (WAVE) stack-based and dedicated short-range communication (DSRC) devices, an response providing processor, and connection to the V2I messaging network [4, 5]. Most

M. Pasha (✉) · M. U. Farooq · T. Yasmeen
Muffakham Jah College of Engineering and Technology, Hyderabad, India

K. U. R. Khan
ACE Engineering College, Hyderabad, India

H. S. Saini et al. (eds.), *Innovations in Computer Science and Engineering*,
Lecture Notes in Networks and Systems 103,
https://doi.org/10.1007/978-981-15-2043-3_4

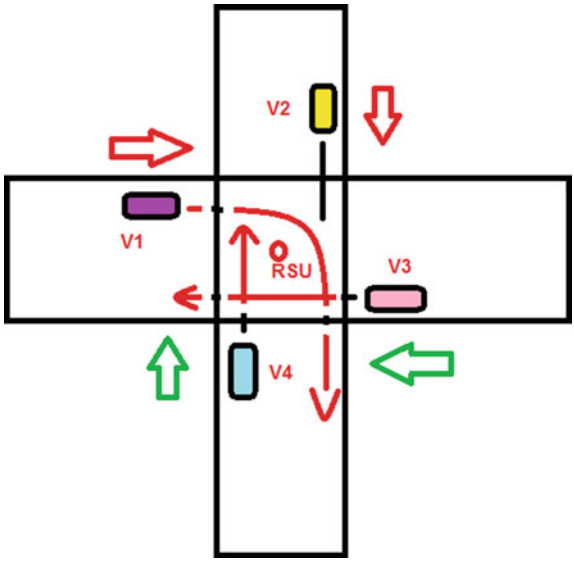


Fig. 1 A depiction of an intersection with vehicles V1, V2, V3 and V4 are vehicles with RSU (Roadside Unit) at the center

of the vehicle collision avoidance systems developed is based on ITS concept. In recent studies vehicular networking, safety-enhancing protocols and applications are evaluated based on packet loss rates that form the networking metrics.

So, proposed evaluation scheme provides cooperative awareness message to be used to determine the metrics to achieve active safety system. We used Vehicle In Network Simulation (VEINS) structure to imitate dissimilar dynamic traffic scenarios at city cross roads. The proposed model marks to authenticate the anticipated system's feat as a new joint cross roads crash evasion system laid on V2I communication. Based on calculated metric, the criticality of situation is differentiated and depending upon this, the warning message will be sent to the potential vehicle (Fig. 1).

2 Related Work

Yang [6], proposed a V2V message procedure for mutual crash caution. The presented procedures take account of the different types of information to contribute to a widespread outlet for erstwhile non-safety purposes and describe overcrowding and managing strategy for disaster caution communication. Thus, it is used to attain minimum latency in distributing crisis alarming in a variety of street scenarios.

Authors, Tang et al. presented different caution forwarding approaches for crash evasion foundation on time trials. The proposed policy is restricted by a number of proceedings, such as the message delivery point, discovery scope, road state, driver response and deceleration pace. They explain the two crash evasion timings: the dangerous and the favored time to keep away from accident.

3 Proposed Work

When objectives of the proposed paper are as follows:

(a) Recommend a new joint cross roads supervision system which is efficient to handle a outsized quantity of information and compliments their time restrictions by the incorporation of realistic vehicular datasets.
(b) To evaluate the framework for collision avoidance and road safety.
(c) Introduce new accident evasion system for cross roads by earnings of V2I messaging.

The simulation tool, OMNeT++, is a widely used, discrete event simulator and known for C++ supported modeling for message exchange system. The veins support take account of a wide-ranging collection of representation to build vehicular arrangements reproduction as sensible as achievable, devoid of forfeited speediness. The included representations are to be carried out by a discrete event and arrangement simulator at the same time as interrelating with a motorway travel model called as Simulation of Urban Mobility (SUMO). In the proposed cooperative cross roads collision avoidance (CICA) system [7], V2I communication and the realistic vehicular dataset of Bologna state is used. Each car ascertains an association in the company of a road side unit.

Evading mishap at cross roads and to diminish crash jeopardy, every one of the cars provisions its in sequence as able-bodied as the close by car in sequence in a record. We consider two types:

- Collection of data
- Database model.

3.1 Collection of Data

The facts provided or learned about each packet are positioned in a network- info container embossed by way of the ID digit of the subsequent car. Every info container begins by means of ID numeral of the car (V_ID) and stops with the instance (instance) when the information is achieved. Adding together to V_ID and instance information, the communication made of car's pace (pace), the location communication, (i.e., the location identifiers: Coordinate_X and Coordinate_Y) and the route communication, (i.e., the car's route: route). For instance, the arrangement of the location container is as exposed underneath. After that, each info container is transmitted to close by cars. As soon as a car gets a info container, it maintains the data in local records (Fig. 2).

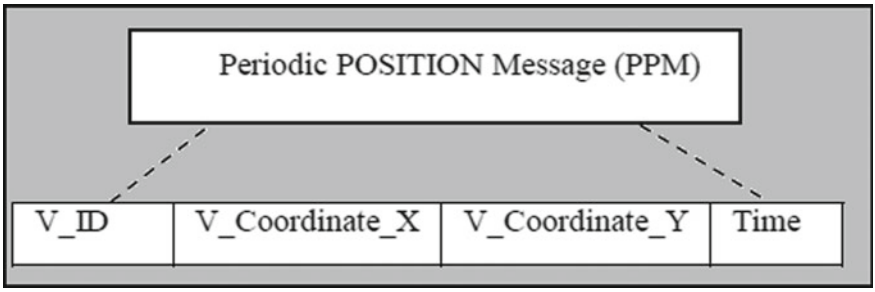


Fig. 2 Structure of location packet

3.2 Data Record Model and Parameters

Firstly, the vehicle database table is used to store the parameters of the vehicles and update the database table of the new entry of vehicles.

These are the following parameters

- initialPosition: The position at which the vehicle starts.
- currentPosition: The current position of the car.
- vehicleSpeed: Determines the pace of the car.
- vehicleDirection: It determines the direction of vehicles with X and Y coordinates.
- intersectionTime: The time between the two vehicles to reach the cross roads point at the same time.

3.3 Algorithm

This algorithm, first the vehicle request is sent to RSU and all the parameters of the vehicles are initialized and added to the database. The range of the vehicle taken here is 500mts. The slope of the two vehicles are calculated as m1 and m2 and if both the slopes are equal to 0, i.e., $m1 = 0$ and $m2 = 0$, then the vehicles are running in parallel otherwise the vehicles are passing through cross roads. If the two vehicles are passing through the same junction, then the time between the cross roads and vehicle is calculated, if the time is less than 10 s, then the collision may occur. If the time between the cross roads and the vehicle is more than 10 s, then the warning message is sent by the RSU in a way to reduce the pace and duration of the car and, thus, the collision avoidance takes place. Thus, the collision is avoided and the road safety is maintained (Table 1).

Table 1 Algorithm for collision prediction and avoidance

Step 1. **Declaration and Initialization**

Each vehicle k has a parameters vector such as: $\{X, Y, V_S, V_D, I_T\}$
//X is Initial position, Y is Current position, V_S is vehicle speed,
//V_D is vehicle data, I_T is intersection time
Indicate the subject and other vehicles (SV, OV)
D_{Coll} = 500m //the diameter of the collision area
X_{sj}, Y_{sj} // coordinates on the $road_j$, N: number of iterations

Step 2. **foreach vehicle *k* do**
foreach iteration *i* = 0 to N
Calculate the $\{X, Y, V_S, V_D, I_T\}$
end_for
end_for

Step 3. **foreach vehicle do**
//Calculate the collision point C(X,Y)
d=sqrt $(cp2-v1)^2+(v2-cp1)^2$
t=d/s
If t<10s
Collision predicted
else if t>10s
No collision predicted
end_if
end_for

Step 4. end_for

Step 5. **foreach Vehicle do**
//Avoidance Collision Procedure
Y1=m1x+c for v1
Y2=m2x+c for v2
if m1-m2==0
Vehicles run in parallel
else
Vehicles run at intersection point
Update the collision coordinates
Trigger alerts to Neighbor OV;
end_if
end_for

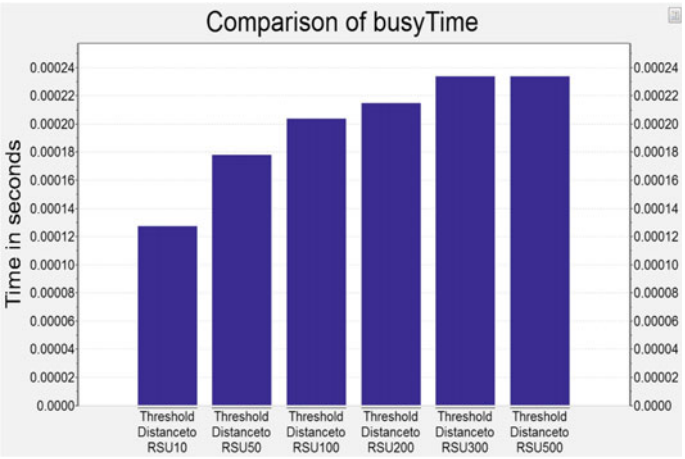


Fig. 3 Comparison of busy time

4 Implementation

The proposed system is implemented to model the realistic vehicular movements in the city junctions of Bologna [8]. We identified sample junctions to run our simulations. The sampled junction is mapped with RSU placement to coincide with junction location. It receives messages from approaching vehicles and predicts a crash by approaching vehicles which appear from perpendicular directions. We evaluated the effect of predicting the crash at cross roads by varying the distance of car to the junction (Fig. 3).

5 Results

Here, we plotted RSU distance to channel busy time in Seconds. Hence, we find the lesser the distance between the vehicle and RSU, the lesser the time to send the messages, making wireless channel less busy (Fig. 4).

Here, we plotted RSU distance to number of broadcasted packets. Hence, we find the lesser the distance between the vehicle and RSU, the lesser the time to receive broadcasts of the messages. If the distance between the vehicle and RSU is long then the number of packets to receive broadcasts of the messages is more (Fig. 5).

Here we plotted RSU distance to Number of Packets sent within the RSU range. Hence, we find the lesser the distance between the Vehicle and RSU, the lesser the number of packets sent (Fig. 6).

Here, we plotted RSU distance to number of collision reported. The optimal distance between the vehicle and RSU is 50 m where the lesser the number of collisions reported (Fig. 7).

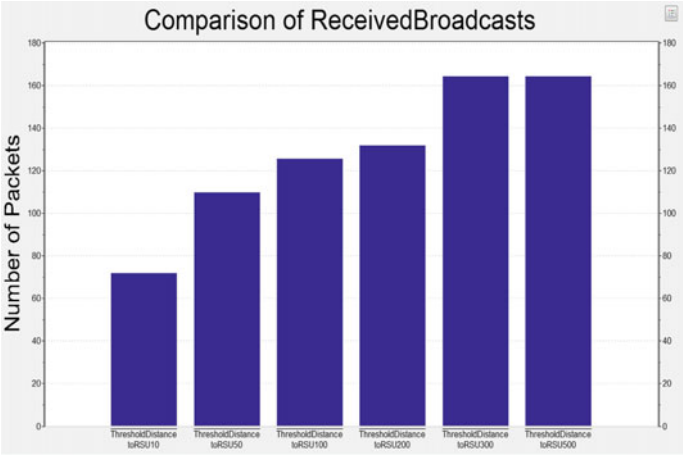


Fig. 4 Comparison of received broadcasts

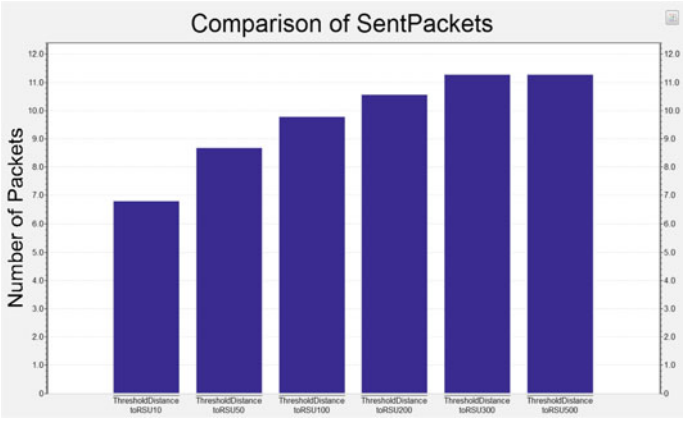


Fig. 5 Comparison of sent packets

Here, we plotted RSU distance to number of lost packets. The comparison of total lost packets is shown.

6 Conclusion

The work on crash prediction at cross roads proposed a new mutual cross roads crash evasion (CICA) module, based on V2I messaging, using a realistic vehicular dataset. We bring in a new scheme for cross roads with an administrative range. On the other side, we integrated a realistic vehicular dataset to simplify and to perform

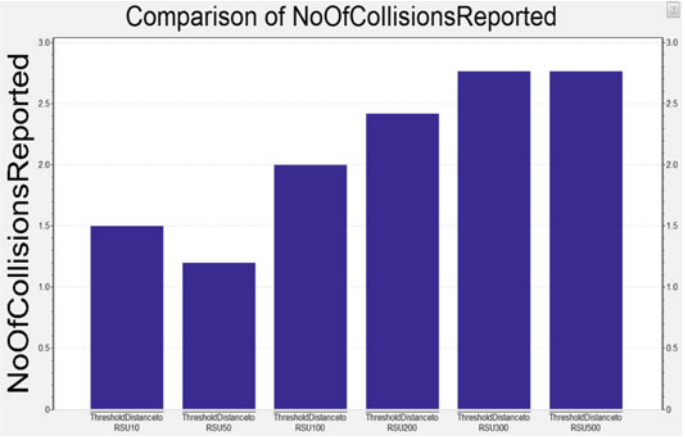


Fig. 6 Comparison of number of collisions reported

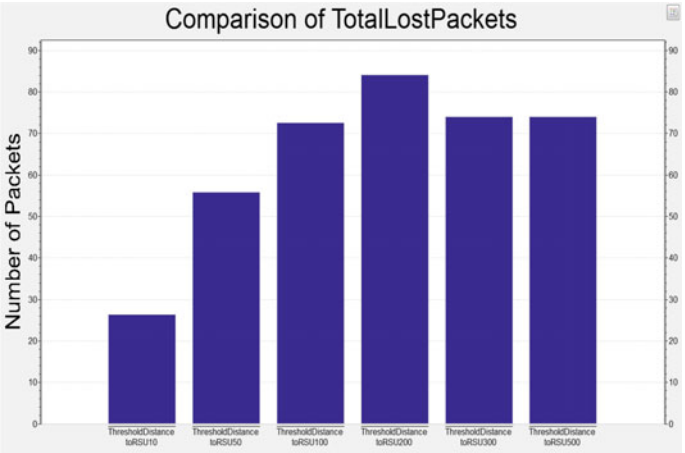


Fig. 7 Comparison of total lost packets

calculations. We studied the effect of varying the distance of communication to report the collisions. The inference is that farther distance of reporting collisions generates more network traffic compared to nearer distances. We need an optimal distance of reporting collision based on vehicle speed and distance to the junction.

References

1. Lyu F, Zhu H, Zhou H, Xu W, Zhang N, Li M, Shen X (2018) SS-MAC: a novel time slot-sharing MAC for safety messages broadcasting in VANETs. IEEE Trans Veh Technol 67(4):3586–3597
2. Yao L, Wang J, Wang X, Chen A, Wang Y (2018) V2X routing in a VANET based on the hidden markov model. IEEE Trans Intell Transp Syst 19(3):889–899
3. Xu W, Zhou H, Cheng N, Lyu F, Shi W, Chen J, Shen X (2018) Internet of vehicles in big data era. IEEE/CAA J Autom Sin 5(1):19–35
4. Zhou H, Zhang N, Bi Y, Yu Q, Shen X, Shan D, Bai F (2017) TV white space enabled connected vehicle networks: challenges and solutions. IEEE Netw 31(3):6–13
5. Xu Z, Li X, Zhao X, Zang MH, Wang Z (2017) DSRC versus 4G-LTE for connected vehicle applications: a study on field experiments of vehicular communication performance. J Adv Transp
6. Pu W, Long L, Yang X (2004) Traffic signal warrant study for stop-controlled intersections [J]. Urban Transp China 3
7. Bazzi A, Masini BM, Zanella A, Thibault I (2017) On the performance of IEEE 802.11p and lte-v2v for the cooperative awareness of connected vehicles. IEEE Trans Veh Technol 66(11):10419–10432
8. Bieker L et al (2015) Traffic simulation for all: a real world traffic scenario from the city of Bologna. Modeling mobility with open data. Springer, Cham, pp 47–60

Smart Device Challenges and Security Channels

Paramveer Singh and Monika Sharma

Abstract The bulk evolution of IoT devices has resulted in easy monitoring of various daily activities in this modern world. But huge invention of such devices has resulted in easy access of information through these devices, leakage of privacy and resulted in system hackings in household and office areas. Due to flaws in the systems of smart devices results is that IoT devices become vulnerable to hackers. In this research paper, we have proposed a framework in which a channel is implemented through which various firewalls are used to locate and detect such intrusions by the hackers.

Keywords IoT attacks · Security · Smart devices · Firewall · Pseudo channel

1 Introduction

It is twentieth century and today's human need is growing in such a fast track that IoT is taking over large areas of human's daily activity needs. It has developed in such a way that we can shop by sitting at our home.

From early 1900s to the modern era, it has gone through a series of developments from small heater to large networks which controlled many tasks of humans in which time were early very consuming and hard to do. This has impacted the life style of people and changed their thinking. The evolution of the smart devices over the years is shown in the framework proposed and it also discusses the patterns and creativity followed over the years.

P. Singh (✉) · M. Sharma
Amity Institute of Information Technology, Amity University, Noida, Uttar Pradesh, India

M. Sharma
e-mail: msharma5@amity.edu

H. S. Saini et al. (eds.), *Innovations in Computer Science and Engineering*,
Lecture Notes in Networks and Systems 103,
https://doi.org/10.1007/978-981-15-2043-3_5

2 Literature Review

The various aspects of IoT attacks which happened in recent years have been discussed in various articles published in recent years. Like Deogirikar and Vidhate have talked about various vulnerabilities of IoT devices due to which various attacks have been introduced before introduction of these devices and the authors have discussed various types of attacks and shown the comparison between them by considering various parameters such as damage level, existing proposal and detection chances, vulnerability, etc., as we go further through the context of the paper, it has shown their survey about how much level of damage attackers can create on various smart devices by the results of these attacks [1].

Kolias, Kambourakis, Stavrou and Voas have mentioned various aspects of the DDOS attacks by Mirai botnet and discussed the steps to countermeasure such attacks and shown the patterns of such types of attacks in the paper. This paper shows the areas of the IoT which are vulnerable to the attacks and this should be prevented [2].

Apthorpe, Reisman, Sundaresan, Narayanan and Feamster have talked about an ISP or network that will analyze the Internet in smart home devices and will monitor the privacy risks associated with the smart home devices like tunneling, blocking and rate shaping. This paper has shown the importance of traffic shaping and how it can prevent the privacy of various smart devices [3].

Abera, Asokan, Davi, Koushanfar, Paverd, Sadeghi and Tsudik have talked about a technique which talks about to increase the reliability of the remotely controlling the smart devices by introducing remote attestation technique which will provide security feature to many remote devices [4]. Mathur, Newe and Rao have shown the routing attacks which happen in the hospitals in the WSN networks and the proposed solutions have proven in successfully detecting the selective forwarding attack [5]. Sivaraman, Chan, Earl and Bureli have demonstrated an attack on a smart home device by using a doctored smart phone app which could scout vulnerable smart devices and modify their firewall by some external source and directly attack the device [6]. This paper shows that home routers are not a best option to save the smart devices from certain high-level malicious attacks.

Leo, Battisti, Carli and Neri paper discusses a federated design model of architecture for the IoT-connected devices for exchange of various IoT services and protecting the privacy of the devices which was difficult for the conventional systems to handle [7].

Gupta, Sengupta and Naik discuss to provide a firewall facility by using Raspberry Pi as a gateway which secures the communication with the cloud database and furthermore the author has future to further use signatures for traffic detection in the dashboard of the raspberry pi [8].

Andrea, Chrysostomou and Hadjichristofi mentioned new classification of various security attacks on smart devices and discussed how to counter these challenges. This paper also showed the various areas of improvements in the IoT field in case of security and privacy and addressed these issues [9].

The paper discussed by Oriwoh, Jazami, Epiphaniou and Sant shows the need of a digital forensics model to investigate the various attacks that occur in various smart devices. The authors have mentioned the need of two approaches which could lead to solving the IoT security issues by proposing a 1-2-3 model and second, the next-big-thing models of approaches rather than the conventional other DF models [10].

3 Smart Devices and Their Types

A smart device, as the name suggests, is an Internet-based hardware that can connect, allot and collaborate with its user and can connect to other smart devices. Although usually small in size, its smart accessories have a frequency of a few gigabytes. While similar smart accessories are small-designed electronics, they are adaptable to a change to its arrangement to allotment and collaborate remotely [4]. TV sets and refrigerators are as well accordingly related to smart devices.

There are some of the examples of IoT attacks which have happened in the previous years like in the year 2016, there was a largest distributed denial of service (DDoS) attack on service provider domain name system (DYN) using an IoT botnet [2]. This made huge number of devices on the Internet vulnerable. Moreover, the TRENDnet marketed its cameras for various uses which they claimed were highly secure but instead they had a faulty software which could be used by hacker to have visuals and even listen to noise.

Three types of smart devices are there which are available in the industry nowadays:

- Smart lighting—We use lighting for a lot of the time we are at home, which makes smart lighting one of a lot of apparent and impactful accessories you can buy. With millions of shades of color and color combinations, you can pre-program scenes for any mood, and by abutting your lighting to you added smart accessories and services, you can accomplish it's change according to a near-unlimited aggregate of circumstances.
- Smart security camera systems—The Internet of things (IoT) has revolutionized home automatic systems. Gone are the canicular if you had to wait on a careful beholder to in fact do something about your anxiety traveling off or pay bags of pounds for a monitored anxiety system.
- Smart entertainment and climate control—While it can be argued that any smart accessory is absorbing, the huge amount and composure of smart television apps, alive accessories and speakers are growing rapidly. The examples are Amazon Alexa, Samsung Smart Hub, Nest smart thermostat and name few others. Amazon's able claimed assistant, Alexa, can be a lot of calmly accessed via the articulation activated Echo and Echo Dot.

3.1 Reasons of Attacks on Smart Devices

Cyber thieves actively search for compromised Internet of things devices for use as an intermediate for Internet requests to route malicious traffic for cyber and computer network attacks. These vulnerable devices include wireless radio links, time clocks, audio/video streaming devices, digital video recorders and some others including satellite antenna equipment, smart garage door openers and network storage devices [9]. Using compromised IoT devices as proxies, these cybercriminals can send unusual traffic, spam and create one-click fraud activities. These state that the anonymity gives freedom attackers to carry out cybercrimes.

There are various types of IOT attacks which are mentioned below:

- Physical attack—These kinds of attacks interfere with the hardware components and are harder to perform as it requires expensive material.
- Side channels attack—These types of attacks use any encryption device to retrieve information from various side channels.
- Cryptanalysis attack—These attacks are based on various cipher texts that is they try to break the encryption of a plain text to retrieve information of a device.
- Software attack—This is the attack which impacts various security measures in an IoT device.
- Network attack—These are the attacks which happen on wireless devices because of the broadcast nature of various communication channels.

The areas where such kinds of security attacks happen are the areas related to automobile, music, medical and office intrusions [3]. Self-driving cars are using sensors which include GPS, millimeter wave (MMW) radar, LiDAR sensor, ultrasonic sensor and camera sensor. The recent testing demonstrated in Defcon24 in 2016 used various off-shelf hardware systems were used which shown the various flaws in these sensors [1].

4 Proposed Security Attack Prevention Framework

4.1 Main Network Channel

This is the main network channel to which all the IoT devices are connected which make it easier to track the availability of various devices in an IoT system and manage them accordingly in an IoT system. This is the main pathway through which all the various devices can be accessed at different times. It will contain all the addresses of different devices and so it requires so much attention and makes it vulnerable to the eyes of hackers. This is making so many devices vulnerable and showing that huge amount of IoT devices still need care.

4.2 Pseudo Network Channel

This is the network channel which will be the clone of the main network in the server connecting various devices. This will be different from the usual network as all the IoT devices which will be connecting to this network and the main job of this channel would be if the intruders will try to unlock into the systems they will require to access the IP address of that system which will be only accessed from the network to which all the IoT devices in a system are connected [5]. So, the basic idea is to provide enough security to the system so that maximum damage can be controlled. In this way, there can be more serenity to the customer satisfaction and the channel could prevent them from large attacks like the DYN attacks which happened in the year 2016 in which hackers inserted MIRAI malware that allowed the use of 100,000 IoT devices which included printers, scanners, IP cameras, residential gateways in the USA [2]. In the framework, it has the segmentation division of channel so that it becomes difficult for the hacker to access the network to which all the devices connected and make the devices hidden from their reach, so to make a pseudo channel, that will reduce the chances of accessing, the original network directly by the hacker (Fig. 1).

Method and technique: The pseudo channel can be used to enhance the security of the private data of various smart devices. The pseudo channel used separates the data of the various devices into a separate tunnel-like path from the actual main channel [10]. The IP addresses of the various devices are stored in the form of encrypted code like A, B, C,… so anybody in the circle of the devices would be required to access the code from the pseudo channel of the IoT network [8]. The visual perceptions are as follows:

- Connect the required device to the pseudo network.
- Give access to the IP address of the same device to the pseudo server.
- The pseudo channel converts the IP address to an encrypted code.
- The user needs to remember the code to access the information from the pseudo channel of IoT network.

We have used a pseudo channel of network which contains all the data of various smart devices in its server called pseudo server. For input changes, we have used are encrypted codes which will hide the IP address information of various devices. This makes the whole system more secure than the federated model of architecture which is used previously in the IoT [7]. The basic approach of the pseudo channel is to divert the access of the main channel of the smart devices to the hacker and make the system more reliable.

In Fig. 2b, the arrows describe the hackers or intruders who are trying to invade into the IoT network. The blue-curved lines which describe the pseudo network channel in which there are some blue circle shaped which are showing the firewall which are deployed in the network to prevent the devices from any kind of attack [6]. In Fig. 2a the federated model of architecture is used which is more vulnerable to the outside intruders as in this the main network has no protection in comparison of the pseudo model of architecture in which the whole main network is protected

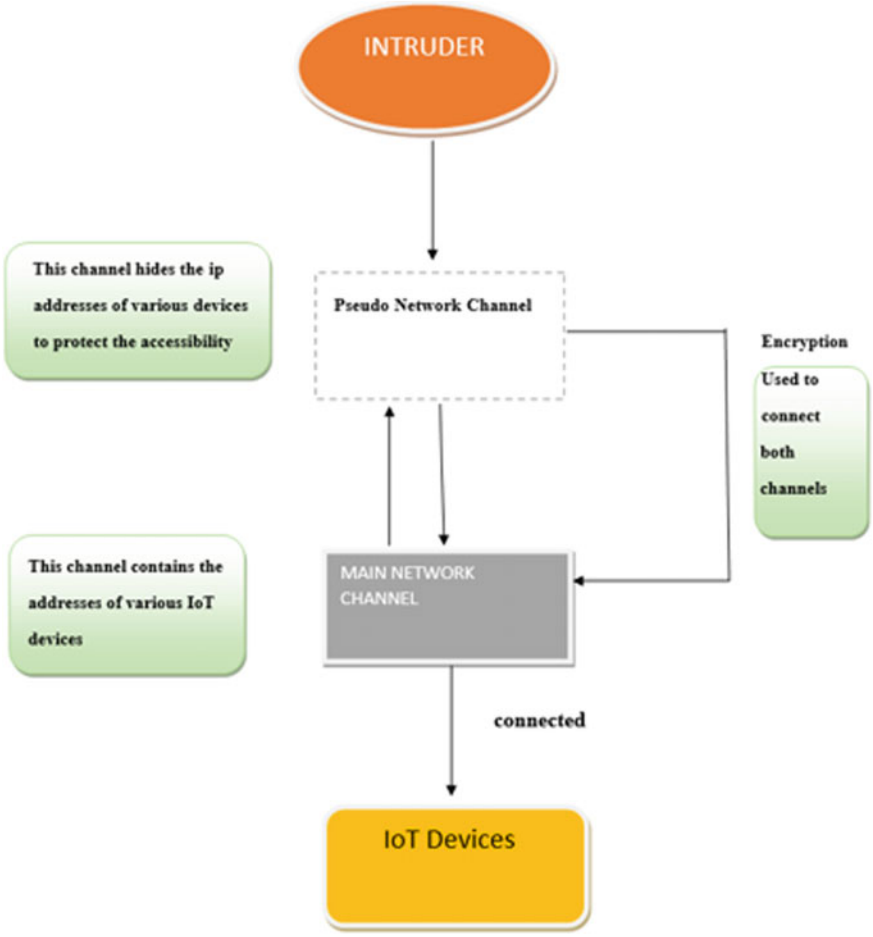


Fig. 1 Security framework for IoT-connected devices

by the pseudo network and further the network contains firewalls which give backup strength to the architecture of pseudo network.

5 Conclusion

Our analysis of the framework shows the potential of preventing attacks related to smart devices. In this paper, we have shown comparison between our framework and the model proposed by Leo and Marco for various attacks prevention. The framework which we have proposed shows the hope of eliminating DDOS and MIRAI attacks which happened on various IoT devices in the recent years and it has the potential of

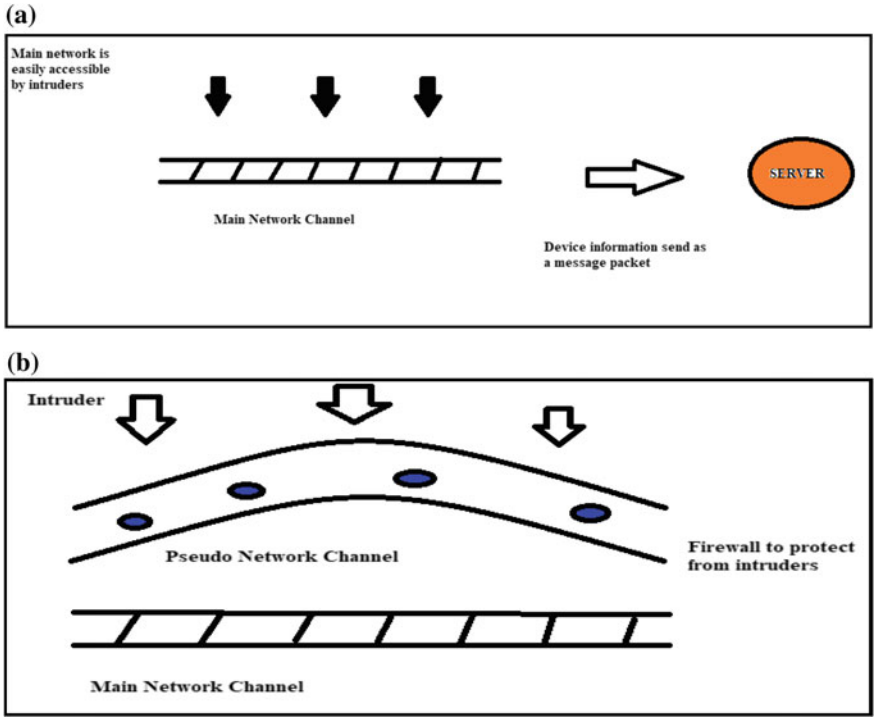


Fig. 2 **a** Federated architecture approach for IoT security, **b** proposed framework

creating more secure and robust environment for various smart devices to operate. The pseudo network and use of firewalls have created an accurate path for devices to secure their data through coordinated collaboration. The model which we have proposed prevent the direct access to the IP address as we have used a pseudo channel, whereas in the federated model it has used packets for device information sharing in which IP address of various devices can be easily accessed.

References

1. Deogirikar J, Vidhate A (2017) Security attacks in IoT: a survey. In: 2017 international conference on I-SMAC (IoT in Social, Mobile, Analytics and Cloud), (I-SMAC). IEEE, pp 32–37
2. Kolias C et al (2017) DDoS in the IoT: Mirai and other botnets. Computer 50(7):80–84
3. Apthorpe N et al (2017) Spying on the smart home: privacy attacks and defenses on encrypted IoT traffic. arXiv preprint, arXiv:1708.05044
4. Abera T et al (2016) Things, trouble, trust: on building trust in IoT systems. In: Proceedings of the 53rd annual design automation conference. ACM, p 121
5. Mathur A, Newe T, Rao M (2016) Defence against black hole and selective forwarding attacks for medical WSNs in the IoT. Sensors 16(1):118

6. Sivaraman V et al (2016) Smart-phones attacking smart-homes. In: Proceedings of the 9th ACM conference on security & privacy in wireless and mobile networks. ACM, pp 195–200
7. Leo M et al (2014) A federated architecture approach for internet of things security. In: 2014 Euro Med Telco conference (EMTC). IEEE, pp 1–5
8. Gupta N, Naik V, Sengupta S (2017) A firewall for internet of things. In: 2017 9th international conference on communication systems and networks (COMSNETS). IEEE, pp 411–412
9. Andrea I, Chrysostomou C, Hadjichristofi G (2015) Internet of things: security vulnerabilities and challenges. In: 2015 IEEE symposium on computers and communication (ISCC). IEEE, pp 180–187
10. Oriwoh E et al (2013) Internet of things forensics: challenges and approaches. In: 9th IEEE international conference on collaborative computing: networking, applications and worksharing. IEEE, pp 608–615

Performance Analysis on the Basis of Learning Rate

Vidushi and Manisha Agarwal

Abstract In this research paper, a detailed analysis is done on effect of learning rate on machine. Subtle changes in learning rate can bring great impact and can simplify complex research methodologies to a great extent. Our main focus will be on trade-off between learning rate and convergence rate toward an optimal solution. In range of this research, it will be made sure that local optimal solution will not be skipped and the most optimal global solution will be achieved. Keeping all other factors like number of iterations, dataset and algorithm static, we would be verifying our results using experimental analysis done with the help of graphical and statistical observations.

Keywords Machine learning · Activation function · Learning rate · Convergence rate · Optimal solution

1 Introduction

Machine learning [1] is artificial intelligence [2] application that enhances and improves instinctually from past or previous experience. The main aim is without any human interference, computer can perform the tasks independently. In the current scenario, machine learning plays a vital role in a number of applications like image processing [3, 4], natural language processing [5, 6], data mining [1, 3, 4], expert system [5, 7, 8]. In real world, the problems are difficult; so to solve these problems, machine learning uses the previous experience and apply on the task to be performed. Deep learning [9, 10] or artificial neural network [11, 12] works with multiple layers—input layer, one or more hidden layers and output layer. Neural network [11] provides the efficient result because it works like Human neuron system. There are a number of neural networks available. Some of them are multilayer perceptron [3, 13, 14] convolutional neural network [15, 16], recursive neural network [14, 16, 17], recurrent neural network [14, 18, 19], long short-term memory [18, 20], sequence to sequence model [7, 14] and shallow neural network [7, 14, 15]. In

Vidushi (✉) · M. Agarwal
Banasthali Vidyapith, Computer Science and Engineering, Jaipur, Rajasthan 304022, India

H. S. Saini et al. (eds.), *Innovations in Computer Science and Engineering*,
Lecture Notes in Networks and Systems 103,
https://doi.org/10.1007/978-981-15-2043-3_6

real time, more complex problems occurred, to work upon and solve the problem occurred, appropriate neural network [14] is used. This paper applies convolutional neural network [15, 17, 21] on MNIST and CIFAR10 dataset [17, 21] to get the required result. Different parameters on which neural network [11] result depends are dataset, number of hidden layers, number of neurons in a layer, learning rate, iteration of work, optimizer used, etc. This research concentrates on the learning rate keeping all other factors constant. To get the local minima, accurate learning rate is required.

1.1 Learning Rate, MNIST and CIFAR10 Dataset [18, 22]

Learning rate parameter value set in the beginning of any process; these parameters are also called hyper-parameter. To get the appropriate result, adjustment of weight and bias is required. There is no one leaning rate that works for all problems, it varies from task to task. Having a high learning rate can miss the optimized solution and having a low learning rate may stuck in local minima. This paper works on learning rate by performing experiment on two well-known dataset, MNIST and CIFAR10.

MNIST dataset represents a well-known dataset for handwritten digits, having digits in different styles, as one example is shown in Fig. 1 [8, 18, 22]. It benefits in research as utilized by many researchers in their research purpose. It is divided into two parts, training and test set having 60,000 and 10,000 images, respectively. It has image size of 28 × 28 [3, 4, 6]. It has all the digits from 0 to 9 in almost every possible form. The CIFAR–10 dataset [6, 14, 23] is a set of images used by scientists of different fields to train and test the results, especially in computer vision and machine learning. This dataset helps to learn a computer or machine, to recognize an object. This dataset [6, 14, 23] consists of 60,000 color images, having size 32 × 32 [21].

2 Methodology Used

The paper used convolutional neural network that is one of the types of artificial neural network. The basic equation of neural network is given below:

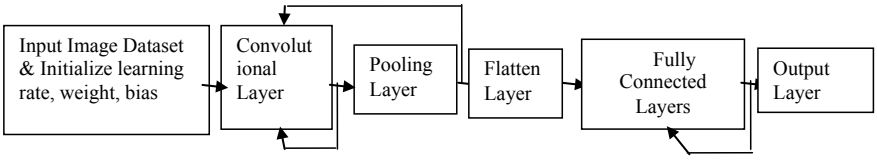


Fig. 1 CNN work flow

$$y = f\left(\sum_{i=1}^{i=n} x_i w_i + b\right) \tag{1}$$

where y is artificial neural network output, f is activation function, x_i is set of input (x_1, x_2, … x_n), w_i is weight corresponding to each input x_i, and b is biased. This equation explains the basic working in which each input x_i is multiplied with its corresponding weight w_i. The weights are adjusted just to minimize the error as per the dataset. Learning rate is a parameter whose value set to get the appropriate result by adjustment of weight.

2.1 Algorithm Proposed

Step 1: Input the dataset in convolutional neural network (CNN) model.
Step 2: Initialize the learning rate, weight and bias.
Step 3: Train the network. (Pass input through layers, use required Activation function).
Step 4: Predict or calculate the output.
Step 5: Find the error, i.e. predicted output–desired output.
Step 6: If predicted output (y) is not as per the desired output. Then
Step 7: Adjust the weight by learning rate and repeat step from 3 to 5. Else Stop.

2.2 Convolutional Neural Network (CNN) Working

CNN is basically having layers showed in Fig. 1. It receives input through input layer, process through all other layers and generates result through the output layer.

3 Experimental Result

Using MNIST dataset dependency of accuracy and test loss on learning rate is shown in Table 1 by keeping all other factors constant (Figs. 2 and 3).

Using CIFAR10 dataset dependency of accuracy and test loss on learning rate is shown in Table 2 by keeping all other factors constant [13, 14, 22] (Figs. 4 and 5).

Table 1 Learning rate versus accuracy and test loss

Learning rate	Accuracy	Test loss
2	0.9923	0.03252
1.5	0.9921	0.03085
1	0.993	0.03379
0.5	0.9932	0.03103
0.1	0.9935	0.03277
0.00001	0.9938	0.02682
0.0000001	0.9924	0.02954

Fig. 2 Learning rate v/s accuracy

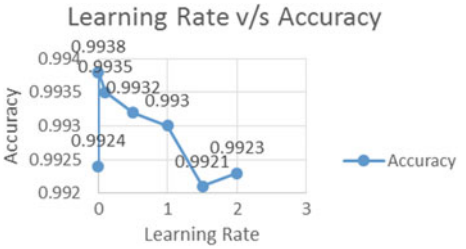


Fig. 3 Learning rate versus test loss

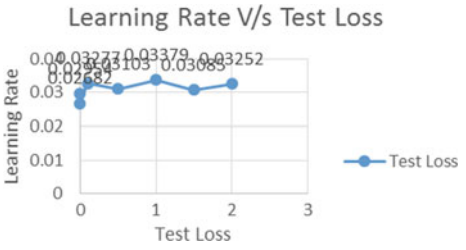
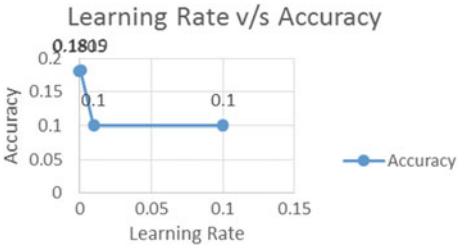


Table 2 Learning rate versus accuracy

Learning rate	Accuracy	Test loss
0.1	0.1	14.506
0.01	0.1	14.506
0.001	0.1819	2.1563
0.0001	0.1805	2.2316

Fig. 4 Learning rate versus test loss



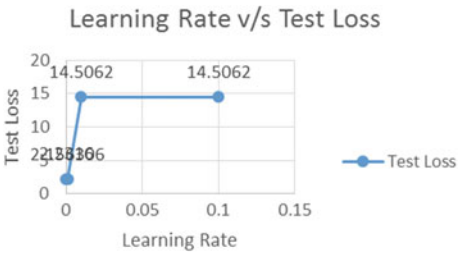


Fig. 5 Learning rate versus test loss

4 Conclusion and Future Work

After deep analysis [9] and experimental result, this paper concludes that learning rate affects the result. It should not be high as well as too low. To low the value of learning rate can be a good idea, through it we can achieve desired result and not miss any value. There is no one leaning rate that works for all problems, it varies from task to task. Having a high learning rate can miss the optimized solution and having a low learning rate may stuck in local minima. The scientists or researchers who are working in the field of machine learning can use this research. This paper result shows how machine behaves same as human with respect to learning rate, i.e. adjustment of weight and biases.

References

1. Choudhary S, Agarwal M, Jailia M (2019) Design framework for facial gender recognition using MCNN. Int J Eng Adv Technol (IJEAT) 8(3)
2. Ahmad AS (2017) Brain inspired cognitive artificial intelligence for knowledge extraction and intelligent instrumentation system. In: 2017 International symposium on electronics and smart devices (ISESD). IEEE, pp 352–356
3. Ming J, Zhang L, Sun J, Zhang Y (2018) Analysis models of technical and economic data of mining enterprises based on big data analysis. In: 2018 IEEE 3rd international conference on cloud computing and big data analysis (ICCCBDA). IEEE, pp 224–227
4. Chen X, Zhai G, Wang J, Hu C, Chen Y (2016) Color guided thermal image super resolution. In: Visual communications and image processing (VCIP). IEEE, pp 1–4
5. Seng KP, Ang LM, Schmidtke LM, Rogiers SY (2018) Computer vision and machine learning for viticulture technology. IEEE Access
6. Gupta P, Goswami A, Koul S, Sartape K (2017) IQS-intelligent querying system using natural language processing. In: 2017 international conference of electronics, communication and aerospace technology (ICECA), vol 2. IEEE, pp 410–413
7. Wang J, Zhang J, Wang X (2018) Bilateral LSTM: a two-dimensional long short-term memory model with multiply memory units for short-term cycle time forecasting in re-entrant manufacturing systems. IEEE Trans Ind Inform 14(2):748–758
8. Zarandi MF, Tarimoradi M, Shirazi MA, Turksan IB (2015) Fuzzy intelligent agent-based expert system to keep information systems aligned with the strategy plans: a novel approach toward SISP. In: 2015 annual conference of the North American fuzzy information processing society (NAFIPS) held jointly with 2015 5th world conference on soft computing (WConSC). IEEE, pp 1–5

9. Zhang D, Han X, Deng C (2018) Review on the research and practice of deep learning and reinforcement learning in smart grids. CSEE J Power Energy Syst 4(3):362–370
10. Kim DE, Gofman M (2018) Comparison of shallow and deep neural networks for network intrusion detection. In: 2018 IEEE 8th annual computing and communication workshop and conference (CCWC). IEEE, pp 204–208
11. Sharma V, Rai S, Dev A (2012) A comprehensive study of artificial neural networks. Int J Adv Res Comput Sci Softw Eng 2(10)
12. Sharma V, Dev A, Rai S (2012) A comprehensive study of cellular automata. Int J Adv Res Comput Sci Softw Eng 2(10)
13. Weng WT, Lin DT (2018) Crowd density estimation based on a modified multicolumn convolutional neural network. In: 2018 International joint conference on neural networks (IJCNN). IEEE, pp 1–7
14. Nijhawan R, Srivastava I, Shukla P (2017) Land cover classification using super-vised and unsupervised learning techniques. In: 2017 international conference on computational intelligence in data science (ICCIDS). IEEE, pp. 1–6
15. Yang Q, He Z, Ge F, Zhang Y (2017) Sequence-to-sequence prediction of personal computer software by recurrent neural network. In: 2017 International joint conference on neural networks (IJCNN). IEEE, pp 934–940
16. Wang Q, Huang Y, Mo X, Lai W, Dong H, Yang Y, Liu J, Huang J, Sun Y (2016) The study of the improved multilayer perceptron algorithm on hydrophobicity detection research of composite insulator bushing. In: 2016 8th International conference on intelligent human-machine systems and cybernetics (IHMSC), vol 1. IEEE, pp 438–441
17. Yuan J, Yu J (2016) Semi-supervised learning with bidirectional adaptive pairwise encoding. In: 2016 15th IEEE international conference on machine learning and applications (ICMLA). IEEE, pp 677–681
18. Heck J, Salem FM (2017) Simplified minimal gated unit variations for recurrent neural networks. arXiv preprint, arXiv:1701.03452
19. Mohapatra RK, Majhi B, Jena SK (2015) Classification performance analysis of MNIST Dataset utilizing a multi-resolution technique. In: 2015 international conference on computing, communication and security (ICCCS). IEEE, pp 1–5
20. Wang J, Zhang J, Wang X (2017) A two-dimensional long-short-term memory model with multiply memory units for short-term cycle time forecasting in re-entrant manufacturing systems. IEEE Trans Ind Inf 14(2):748–758
21. Chu CT, Chiang HK, Lin TC, Kung CT (2014) Recursive wavelet elman neural network for a synchronous reluctance motor. In: 2014 International symposium on next-generation electronics (ISNE). IEEE, pp 1–4
22. Reddy KS, Singh U, Uttam PK (2017) Effect of image colourspace on performance of convolution neural networks. In: 2017 2nd IEEE international conference on recent trends in electronics, information & communication technology (RTEICT). IEEE, pp 2001–2005
23. Chen S, Peng C, Cai L, Guo L (2018) A deep neural network model for target-based sentiment analysis. In: 2018 International joint conference on neural networks (IJCNN). IEEE, pp 1–7

Cryptocurrency Price Prediction Based on Historical Data and Social Media Sentiment Analysis

Soumyajit Pathak and Alpana Kakkar

Abstract The cryptocurrency space is highly volatile, and predictive systems working in this space are still in their infancy phase. The findings made during an extensive literature survey suggest the lack of a balanced approach and the right combination of data sources, which lead to biased feature sets and discriminative results. These have an impact on the accuracy of the models and skew the classification and prediction results. In this paper, we explore a better approach where a combination of sentiment analysis of social media content, contemporary pricing and market volume data is considered to extract a refined feature set. The features extracted from the preprocessing pipeline will then be used to classify and predict future pricing using a neural network model.

Keywords Cryptocurrency · Long short-term memory · Sentiment analysis

1 Introduction

Cryptocurrency and the underlying blockchain technology are a promise of better tomorrow. Since its inception in 2008, Bitcoin and other cryptocurrencies harnessing the underlying blockchain technology have garnered an immense amount of interest from the technology as well as the finance world. The blockchain technology has since then diverged into multiple fields and has been widely hailed as one of the most innovative and influential inventions in the modern information era [1]. However, the cryptocurrency space currently suffers from major setbacks which include unpredictability, instability and inaccurate forecasting or trend analysis. This paper attempts to solve the problem by focusing on various key performance indicators and proposing a novel approach that explores a more balanced data preprocessing pipeline involving sentiment analysis of social media content combined with contemporary price fluctuations and market data to make a weighted resultant feature

S. Pathak (✉) · A. Kakkar
Amity Institute of Information Technology, Amity University, Noida, Uttar Pradesh, India

A. Kakkar
e-mail: akakkar@amity.edu

H. S. Saini et al. (eds.), *Innovations in Computer Science and Engineering*,
Lecture Notes in Networks and Systems 103,
https://doi.org/10.1007/978-981-15-2043-3_7

set. The features are then used to train an artificial recurrent neural network of Long Short-Term Memory model.

In Sect. 2, we review the existing approaches and developments in the cryptocurrency and related domain. We also explore the technologies that we will be using in our proposed model. Published research papers, articles and case studies from various reputed sources are considered in this section. In Sect. 3, we explore the data gathering and preprocessing techniques used for structuring the Twitter data set for sentiment analysis, historical pricing, volume and market cap data of Bitcoin. In Sect. 4, we extract the final weighted data points that will be used for the final prediction and explore the high-level architecture of the proposed model that will be used for the predictive system. In Sect. 5, we evaluate the results and observations from the previous section before drawing a conclusion based on our findings in the final section.

2 Literature Survey

Since the seminal white paper by Satoshi Nakamoto in 2008 [2], blockchain has seen a rapid growth of interest from various communities all across the globe. Even though cryptocurrencies are the most dominant use case for the blockchain technology presently, it is certainly not the only domain where it can be utilized. Bitcoin remains the clear leader among all the blockchain-based cryptocurrencies out there [3]. The cryptocurrency domain is quite similar to the stock market where the pricing and valuation are always fluctuating and dependent on multiple factors. Therefore, similar to the stock market, the use of price prediction systems is quite lucrative in this domain as well.

Extensive research efforts have been made in the stock market domain to formulate effective price prediction systems. Same cannot be said about the cryptocurrency space. But due to the similar nature of their valuation dynamics, inspiration can be drawn from across the domain. Price prediction models have been of huge interest in the stock market domain but not without a fair share of scientific scepticism. Maredza et al. examined the Johannesburg stock exchange market and concluded that the returns follow the random walk theory, and hence, any price predicting model is bound to be inefficient and weakly accurate [4]. Degutis et al. reviewed the underlying concept of efficient market hypothesis which suggests that returns in an efficient market are random in nature and that the market efficiency is likely to be dependent on the market size and maturity [5]. Despite of these researchers highlighting the presence of randomness in the market, there have been many groundbreaking papers related to prediction systems and models.

Niaki and Hoseinzade employed an artificial neural network model to forecast the daily direction of the S&P 500 index and managed to outperform traditional buy-and-hold strategy in terms of obtained profit via forecasting [6]. They determined exchange rates to be influential features. Dixon et al. similarly used deep neural networks for building classifiers that can be trained concurrently to possess substantially

enhanced predictive capabilities [7]. Short-term price prediction, specifically opening or closing price, is a very valuable insight, and Zhang et al. employed a self-adapting variant PSO-Elman neural network model that demonstrated the superiority of recurrent neural networks in resolving time series issues [8]. A recurrent neural network is one of the most common types of machine learning model used to predict pricing patterns in the financial as well as cryptocurrency space [9]. Tiwari et al. examined the error margin of various prediction model techniques and concluded that feed-forward neural networks tend to produce significantly less error-prone results [10]. The autoregressive integrated moving average (ARIMA) model is another model that is quite widely explored for time series prediction, and Ariyo et al. have obtained results that suggest it has a strong potential as a short-term prediction model [11]. Yulin has further explored and found that the combination of the ARIMA model with BP neural network seems to perform better in terms of accuracy than a single ARIMA model [12]. ARIMA model has also been extensively used in predicting Bitcoin prices. Yenidoğan et al. compared the ARIMA model with Facebook's Prophet model for Bitcoin time series prediction results [13]. Other researchers have also explored multivariate time series data sets for Bitcoin price prediction models [14].

Social media content if extracted and analysed efficiently can often serve as a prior indicator of economic and commercial trends and hence can be helpful in predicting the future pricing patterns. Li, Shah et al. demonstrate the sentiment analysis of tweets by incorporating word embedding and weighted text features that outperform the state-of-the-art sentiment classification methods [15]. Bollen et al. demonstrated the impact of Twitter on stock market prices [16]. Classification models like Naive Bayes have been used in conjunction with sentiment analysis results from Twitter in many papers to predict stock market prices and returns [17]. Sentiment analysis of content from various other sources has also been widely used for stock market price prediction [18]. Porshnev et al. explored a support vector machine model that leverages a combination of the sentiment analysis data and historical market indicator data that demonstrated a 62.03% predictive accuracy [19]. Simões et al. further attempted to optimize sentiment analysis-based models using genetic algorithms and concluded that adding more features to the optimization approach can lead to stronger calibration and consequently better performance of the models [20]. Jain et al. explored the effect of Twitter-based sentiment analysis approach in the cryptocurrency space [21]. Recurrent neural network models have been at the forefront in this domain as well [22].

Researchers have also explored the influence of transaction graph and network flow. Features extracted from it which included influential agents, flow features and centrality measures can be highly lucrative and reveal the predictive information embedded in the network itself [23].

3 Data Gathering

In order to create the data set required for training, validation and testing our predictive model, we first need to gather data sets primarily of two types—tweets from Twitter related to Bitcoin and Bitcoin market data which include opening price, closing price, high and low prices along with market cap and transaction volume.

We use the Tweepy Python library along with the Twitter Developer API to gather past tweets as well as collect real-time tweet stream related to Bitcoin. We also use GetOldTweets Python library for extracting older Twitter data that is not readily accessible using the Twitter Developer API used by Tweepy. We store all the tweets that include terms like Bitcoin, BTC and cryptocurrency. We tag tweets as influential if the tweets are from verified accounts or accounts with more than 10 k followers or have more than 100 retweets and/or 200 likes. We filter out only the influential tweets for sentiment analysis. This approach helps us weed out outliers and noisy data that can cause unnecessary skewness. We then use the Python-based natural language processing toolkit library TextBlob to prepare our textual data and perform sentiment analysis to extract a usable feature set for our predictive LSTM model.

First, we use tokenization to extract the words out of each tweet content. Tokenization is the process where we break down each tweet into a sequence of extracted tokens which in this case roughly corresponds to words. Then, we execute another process called Noun Phrase Extraction which helps in identifying the who and what aspects in the tweet. Part-of-Speech tagging or grammatical structure tagging comes next, where the adjectives and verbs are extracted away. This part is very important in determining the polarity of the tweets in the sentiment analysis process. The next process is Word Inflection, where lemmatization and stemming techniques can be employed to extract base forms of words to express the correct grammatical meanings. Finally, N-gram-based modelling is generated for sentiment analysis.

The next phase of data processing, i.e. the sentiment analysis part, determines the attitude or the emotion of the tweet author. The sentiment function available in the TextBlob library returns two computed properties—polarity and subjectivity. The polarity value is a float value ranging from -1 to 1, where -1 indicates a negative sentiment and 1 represents the vice versa. The subjectivity value is also a float value ranging from 0 to 1, where 0 indicates a highly objective statement and 1 indicates a highly subjective statement. Objective statements tend to be more factual and statistically more valuable, while subjective express opinions, beliefs, rumours and speculation.

We parse the whole data set using the technique documented above. Finally, after sentiment analysis is done, we strip the Twitter username and tweet text from the data set, keeping only the timestamps, polarity score and subjectivity score of the process tweets. We also truncate the timestamps using floor method which will round all the times to the closest hour limit (Table 1).

For gathering Bitcoin market historical data, we use a web scraper written in Node.js using Google headless browser puppeteer to periodically scrape data from bitcoin.info. We gather the opening, closing, low and high price data for each hour

Table 1 A sample set of twitter data after computing sentiment analysis scores against truncated timestamps

Timestamp	Polarity	Subjectivity	Tweet volume
2019-03-01 11-PM	0.102672	0.216122	3805
2019-03-01 10-PM	0.098525	0.215452	4421
2019-03-01 09-PM	0.095992	0.225323	3495
2019-03-01 08-PM	0.104512	0.218871	3827
2019-03-01 07-PM	0.096224	0.205252	3650

Table 2 Historic data set sample for Bitcoin before processing (prices in dollars)

Timestamp	Open	High	Low	Close	Volume
2019-03-01 11-PM	3814.01	3816	3805	3806.17	1206194.98
2019-03-01 10-PM	3829.33	3840	3792	3814.01	2881110.81
2019-03-01 09-PM	3829.01	3834.51	3828	3829.33	1147584.09
2019-03-01 08-PM	3829.67	3829.99	3827.62	3829.01	1104754.96
2019-03-01 07-PM	3834.34	3835.88	3827.66	3829.67	944594.55

along with transaction volume. We transform the four prices related field into a single weighted price field that will be used as the feature set in our LSTM model. Before diving into the model section, we add the feature we preprocessed earlier, i.e. tweet and their respective computed field values such as polarity, subjectivity as well as the volume by aggregating and grouping all the already truncated times by the hour (Table 2).

So finally, we end up with a data set that represents day-wise entries containing dates, polarity average of the hour (float value), subjectivity average of the hour (float value), tweet volume for the hour (aggregated value), transaction volume and weighted price average.

4 Proposed Model

We implement a Long Short-Term Memory model for our predictive model. It is a specialized type of artificial recurrent neural network architecture that is one of the most commercially used and powerful deep learning models. It is a general-purpose computational model that specializes in classifying time series data (univariate as well as multivariate) as well as predicting analysis. We have our analysed data prepared from the previous section. Due to the nature of data sets and features, we will be using here, LSTM is well suited because of its enhanced ability to deal with the common problems usually faced by other traditional recurrent neural network models or standard feed-forward neural network model. Its increased tolerance and

insensitivity to gap length make it well suited for our case. LSTM is also less prone to gradient problems of both the expanding and vanishing nature.

We use the common one cell and three gate or regulator architecture LSTM model—forget, input and output gate. The activation function used for the gate is the sigmoid logistic function. The forms of the activation vector equations for the LSTM are

$$f_t = \sigma_g(W_f x_t + U_f h_{t-1} + b_f) \tag{1}$$

$$i_t = \sigma_g(W_i x_t + U_i h_{t-1} + b_i) \tag{2}$$

$$o_t = \sigma_g(W_o x_t + U_o h_{t-1} + b_o) \tag{3}$$

$$c_t = f_t \circ c_{t-1} + i_t \circ \sigma_c(W_c x_t + U_c h_{t-1} + b_c) \tag{4}$$

$$h_t = o_t \circ \sigma_h(c_t) \tag{5}$$

Here, $c_0 = 0, h_0 = 0$ and $\circ$ represent matrix element-wise product (Hadamard Product), while W_q and U_q are the weights of the input and recurrent connections. Equation (1) represents the forget gate activation vector, (2) represents the input gate activation vector, (3) represents the output gate activation vector, (4) represents the cell state vector, and (5) represents the hidden state vector also known as the output vector of the LSTM unit.

Now, to make it usable for our employed LSTM model, we first need to convert the processed data from the time series data format it is currently in, to a more supervised 3D array sequence with normalized variables. We also split the time series data we accumulated into the training and test set. We kept 450 h for data for training while keeping the rest 50 h of data for testing and validating.

The model parameters used for training, in this case, are 50 epochs, with validation split of 0.2 and batch size of 12. We use mean absolute error (MAE) as the loss function used for the regression model. We use MAE in this case, as our training data set is likely to harbour a lot of outlier values. We use this loss function with a dynamic learning rate configuration so as to make up for the fact that the gradient remains the same throughout the training. To fix the issue where the gradient will be quite large even when the loss values are small, our dynamic learning rate will decrease as we move closer to the minima. For our optimization algorithm, we use a popular extension to stochastic gradient descent that has recently seen huge adoption in most major deep learning implementations. The Adam optimizer provides the combination of benefits we expect from other two extensions of stochastic gradient descent namely—adaptive gradient algorithm (AdaGrad) and root mean square propagation (RMSProp) (Fig. 1).

The LSTM model architecture described in the previous section was trained on 450 h of data. The training set spanned up until the end of 1 March 2019. We start

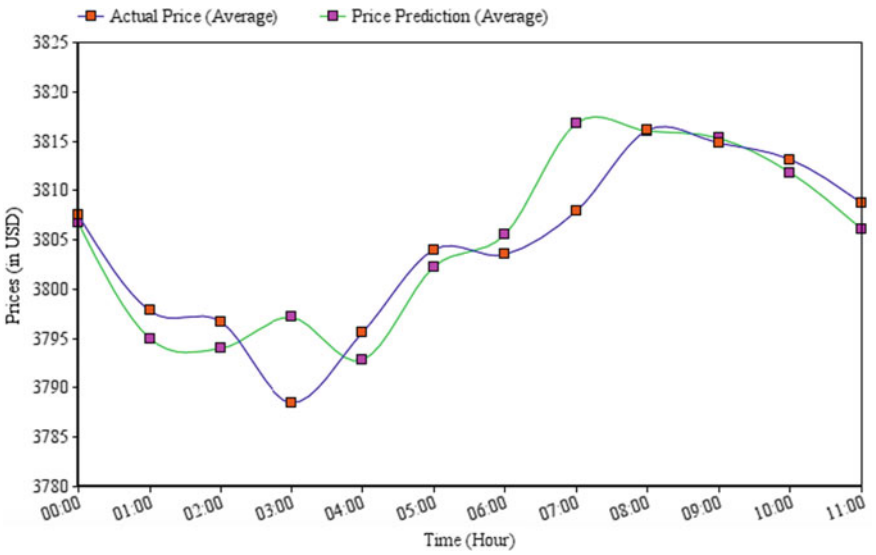


Fig. 1 Visualization of the predicted prices for 2 March 2019

the initial test and validation data set from 2 March 2019 at 00:00. We can see from the visualization of the prediction results plotted against the actual prices (average of the opening, closing, high and low) of the respective hours.

From the comparative visualization plotted here for the initial 12 h time frame on 1 March 2019, it is quite evident that the trend is predicted with great accuracy. The model does falter in predicting a sudden dip at around 03:00 but quickly catches up with the upward trend following that. To tweak the model to be more receptive of the sudden ups and downs, we might consider the use of mean square error (MSE) as the loss function which is more considerate of outliers in the training process. But using MSE instead of MAE may result in effecting in predicting the overall trend drastically.

5 Conclusion and Future Works

The paper explored the results of an LSTM model trained on feature sets influenced by historical market data including pricing, volume and market cap along with Twitter trend features extracted via sentiment analysis. The specialized data preprocessing of the Twitter data before computing sentiment analysis results provides us with a refined set of features. With the available data set that spans across 450 h, the LSTM model we have employed predicts the overall price trend with an accuracy of 77.89%. This suggests that the combination of the features extracted from social media and the historical pricing data yields very useful results.

The approach can be further improved by extracting other correlated features from transaction network or even sentiment analysis features from new content can be of significant value. Many non-English speaking countries have invested in the Bitcoin community as well and have a huge say in how the Bitcoin space evolves and adapts. Effectively extracting multilingual sentiment analysis data utilizing a system like MuSES [24] may be the key to understanding the global trend patterns. The addition of other computed features like volatility index as a feature may also result in improvements in terms of real-world effective accuracy.

Acknowledgements We express our deep sense of gratitude to the Founder President of Amity Group, Dr. Ashok K. Chauhan, for his keen interest in promoting research in Amity University and has always been an inspiration for achieving great heights.

References

1. Tschorsch F, Scheuermann B (2016) Bitcoin and beyond: a technical survey on decentralized digital currencies. IEEE Commun Surv Tutor 18(3):2084–2123
2. Nakamoto S (2008) Bitcoin: a peer-to-peer electronic cash system. Working paper
3. Hileman G, Rauchs M (2017) Global cryptocurrency benchmarking study. Cambridge Centre for Alternative Finance
4. Chitenderu TT, Maredza A, Sibanda K (2014) The random walk theory and stock prices: evidence from Johannesburg stock exchange. IBER 13(6):1241–1250
5. Degutis A, Novickytė L (2014) The efficient market hypothesis: a critical review of literature and methodology. Ekonomika 93(2):7–23
6. Niaki S, Hoseinzade S (2013) Forecasting S&P 500 index using artificial neural networks and design of experiments. J Ind Eng Int 9(1):1
7. Dixon M, Klabjan D, Bang J (2017) Classification-based financial markets prediction using deep neural networks. Algorithmic Financ 1–11
8. Zhang Z, Shen Y, Zhang G, Song Y, Zhu Y (2017) Short-term prediction for opening price of stock market based on self-adapting variant PSO-Elman neural network. In: 2017 8th IEEE international conference on software engineering and service science (ICSESS), Beijing, pp 225–228
9. Phaladisailoed T, Numnonda T (2018) Machine learning models comparison for bitcoin price prediction. In: 2018 10th International conference on information technology and electrical engineering (ICITEE), Kuta, pp 506–511
10. Tiwari S, Bharadwaj A, Gupta S (2017) Stock price prediction using data analytics. In: 2017 International conference on advances in computing, communication and control (ICAC3), Mumbai, pp 1–5
11. Ariyo AA, Adewumi AO, Ayo CK (2014) Stock price prediction using the ARIMA model. In: 2014 UKSim-AMSS 16th international conference on computer modelling and simulation, Cambridge, pp 106–112
12. Du Y (2018) Application and analysis of forecasting stock price index based on combination of ARIMA model and BP neural network. In: 2018 Chinese control And decision conference (CCDC), Shenyang, pp 2854–2857
13. Yenidoğan I, Çayir A, Kozan O, Dağ T, Arslan Ç (2018) Bitcoin forecasting using ARIMA and prophet. In: 2018 3rd International conference on computer science and engineering (UBMK), Sarajevo, pp 621–624

14. Karasu S, Altan A, Saraç Z, Hacioğlu R (2018) Prediction of Bitcoin prices with machine learning methods using time series data. In: 2018 26th Signal processing and communications applications conference (SIU), Izmir, pp 1–4
15. Li Q, Shah S, Fang R, Nourbakhsh A, Liu X (2016) Tweet sentiment analysis by incorporating sentiment-specific word embedding and weighted text features. In: 2016 IEEE/WIC/ACM international conference on web intelligence (WI), Omaha, NE, pp 568–571
16. Bollen J, Mao H, Zeng X (2011) Twitter mood predicts the stock market. J Comput Sci 2(1):1–8
17. Sul HK, Dennis AR, Yuan L (2017) Trading on twitter: using social media sentiment to predict stock returns. Decis Sci 48(3):454–488
18. Ahuja R, Rastogi H, Choudhuri A, Garg B (2015) Stock market forecast using sentiment analysis. In: 2015 2nd International conference on computing for sustainable global development (INDIACom), New Delhi, pp 1008–1010
19. Porshnev A, Redkin I, Shevchenko A (2013) Machine learning in prediction of stock market indicators based on historical data and data from twitter sentiment analysis. In: 2013 IEEE 13th International conference on data mining workshops, Dallas, pp 440–444
20. Simões C, Neves R, Horta N (2017) Using sentiment from twitter optimized by genetic algorithms to predict the stock market. In: 2017 IEEE congress on evolutionary computation (CEC), San Sebastian, pp 1303–1310
21. Jain A, Tripathi S, Dwivedi HD, Saxena P (2018) Forecasting price of cryptocurrencies using tweets sentiment analysis. In: 2018 Eleventh international conference on contemporary computing (IC3), Noida, pp 1–7
22. Pant DR, Neupane P, Poudel A, Pokhrel AK, Lama BK (2018) Recurrent neural network based bitcoin price prediction by twitter sentiment analysis. In: 2018 IEEE 3rd international conference on computing, communication and security (ICCCS), Kathmandu, pp 128–132
23. Yang SY, Kim J (2015) Bitcoin market return and volatility forecasting using transaction network flow properties. In: 2015 IEEE symposium series on computational intelligence, Cape Town, pp 1778–1785
24. Xie Y et al (2014) MuSES: multilingual sentiment elicitation system for social media data. IEEE Intell Syst 29(4):34–42

Detection of Normal and Abnormalities from Diabetics Patient's Foot on Hyperspectral Image Processing

R. Hepzibai, T. Arumuga Maria Devi, P. Darwin and E. SenthilKumar

Abstract This paper's proposed method known as assessment of diabetic foot abnormalities for normal and abnormal patients. To evaluate the diabetic foot by using filtered output from a contrast adjusted hyperspectral image and selecting the four seeds points to obtain the cropped image by adding the pepper and salt noisy and apply median filtering from noisy input in order to get the smoothen output image. Then, differentiate the output value normal and abnormal patients. Finally, assess the diabetic foot abnormalities by hyperspectral image. In this article, there are only some qualities which is to regulate enlarge the gap of the figure with chart the principles of the key concentration of figure to original ethics. The progress development is established to arrange in partial, to strengthen the noise which may be nearby in the figure. A number of the applications are included in medical field and geosciences field also.

Keywords Hyperspectral imaging · Median · N-D filtering · 4 seeds cropping · EMR-Electro Medical Record · Salt and pepper noise

1 Introduction

In diabetes, foot harms is a significant metabolic confusion. The most important cause is lower-extremity amputations, cardiovascular disease, renal failure and retinopathy, (1). In diabetic foot of abnormalities, together with ulcers and lower-extremity amputations, as a result loss of quality in life affecting by ulcers and through lower-extremity amputation, disability and persons affected are extremely valuable (2). Diabetes is preceded with foot abnormalities, for example, ulceration and major amputation (3). In 2012, USA was $245 billion through the common costs among high amount of hospital admissions, as well as foot ulcers only for $9 billion.

R. Hepzibai (✉) · T. Arumuga Maria Devi · P. Darwin · E. SenthilKumar
Centre for Information Technology and Engineering, Manonmaniam Sundaranar University, Abishekapatti, Tirunelveli, Tamil Nadu 627012, India

H. S. Saini et al. (eds.), *Innovations in Computer Science and Engineering*,
Lecture Notes in Networks and Systems 103,
https://doi.org/10.1007/978-981-15-2043-3_8

2 About Hyperspectral Imaging

Hyperspectral imaging which is to be collected the spectral imaging and processes in order to electromagnetic spectrum. The techniques of hyperspectral imaging is to find the spectrum for every pixel in the image of a view to locate the object, resources or detecting processes. There are two major branches of spectral images. One is push broom scanners, and another one is whisk broom scanners which convert the images by snapshot hyperspectral imaging [1]. This method of separate the imaging bands can be extensive into visible. Hyperspectral sensors are used in the engineers build processing systems for the purpose in astronomy and also in farming, molecular environmental science, biomedical imaging, geosciences and physics.

3 Medical Difficulty and General Problem

South Carolina has the seventh rank for cause of death in diabetes, and also, this places tenth highest in percentage of population in nation with diabetes. In most of the associated cost for diabetes, it will be reduced with protective involvement in the main setting, and diabetes is the majority ordinary metabolic confusion. In patients with diabetes foot complications, the most reason is ulcers and amputations for hospitalization. As a result of premature detection, accurate supervision of patients are critical threat in increasing foot ulcers and lower-extremity. In early stage, ordinary foot test made on the enduring by diabetes in the major care location supposed to be in need of attention.

4 Routine Diabetic Foot Test

In history, an accurate foot test is needed for diabetes patients and evaluation of risk factors to examine for any abnormalities, like a neurological assessment and a vascular assessment of the diabetes foot pulses. The major centers for diabetes foot like Medicaid and Medicare Services both integrated to do yearly main care for foot test as a clinical superiority measures [2]. In main care setting, by using an EMR [3, 4], accurate records of afoot will be tested. In the foot test, a clinical quality measures should be taken in a visual inspection [5] through sensory test a monofilament and evaluation of peripheral pulses. These mechanisms should be recognized for main care providers to be amplify from the Centers for Medicaid and Medicare Services.

5 To Evaluate the Feet by Normal and Abnormal

The normal person takes various steps per day, and each step can place strength of your body weight on your feet. This general cyclic use leads to some ordinary changes connected by aging.

They are some symptoms are

(1) The foot becomes longer and wider.
(2) In the flattening of the foot, there is mild settling of the arch.
(3) The foot and ankle become stiffer with some normal range of motion.
(4) While walking some loss of balance. In some foot may occur abnormal or pathological.

There are the problems as follows

(1) Arthritis
(2) Morton's neuronal
(3) Calluses or corns
(4) Clawing of the toes
(5) Hammering of the toes
(6) Bunions, etc.

It tends to happen in connection through extended of illness.

6 Proposed Algorithm and Its Results

Algorithm

Step 1: Given input image for normal patient
Step 2: Convert the input image to gray image and create morphological structuring element and apply top hat filtering
Step 3: From that, we can get filtered image by applying the filtering algorithm
Step 4: Finally, we have to adjust insensitive values by applying partial gap adaptive histogram equalization
Step 5: Create predefined 2D filters and create N-D filtering of multidimensional images.
Step 6: Finally get the contrast adjust image (Fig. 1).

Algorithm for Cropping

Step 1: Get the contribution image as of normal patient.
Step 2: Then resize the contribution image.
Step 3: show the contribution image by selecting four seeds points in an image.
Step 4: Select polygonal region of interest.
Step 5: Show the binary mask image and create buffer for region of interest and create buffer for non-region of interest.
Step 6: Display region of interest that is cropped image (Figs. 2 and 3).

Algorithm for Pepper and Salt

Step 1: Get the input image for normal patient

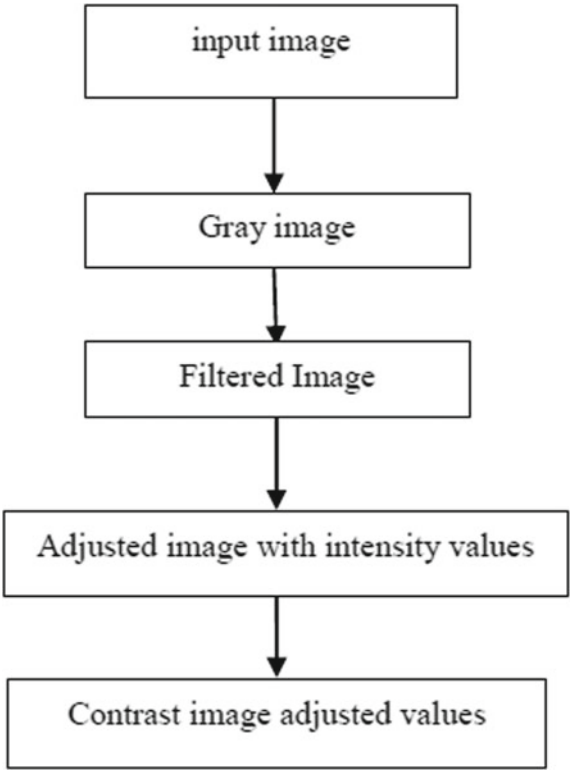


Fig. 1 Flow chart for the architecture of filtering image with contrasted output on normal patient

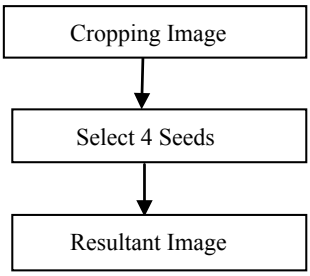


Fig. 2 Flow chart of architecture for cropping image on normal patients by selecting four seeds points in an image

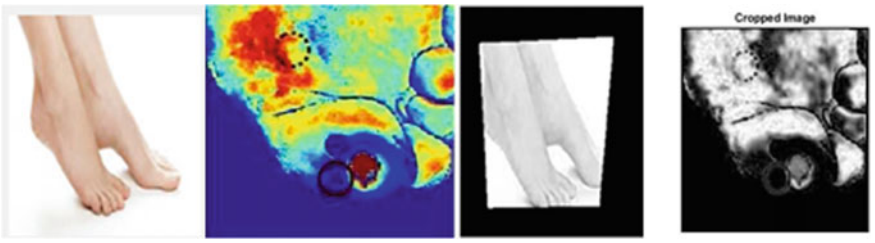


Fig. 3 Original and cropped normal image, original and cropped hyperspectral image [6, 7] for normal patients

Step 2: Add salt and pepper noise to the input image
Step 3: Applying median filtering and display the extracted filtering image (Figs. 4, 5, 6 and 7).

Algorithm for Pepper and Salt Noise removal from abnormal patients

Get the input image from abnormal patients

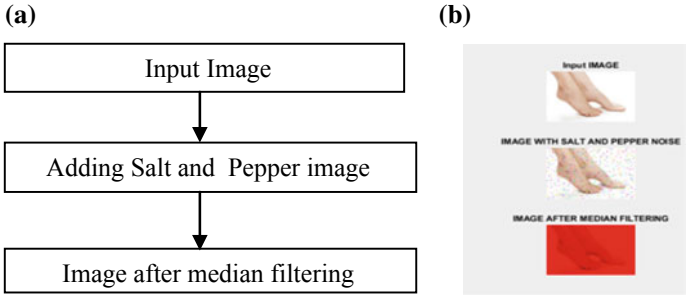


Fig. 4 **a** Flow chart for system architecture of removing noise from filtering on normal patient, **b** adding salt and pepper noise with median filtering image on normal patient

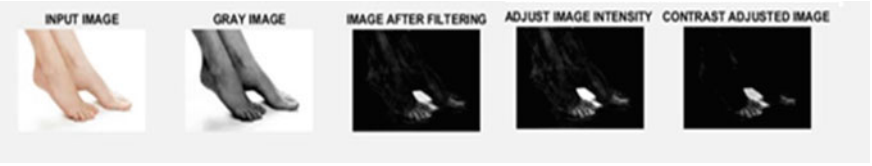


Fig. 5 Output for pepper and salt noise with contrasted one from normal patient

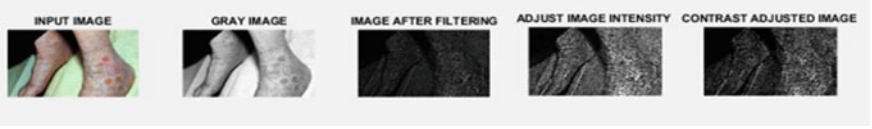


Fig. 6 Output for pepper and salt noise with contrasted one from abnormal patient [8]

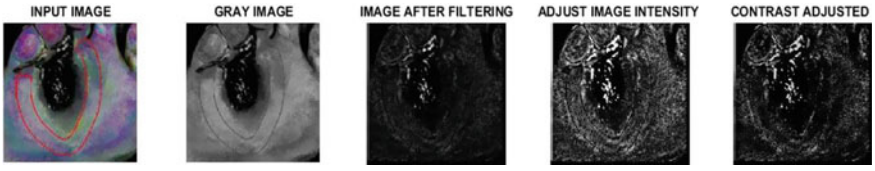


Fig. 7 Output for pepper and salt noise with contrasted one from abnormal patient using hyperspectral image [3]

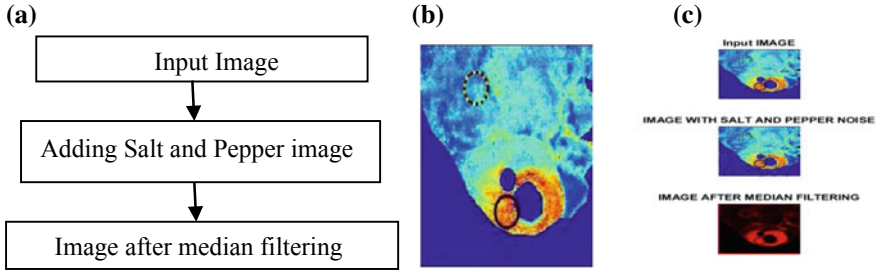


Fig. 8 Removing noise from median filtering using hyperspectral imaging, **a** flow diagram for adding salt and pepper image with median filtered image, **b** original hyperspectral image and **c** processed salt and pepper noise after filtering on hyperspectral image from abnormal patient

From the input image, add salt and pepper noise
Applying median filtering with the display extracted filtering image.

System architecture for removing noise from median filtering on abnormal patient (Fig. 8).
Thus, the assessment of diabetic foot abnormalities for normal and abnormal patients would be evaluated by the filtered output from a contrast adjusted hyperspectral image and selecting the four seeds points to obtain the cropped image by adding the pepper and salt noisy and apply median filtering from noisy input in order to get the smoothen output image [6]. Then, differentiate the output value of normal and abnormal patients. Finally, evaluate the diabetic foot abnormalities using hyperspectral image. It can be applicable for multi-spectral and ultra-spectral technologies [9]. Now, we have to divide the images into thousand numbers of bands [10–16]. In order to get the detailed and exact sequence of any pixels in an image which means for differentiate normal and abnormal patients. Finally, by using these techniques we can prevent the diabetic foot's abnormalities from normal and abnormal patient.

7 Conclusion

The results proves the detection of normal and abnormalities of the diabetic patient by using 2D filtering, N-D filtering and Median Filtering on Normal Imaging and Hyperspectral Imaging. Thus, we conclude that the similarities of the abnormalities are also detected by using hyperspectral imaging for normal and abnormal patients.

References

1. Devi TAM, Rajeswari I (2016/3) Hyperspectral band clustering on ebcot pre encoding technique. J Chem Pharm Sci (JCPS) Scopus Index J 9(1)
2. Devi TAM, Muthukumar D, Kumar P A systematic novel approach for PC based hyper spectral analysis on bio-medical signals. In: ICRTES'2018—International conference on recent trends in engineering and sciences. www.sciencepubco.com/index.php/IJET
3. Devi TAM (2016) A non invasive computer aided diagnosis system for early detection of lunc carcinoma in CT medical images. Int J Latest Trends Eng Technol (IJLTET) 8(4–1)

4. Vijithan SM, Parasuraman K, Devi TAM (2016) A novel approach for MRI brain image segmentation using local independent projection model. J Digit Image Process 8(7):237–243
5. Raja M, Devi TAM (2016/6) Simultaneous visualization and segmentation of hyperspectral data using fuzzy K means clustering. Int J Res Appl Sci Eng Technol (IJRASET) 4(VI)
6. Devi TAM, Percy S (2016/5) An efficiently identify the diabetic foot ulcer based on foot anthropometry using hyperspectral imaging. Int J Inf Technol Manag Inf Syst (IJITMIS) 7(2)
7. Devi TAM (2015/7) A modified MSRCR technique for hyper spectral images on various levels of resolution enhancement. J Int J Adv Res Electr, Electron Instrum Eng 4(7)
8. Devi TAM (2016/5) A novel technique of resolution enhancement in hyperspectral images on proposed cHLAE. J Chem Pharm Sci (JCPS) Scopus Index J 9(1)
9. Devi TAM, Rekha N (2013/7) Hyperspectral image classification using spatial and spectral features. J Int J Sci Eng Res
10. Devi TAM, Muthukumar D, Kumar P (2017) Graphical representation of voltage and current measurements in series or parallel RLC resonant circuits for magnification using hyperspectral analysis. In: 2017 IEEE international conference on intelligent techniques in control, optimization and signal processing. IEEE, 978-1-5090-4778-9/17/$31.00 © 2017
11. Arumuga Maria Devi T (2014) Video transcoding of temporal hyperspectral images on web browsing. Int J Comput Appl Eng Technol 3(3), ISSN 2277-7962, July 2014
12. Arumuga Maria Devi T, Arumugaraj G (2015) A modified MSRCR technique for hyper spectral images on various levels of resolution enhancement. Int J Adv Res Electr Electron Instrum Eng 4(7), ISSN (Print): 2320-3765, ISSN (Online): 2278-8875, July 2015
13. Senthilkumar V, Arumuga Maria Devi T (2015) Hyper spectral image processing in coal detection. Trans Eng Sci 3(5), ISSN 2347-1964 (online), ISSN 2347-1875, July–Sep 2015
14. Mebin Jose VI, Arumuga Maria Devi T (2017) A non invasive computer aided diagnosis system for early detection of lung carcinoma in CT medical images. Int J Latest Trend Eng Tech, IJLTET, UGC Indexed J, 8(4–1), pp. 125–130. https://doi.org/10.21172/1.841.22, Aug 2017
15. Muthukumar D, Arumuga Maria Devi T (2018) Performance comparison on various bio electrical signals of MRI, CT and HSI in human abnormal conditions using hyperspectral signal analysis based 3D visualization. Inter J Res Eng Application and Management Scopus and UGC approved J 4(4), ISSN 2454-9150, July 2018
16. Arumuga Maria Devi T, Arumugaraj G (2015) A modified MSRCR technique for hyper spectral images on various levels of resolution enhancement. Inter J Adv Res Electr Electron Instrum Eng 4(7), ISSN (Print): 2320-3765, ISSN (Online): 2278-8875, July 2015

Ms. Hepzibai R Received M.Sc. degree in Software Engineering from Periyar University, Salem, Tamil Nadu, India, in May 2006. Currently, she is doing Ph.D in Computer and Information Technology, Center for Information Technology and Engineering, Manonmaniam Sundaranar University, Tirunelveli-627012, Tamil Nadu, India. Her area of research includes Hyperspectral Image Processing, Machine Learning and Internet of Things (IOT).

Dr. T. Arumuga Maria Devi Received B.E. degree in Electronics & Communication Engineering from Manonmaniam Sundaranar University, Tirunelveli, Tamil Nadu, India, in 2003, M.Tech degree in Computer & Information Technology from Manonmaniam Sundaranar University, Tirunelveli, Tamil Nadu, India, in 2005, also received Ph.D degree in Information Technology—Computer Science and Engineering from Manonmaniam Sundaranar University, Tirunelveli, Tamil Nadu, India, in 2012 and also the Assistant Professor of Center for Information Technology and Engineering of Manonmaniam Sundaranar University since November 2005 onwards. Her research includes Signal Processing, Remote Communication, Multimedia and Mobile Computing.

Mr. Darwin P Research Scholar, Center for Information Technology and Engineering, Manonmaniam Sundaranar University, Tirunelveli–627012, Tamil Nadu, India. He has completed his M.Tech Computer Science and Engineering in 2011 and B.Tech Information Technology in 2006. His research areas include Hyperspectral Image Processing, Machine Learning and Internet of Things (IOT).

E. SenthilKumar received MBBS degree in Tirunelveli Medical College in 2010 from Dr. M.G.R Medical University, Chennai. Currently, he is doing MD in pharmacology in Dhanalakshmi Srinivasan Medical College and Hospital, Perambalur under Tamil Nadu Dr. M.G.R Medical University, Chennai, and also worked as Assistant Surgeon in Ayakudi Government Hospital at Ayakudi. His research interest includes pharmacology.

Application of Artificial Intelligence in Cybersecurity

Shivangi Verma and Neetu Gupta

Abstract This paper provides an introduction to application of artificial intelligence (AI) could solve the problems in cybersecurity. The physical gadgets and human impedance are insufficient for managing and ensuring the cybercrimes. Criminals use the Internet to pass on numerous cybercrimes. The specialists want help to stop attacks and security breaks and also react on attacks. The main goal of the cybersecurity is to reduce the attacks by using this AI technology. Applications of artificial intelligence in cybersecurity which exist already and some cybersecurity issues can be resolved by using AI strategies and concluded some useful AI applications.

Keywords Cybercrime · Artificial intelligence · Intrusion detection and prevention system · Intelligent cyber defenses methods

1 Introduction

In information technology (IT), criminals are usage of our online world to commit numerous cybercrimes, the important question raises about information safety and privacy by growing traits of complex dispensed and internet computing. Digital foundations are very powerless to interruptions and diverse dangers physical devices, for example, sensors and identifiers are not acceptable for observing and assurance of these frameworks in future, there is a requirement for increasingly tasteful IT that can show ordinary practices and notice atypical ones these digital guard frameworks should be adaptable, versatile and vigorous and skilled to wind up mindful of an enormous scope of dangers and set aside a few minutes choices [1, 2].

With the frequency of cyberattacks, human mediation is surely now insufficient for very much coordinated attacks assessment and astounding reaction. The most system-driven cyberattacks are completed by methods for able venders, for example,

S. Verma (✉) · N. Gupta
Amity Institute of Information Technology, Amity University, Noida, Uttra Pradesh, India

N. Gupta
e-mail: ngupta5@amity.edu

H. S. Saini et al. (eds.), *Innovations in Computer Science and Engineering*,
Lecture Notes in Networks and Systems 103,
https://doi.org/10.1007/978-981-15-2043-3_9

computer worms and infections consequently, fighting with reasonable semi-self-ruling advertisers that may can recognize, measure and answer to the digital attacks takes come to be necessity. For example, to finish up what kind of attack is happening and what are the interests and what remains the marvellous reaction just as how to establish and stop supplementary attacks [3]. This is the reason we need present day systems, for example, techniques for AI that will be applied which give adaptability and becoming more acquainted with capacity to software development which will help individuals in threats cybercrimes [4, 5]. Inspiration of this paper is to exist the advancements made in the area of AI and its utilization with the applications.

2 Literature Survey

Jian-hua Li [6] discusses about the intersections between the artificial intelligence (AI) and cybersecurity and also about the AI technologies and that can be presented into cybersecurity for concept of smart models for implementing the classification and intrusion detection and AI models also expressions several cyber threats which can disturb their decisions and learning and also discuss about the how to build a secure AI system.

Faye Rona Mitchell [6] in his paper investigates IT system which is under the consideration is complex and also where there is important and recompensed change in the systems of attacks and artificial intelligence (AI) is an area of CS (computer science) and emphasized some of key themes in AI and their suitability for usage in a security.

Enn Tyugu [7] proposed that cyberspace cannot be easily handled by humans without significant mechanization for well protecting against the attacks in networks, this attacks can be easily handled by applying the techniques of artificial intelligence that provides the learning capability and flexibility to the software, and his paper presents the brief survey of artificial intelligence (AI) applications in cybersecurity.

Alberto Perez Veiga [8] in his paper discusses about how attacks to networks are now becoming more complex and with the ability and resources hackers can access the network, so, to stop this attack, we need for evolution of cybersecurity applications and how AI could solve the problems.

3 AI in Cybersecurity

The change of new technology brought a lot of high effect in many services in day to day lives. However, to some point of view, it triggers a new area of crimes. For instance, some crimes such as fraud and theft had become a new form of "cybercrime" through typical information technology. With the growth of science, crime is also

growing. Criminals are also becoming smart with the growth of new technology. And data technology provides globalization of these crimes by making it worldwide which makes it plenty more difficult to detect, monitor, stop or detention cybercriminals [8, 9].

Nowadays, cybercrime is too usual problem which is tough to measure. Almost half of the present definition was developed in experimental case. Gordon and ford in 2006 describe cybercrime as: "any crime that is facilitated or committed using a computer, network, hardware device" where "computer or device may additionally be the agent of the crime, the facilitator of the crime or the target of the crime" [10–12].

4 Applications of AI in Cybersecurity

4.1 Artificial Neural Network (ANN)

ANN is somewhat computational segment which repeats essential and viable pieces of neural frameworks which exist in natural tangible frameworks. These are perfect for conditions which need desire, characterization and authority over ground-breaking and composite PC circumstances [13].

Chen [14] arranged NeuroNet—It is a neural framework structure which have an accumulates and methodology assumed information, sorts out the activities of focus framework devices, looks for individualities, begins countermeasures and makes alerts. Examinations displayed NeuroNet is convincing the contradiction of low-rate TCP-concentrated on approved on DoS attacks.

Barika et al. [15] exhibited a point-by-point engineering of a conveyed IDS dependent on fake neural arrange for progressed break location in systems.

Barman and Khataniar [16] additionally considered advancement of IDSs dependent in neural system frameworks. The tests demonstrated "framework" they planned has interruption recognition charges like other accessible IDSs, it turned out to remain in any event "20.5" occasions quicker in the location of DoS attacks (Fig. 1).

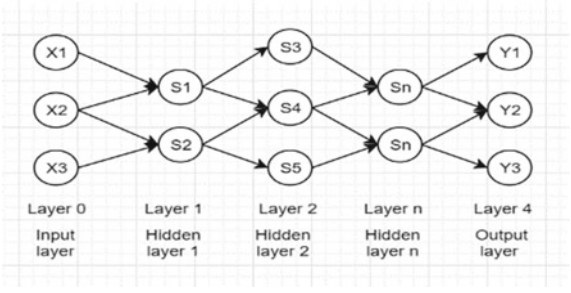


Fig. 1 Neural nets: on the off chance that the system is planned to perceive an object, the primary layer may break down the brilliance of its pixels as shown in figure

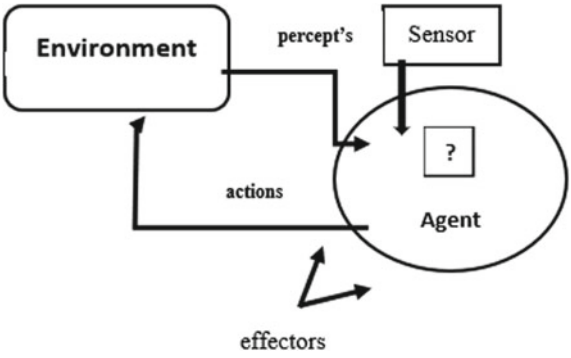


Fig. 2 Intelligent agents: according to this architecture, agents take precepts from the environment, process them in some way that prescribes actions, perform these actions, take in new precepts and continue in the cycle

4.2 Intelligent Agent

Intelligent agent is self-determining PC created controls that talk through each other to share information, data and work together with each other in order to design and execute fitting responses if there ought to emerge an event of surprising events. Their compression and flexibility in the conditions they are passed on, similarly as their aggregate nature, makes savvy authority advancement sensible for battling computerized attacks. Rowe [17] advanced a "counterplan" system which maybe foresee explicit advanced attacks and the plans using multi-administrator orchestrating organized with some original deduction systems.

Wei et al. [18] proposed a speculative layered procedure for verifying force organize motorization systems compared to advanced attacks which might start from moreover the Internet or inside masterminded sources. The outcomes found by testing a model of the planned system showed their structure is able towards regulate and direct about ordinary shortcoming problems of power structure robotics systems (Fig. 2).

4.3 Artificial Immune System (AISs)

AISs, much the same as the natural invulnerable frameworks which they depend on, are utilized to maintain steadiness in an evolving domain. In order to oppose pathogens, the safe framework generates antibodies and the interruption power that can be assessed through variety of the immunizer fixation. In this manner, AISs play a critical job in field of very convening future, i.e. cybersecurities [19].

Sirisanyalak and Sornil [20] introduced one of its own A.I.S-based email highlight abstraction method for spam identification, and the execution assessment outcomes demonstrated that the way it was planned is far proficient in a spam discovery than frameworks which for now exist, with low false plus and negative rates (0.91–1.95% separately) [21]. Chao and Tan [22] proposed a novel infection discovery framework

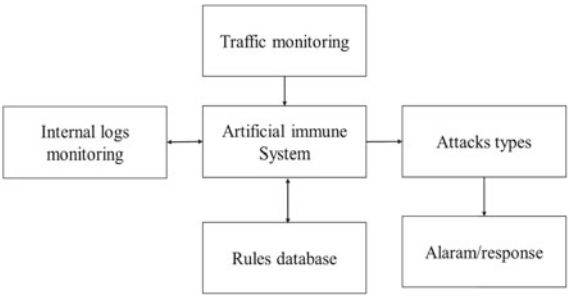


Fig. 3 Artificial immune system: the general architecture of IDS using artificial immune system is present in figure

Table 1 Cybersecurity artificial intelligence (AI) expert system has some of the following components in knowledge base and in inference engine

Components of expert systems	
Knowledge base	*Inference engine*
Approved applications	Connection patterns
Approved IP addresses	Frequency of program use
End point usage statistics	Document usage
Malicious IP address	IP address geographical location
Known virus	Connection attempts
Known malware	Login attempts
	Login timestamps
	Port communication
	File/folder access patterns

dependent on AIS. The test results demonstrated that infection discovery framework they proposed has a "solid location capacity and great speculation execution".

Danforth [23, 24] explored the likelihood of growing AI. Ss for characterization of web server attacks, which can help the framework head in come with point regarding seriousness of attacks or direct attacks (Fig. 3).

4.4 Expert Systems

An expert system that follow the decision marking ability of a human and this is a computer system and also the best example of knowledge-based system and are composed of two subsystems one is the knowledge base and other one is the inference engine [25, 26] (Table 1).

5 Advantages

See Table 2.

Table 2 Advantages of AI in cybersecurity [27, 28]: we can use AI in many ways for cybersecurity, or maybe in future, we have many more ingenious frameworks than these procedures. Advantages of these applications are given in the table

Intelligent agent	Artificial neural network	Expert system	Artificial immune system
• Energetic • Flexibility • Responsive	• Operation held in high speed • Detection of worm • Used in forensic investigation	• Decision support • Knowledge base • Used for decision support	• Structure is dynamic in nature • It is self-adapting, i.e. no human involvement is required

6 Future Work

Cybersecurity wants considerably more consideration. The human limits and way that specialists like PC corruptions and worms they are clever, the smart digital sensor operators (or PC produced powers) which will recognize require by arrange single-minded conditions, measure and react to digital attacks in a convenient way [3]. Use of AI procedures in digital guard will require arranging and future study. One of the tasks is information the board in system-driven fighting, henceforth a promising zone for look into is how measured and various level learning engineering is presenting in the choice making programming. It is pivotal meaning that we can use well AI invention in digital safeguard that maybe single criminals had [5].

7 Conclusion

The quick improvement of IT had a many positive effects and brought numerous comforts into our lives. It additionally caused issues that are hard to oversee, for example, the rise of digital violations. As the innovation keeps on developing, criminal cases change correspondingly. Use of AI systems are as of now being utilized to help people in fighting cyberattacks, it has turned out to be clear wide information utilization in basic leadership process requires keen choice help in cyber defence which can be effectively accomplished utilizing AI applications. Available scholarly assets demonstrate that AI procedures as of now have various applications in fighting digital violations. This paper has quickly exhibited advances made so far in the field of applying AI procedures for fighting cyberattacks, their present limits and wanted qualities, just as given the degree for future work.

References

1. Chen H, Wang FY (2005) Guest editors' introduction: artificial intelligence for homeland security. IEEE Intell Syst 20(5):12–16
2. Dasgupta D (2006) Computational intelligence in cyber security. In: IEEE international conference on computational intelligence for homeland security and personal safet (CIHSPS 2006), pp 2– 3
3. Stytz, MR, Lichtblau DE, Banks SB (2005) Toward using intelligent agents to detect, assess, and counter cyberattacks in a network centric environment. Institute for defense analyses, Alexandria, Va
4. Helano J, Nogueira M (2006) Mobile intelligent agents to fight cyber intrusions. Int J Forensic Comput Sci (IJoFCS) 1:28–32
5. Patel A et al. (2012) Taxonomy and proposed architecture of intrusion detection and prevention systems for cloud computing. In: Cyberspace safety and security. Springer, Berlin, Heidelberg, pp 441–458
6. https://link.springer.com/article/10.1631/FITEE.1800573
7. https://ieeexplore.ieee.org/document/5954703/authors#authors
8. https://arxiv.org/ftp/arxiv/papers/1803/1803.09992.pdf
9. Dijle H, Doğan N (2011) Türkiye'de Bilişim Suçlarına Eğitimli İnsanların Bakışı. Bilişim Teknolojiler Dergisi, 4(2)
10. Gordon S, Ford R (2006) On the definition and classification of cybercrime. J Comput Virol 2(1):13–20
11. http://dictionary.reference.com/browse/cybercrime, 24/11/2014
12. Fisher BS (ed) (2010) Encyclopaedia of victimology and crime prevention. vol 1. Sage
13. Bitter C, Elizondo DA, Watson T (2010) Application of artificial neural networks and related techniques to intrusion detection. In: The 2010 international joint conference on neural networks (IJCNN). IEEE
14. Chen Y (2008) NeuroNet: towards an intelligent internet infrastructure. In: 2008 5th IEEE consumer communications and networking conference, IEEE
15. Barika F, Hadjar K, El-Kadhi N (2009) Artificial neural network for mobile IDS solution. Secur Manag 271–277
16. Barman DK, Khataniar G (2012) Design of intrusion detection system based on artificial neural network and application of rough set. Int J Comput Sci Commun Netw 2(4):548–552
17. Rowe NC (2003) Counterplanning deceptions to foil cyber-attack plans. In: IEEE systems, man and cybernetics societyinformation assurance workshop, 2003. IEEE
18. Wei D et al. (2010) An integrated security system of protecting smart grid against cyber-attacks. In: 2010 innovative smart grid technologies (ISGT). IEEE
19. Rui L, Wanbo L (2010) Intrusion response model based on AIS. In: 2010 International forum on information technology and applications, vol 1. IEEE
20. Sirisanyalak B, Sornil O (2007) An artificial immunity-based spam detection system. In: IEEE congress on evolutionary computation (CEC 2007), pp 3392–3398
21. Hong L (2008) Artificial immune system for anomaly detection. In: 2008 IEEE international symposium on knowledge acquisition and modeling workshop. IEEE
22. Chao R, Tan Y (2009) A virus detection system based on artificial immune system. In: 2009 international conference on computational intelligence and security, vol. 1. IEEE
23. Danforth M (2009) Towards a classifying artificial immune system for web server attacks. In: 2009 International conference on machine learning and applications. IEEE
24. Fang X et al. (2012) An artificial immune system for phishing detection. In: 2012 IEEE congress on evolutionary computation. IEEE
25. Anderson Frivold Valdes. Next-Generation Intrusion-detection Expert System (NIDES)
26. https://www.irjet.net/archives/V5/i3/IRJET-V5I327.pdf

27. Jongsuebsuk P, Wattanapongsakorn N, Charnsripinyo C (2013) Real-time intrusion detection with fuzzy genetic algorithm. In: 2013 10th international conference on electrical engineering/electronics, computer, telecommunications and information technology. IEEE
28. Alrajeh NA, Lloret J (2013) Intrusion detection systems based on artificial intelligence techniques in wireless sensor networks. Int J Distrib Sens Netw . Article ID 351047

An Efficient Web Server Log Analysis Using Genetic Algorithm-Based Preprocessing

Naresh Kumar Kar, Megha Mishra and Subhash Chandra Shrivastava

Abstract Popularity of web increases day by day, everything associated with daily life of human being all are connected to web and most of the people spending their time over the web through social networking web apps for their purchasing. Web server stores every activity of users in the form of logs, which contain very useful patterns, henceforth web server log analysis is the vital research area. Web log data analysis has primary step is preprocessing which is meant for dimensionality reduction because web log data is hefty in size and need to normalize the data for further cognitive analysis or other data analysis. Bulky data size degrades the performance of data analytic algorithm so there is necessity of an efficient algorithm for preprocessing over web server log data. In this paper, we put emphasis on data preprocessing. We have proposed the use of genetic algorithm for dimension reduction and normalization of input web server log data. Experimental result shows the data preprocessed data produces higher precision value, precision calculated using MATLAB 2016 classification learner tool.

Keywords Genetic · ROC · TPR · FNR · Confusion matrix · WM · URL

1 Introduction

Internet users are increasing day by day, as stated by International Telecommunication Union (ITU) [ITU, 2018] the number of Internet users founds more than 40% of the world population. Web usage mining in the technique can identify an interesting pattern from web server logs, for example, if we take any Web site web server log data, which stores the identification of user, login time, logout time, URL visited.

Business intelligence can be generated from this log, suppose Web site owner wanted to know which URLs are less visited and which URLs are highly visited by applying web usage mining algorithm this interesting pattern can be identified, then Web site owner can take decision accordingly. Web usage mining makes assistance

N. K. Kar (✉) · M. Mishra · S. C. Shrivastava
Department of Computer Science and Engineering, Rungta College of Engineering and Technology, Bhilai, Chhattisgarh, India

H. S. Saini et al. (eds.), *Innovations in Computer Science and Engineering*,
Lecture Notes in Networks and Systems 103,
https://doi.org/10.1007/978-981-15-2043-3_10

to know web user behaviour, their interest area. These motivated us towards this research as cognitive analysis over web server log (Fig. 1).

Web usage mining encompasses different phases as shown in Figs. 2 and 3.

In this paper, we have proposed a novel method for dimension reduction of input web log using genetic algorithm. Further in Sect. 2, we will discuss some research which is carried out in this filed and we will discuss the noteworthy contribution in this research and our research objective, in Sect. 3 discuss our proposed methodology,

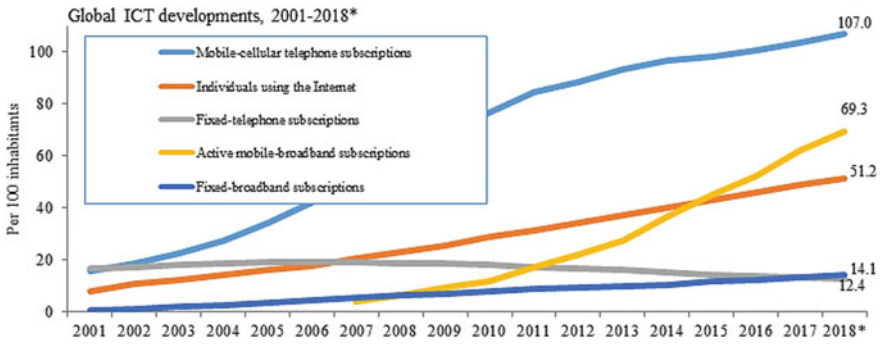


Fig. 1 Internet users statistics [ITU, 2018]

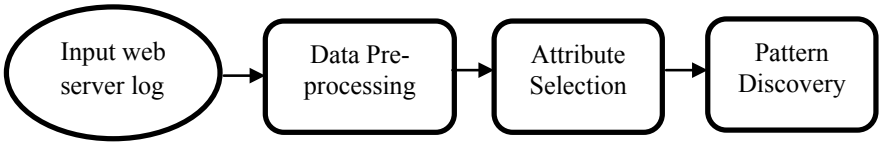


Fig. 2 WM phases

Fig. 3 Proposed model

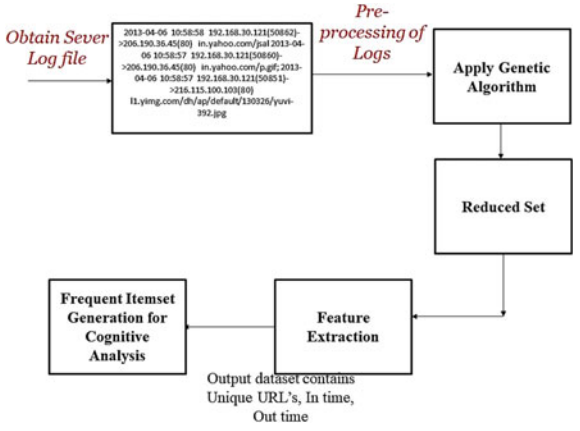


Table 1 Comparison of precision from literature

Precision of different dimension reduction technique					
Database	PCA	ICA	RM	NR	Genetic
CRAN	0.186	0.186	0.111	0.131	0.27
MED	0.253	0.253	0.174	0.197	0.31

in Sect. 4 experimental result and brief about dataset used and finally in Sect. 5 we will conclude how genetic enhance the precision.

2 Literature Survey and Research Objective

Numerous research has been carried out in the field of web usage mining. Rao et al. in 2018 proposed cognitive bias for learning assessment, author has used smart classroom web log data, constructed numerous model from data mouse click and movement. Author has used statistical and data mining techniques for finding learning behaviour [1].

Vishwa Vinay, Ingemar J. Cox et al. in 2005 made comparison among four different dimensionality reduction techniques and assessed their performance and concluded PCA; ICA has lesser precision if applied over large dataset [2].

Mehra in 2018 proposed an algorithm for sever web log statistics preprocessing in web usage mining. Author elaborated each phase of data preprocessing and counted page access frequency [3].

After going to different literature we got following states as [1–5] (Table 1):

In this paper, our research objective is to get reduced dimension web log data with higher precision value so as to if we will apply cognitive analysis over reduced set then get frequent item set for cognitive analysis.

3 Proposed Methodology

In this paper, we have proposed the use of genetic algorithm for preprocessing over input web server log. Genetic algorithm develops the generation using operators: selection operator, crossover operator, and mutation operator.

Dimension reduction can be done in two ways: first, row-wise reduction, i.e., if dataset contain noise value; second, column-wise reduction also called attribute selection removes those columns which will not affect the cognitive analysis. To understand how genetic applied over dataset let us take our dataset fragment:

```
64.242.88.10 - - [07/Mar/2004:16:06:51 -0800]
"GET/twiki/bin/rdiff/TWiki/NewUserTemplate?rev1=1.3&rev2=1.2 HTTP/1.1"
2004523
64.242.88.10 - - [07/Mar/2004:16:10:02 -0800] "GET
/mailman/listinfo/hsdivision HTTP/1.1" 200 6291
64.242.88.10 - - [07/Mar/2004:16:11:58 -0800] "GET / HTTP/1.1" 200 7352
64.242.88.10 - - [07/Mar/2004:16:20:55 -0800] "
/twiki/bin/view/Main/DCCAndPostFix HTTP/1.1" 200 5253
```

In above dataset fragment, Row-3 having missing URL so this row should be removed from dataset because it cannot be used for cognitive analysis. Similarly in Row-4, "form method" is missing. Likewise, column-wise reduction, i.e., we saw that there are seven columns in dataset or we can say seven features, in this research we want to do cognitive analysis hence removal of those features which are not meant for cognitive analysis. We wanted to know, how many (No. of users) visited any URL, i.e., URL with their frequency.

Row-wise dimension reduction

Here, we wanted to get URL from web log data. We get following string separated by "\n" (line feed), the fitness function will be D:

$$D = \sum_{i-1}^{n} S_i \tag{1}$$

n = total number of lines in web log file, S_i = string in each line, i = line number.

Need to get URL from S_i. Characters \\, A to Z, a to z are considered as genes. And string generated (URL) from S_i is deliberated as solution or chromosome. Here, fitness functions will be:

$$D1 = S_i \text{ must} \in ["\backslash\backslash]\backslash\backslash[-] \tag{2}$$

$$D2 = S_i \text{ must} \in [-] \tag{3}$$

If $D2$ will be null (ϕ) value, then it must be omitted. If output string is O_s, then

$$O_s = D1 \; U \; D2 \tag{4}$$

where $D2 \neq \phi$.

Column-wise dimension reduction

Here, we want to do cognitive analysis from web log, hence we need to calculate URL with their frequency and how much user spent time in that URL and response code. So other features should be removed from dataset (Tables 2 and 3).

Table 2 Input dataset after getting tokens

IP Address	Login time	Form method	URL visited	Protocol Used	Server response code	Timestamp
64.242.88.10	07/Mar/2004:16:23:12	GET	/twiki/bin/oops/TWiki/AppendixFileSystem?template=oopsmore&param1=1.12&param2=1.12	HTTP	200	11382
64.242.88.10	07/Mar/2004:16:24:16	GET	/twiki/bin/view/Main/PeterThoeny	HTTP	200	4924
			Size = 2 × 7			

Table 3 Dataset after dimension reduction

Login time	URL visited	Server response code
07/Mar/2004:16:23:12	/twiki/bin/oops/TWiki/AppendixFileSystem?template=oopsmore&param1=1.12&param2=1.12	200
07/Mar/2004:16:24:16	/twiki/bin/view/Main/PeterThoeny	200
	Size = 2 × 3	

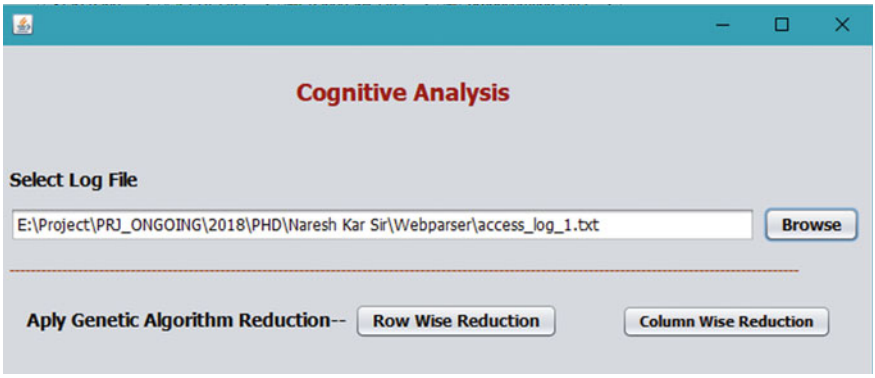


Fig. 4 Main UI of proposed model

Further after preprocessing, we will get reduced item set (URL). Figure 4 depicts the overall mechanism of proposed model.

4 Experimental Result

For the implementation of our proposed algorithm for getting reduced dimension web log, we used JAVA 1.8 to check the algorithm accuracy, and we have passed the reduced set to MATLAB 2016b classification learner app. Reduced set passed to SVM classifier which generates the confusion matrix.

Figure 4 shows the main user interface of our proposed model, which take input as web log text file as input. Figure 5 shows the outcome after row-wise dimension

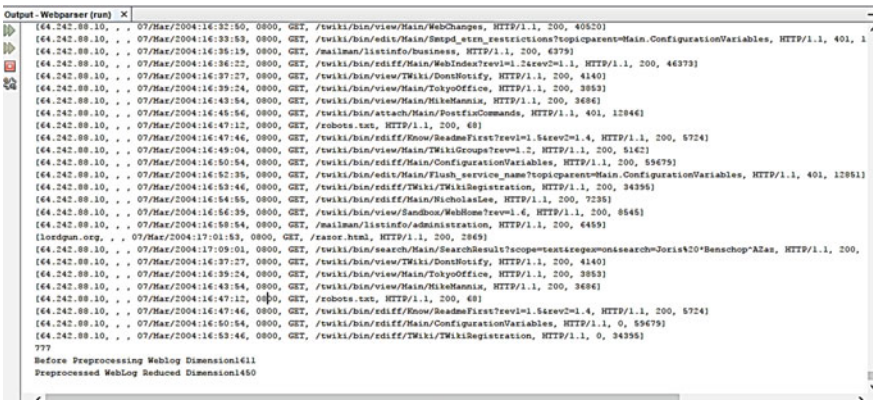


Fig. 5 Row-wise reduced dimension dataset

Fig. 6 Column-wise reduced dimension

url	size	count
/twiki/bin/view/TWiki/WebTopicEditTemplate	3732	1
/mailman/listinfo/business	6379	1
/twiki/bin/view/Sandbox/WebHome?rev=1.6	8545	1
/twiki/bin/view/Main/DCCAndPostFix	5253	1
/twiki/bin/rdiff/Know/ReadmeFirst?rev1=1.5&rev2=1....	5724	1
/twiki/bin/rdiff/Main/ConfigurationVariables	59679	1

Fig. 7 Classification learner outcome (precision)

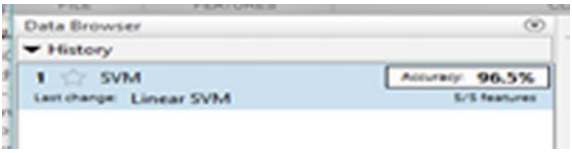


Table 4 Precision value of web log files

S. No.	File name	Precision (%)
1.	access_log.txt	96.5
2.	access_log_1.txt	98.3

reduction; Fig. 6 shows the column-wise dimension reduction data stored in MySQL for further processing.

Figure 7 shows the classification learner MATLAB tool reduced dimension dataset passed to linear SVM classifier, output which generates confusion matrix in which we achieved precision details in Table 4.

5 Conclusion

Due to huge popularity of Internet, we motivated towards this. As we explained in our web log dataset in Sect. 3, from there very useful data can be mined which will be very beneficial for policymakers. As web server log data is very noisy which will affect the machine learning classification performance, hence we need to remove or clean those noisy or missing data. In our proposed algorithm, we have applied genetic algorithm for dimension decline, we have passed data to Liner SVM and achieved 97% average accuracy, one more conclusion drawn is increase in size of training data likewise accuracy also increases.

References

1. Rao RJ, Stewart C, Perez A, Renganathan SM, Assessing learning behavior and cognitive bias from web logs. In: 2018 IEEE Frontiers in education conference (FIE). https://doi.org/10.1109/fie.2018.8658913
2. Vinay V, Wood K, Milic-Frayling N (2005) A comparison of dimensionality reduction techniques for text retrieval. In: Proceedings of the fourth international conference on machine learning and applications (ICMLA'05). 0-7695-2495-8/05 $20.00 ©
3. Mehra J, Thakur RS (2018) An Effective method for web log preprocessing and page access frequency using web usage mining. Int J Appl Eng Res 13(2):1227-1232. ISSN 0973-4562 © Research India Publications. http://www.ripublication.com
4. Xiang S, Zhong Z, Ding K (2015) Multicluster spatial—spectral unsupervised feature selection for hyperspectral image classification. IEEE
5. Miruthula P, Roopa SN (2015) Unsupervised feature selection algorithms: a survey. Int J Sci Res (IJSR)

Blue Brain Technology

Akshay Tyagi and Laxmi Ahuja

Abstract After death, the human body gets destroyed, brain stops working and human eventually loses his/her knowledge of the brain. But this knowledge and information can be preserved and used for thousands of years. Blue brain is the name of the first virtual brain in the world. This technology helps this activity. This article contains information about the blue brain, its needs, blue brain-building strategies, strengths and weaknesses and more. Collect data on the many types of somatic cells. The analog squares measurements were published on a IBM blue-chip central computer, hence the name "Blue Brain." This usually corresponds to the size of the bee's brain. It is hoped that simulation of gallium in the rat brain (21 million neurons) is to be performed by 2014. If you receive enough money, a full simulation of the human brain (86 billion neurons) should be performed, here 2023.

Keywords Blue brain · Virtual brain · Honeybee brain · Neurons

1 Introduction

The blue brain is a machine that can function like a human brain. The Swiss national brain initiative (SNBI) focused to innovate digital brain reconstruction by using reverse engineering brain circuits in mammals. The founder of a project is Hennery Mark Ram and he founded this project in May 2005 [1] by an institution of the mental mind of Ecole Polytechnique Federale De Lausanne (EPFL). The mission of the venture is to utilize BDDR and reenactment of the mammalian mind to perceive the basic standards of cerebrum structure and capacity in the field of wellbeing and sickness. The main period of the Blue Brain Project began after 15 years of deliberate dismemberment of the microanomic, hereditary and electrical properties of the rudimentary neocortex unit, a solitary neocortical segment, somewhat larger than the leader of a stick. Nowadays, researchers are looking for a fake brain that

A. Tyagi (✉) · L. Ahuja
Amity Institute of Information Technology, Amity University, Noida, Uttar Pradesh, India

L. Ahuja
e-mail: lahuja@amity.edu

H. S. Saini et al. (eds.), *Innovations in Computer Science and Engineering*,
Lecture Notes in Networks and Systems 103,
https://doi.org/10.1007/978-981-15-2043-3_11

can think, react, choose and take everything into account. The fundamental point is to transfer the human brain to the machine. Then man can think and demand a choice without any hardwork. After the disappearance of the body, the virtual spirit can act sort of a man. Therefore, even once the death of a private, we are going to not disclose the data, knowledge [2], identities, emotions and recollections of this man which will be used for the advancement of human culture. The review includes the contemplation of the cuts of the brain drawback in vivo mistreatment magnifying instruments and clamping electrodes.

1.1 What is Blue Brain?

It is clear to follow the outline of what the blue brain is. It is an idea that allows to copy/transfer all the substances of the human brain to a virtual brain that survives in the super PC. The super PC used is Blue Gene of the current data revealed. It is like transferring to a computer. The transfer of the brain is more likely to be done by both techniques:

1. Copy and Transfer or
2. Slow and consistent substitution of neurons. In the past strategy, mind transferring would be accomplished by comparing, scanning differentiating the salient feature of a typical biological brain and afterward by replicating, moving and sparing that data into a PC system or other processing machines. The stimulated mind at that point can dwell into a PC that is inside a humanoid robot or a biological body.

2 Achievement Made in Innovation

There is still a doubt on success of mind uploading. Imminent funding for research, typical scientists and scientific journalists still hesitate. The significant research is being conducted on brains of animal, contrasting, comparing and simulation, brain–computer interfaces [3], virtual reality [4], developing of faster supercomputers, connectors and data extraction from different working brains. Unbelievably, brain simulation is interdisciplinary research. The domains involved under this are neuroscience, nanotechnology, brain, imagining, computer science, AI, philosophy, psychology, etc. A logically immense community of discerning researchers has emerged, who pay attention to this apparently science fiction information and rush through hypothetical and exploratory research programs. These supporters notice a considerable lot of the devices and thoughts expected to accomplish mind uploading activity; in any case, they additionally concede that it is extremely hypothetical, yet at the same time in the territory of engineering potential. Human brain has almost 80 billions of nerve cells known as neurons. Each and every neuron is individually connected to

the other neurons by dendrites and axons. Signals are transferred by releasing and distinguishing chemicals know neurotransmitters. Neuroscientists have expressed that critical capacities [5] that a mind performs, for example, learning, memory and awareness, have been conceivable due to totally physical and electrochemical procedures in the mind. Natural world has part known as consciousness. Consciousness is not magical; it depends upon laws of chemistry, physics and biology, logic and mathematics. The idea of loading the mind depends on the mechanical view of the mind. The ritualistic vision of consciousness and human life is totally denied. Leading PCs and leading neuroscientists have anticipated that extraordinarily customized machines will be equipped for reflection and even give some dimension to awareness. Such an ability to understand the machine can provide an essential computer substrate for downloading.

3 Steps to Build a Bule Brain

1. Data collection
2. Data simulation
3. Visualization.

3.1 Data Collection

It works of collecting various sections of the brain, using the microscope and measuring the electrical behavior and physical shape of neurons. This technique of searching and cataloging neurons is incredibly well known (Figs. 1, 2 and 3).

Neurons are trapped by shape, their physiological activity and their electrical action, the site in the cerebral cortex and their populace thickness. These perceptions are converted into precise algorithms that represent the whole procedure, capabilities and localization techniques for neurons. Similarly, allogens are used to prepare virtual neurons [6] of biological appearance for simulation.

These are two main perspectives:

1. Simulation speed
2. Simulation work process.

3.2 Simulation Speed

The simulation of a cortical segment of more than 10,100 neurons continues to function approximately 200 times slower than the one in progress. It takes about five

Fig. 1 Human brain

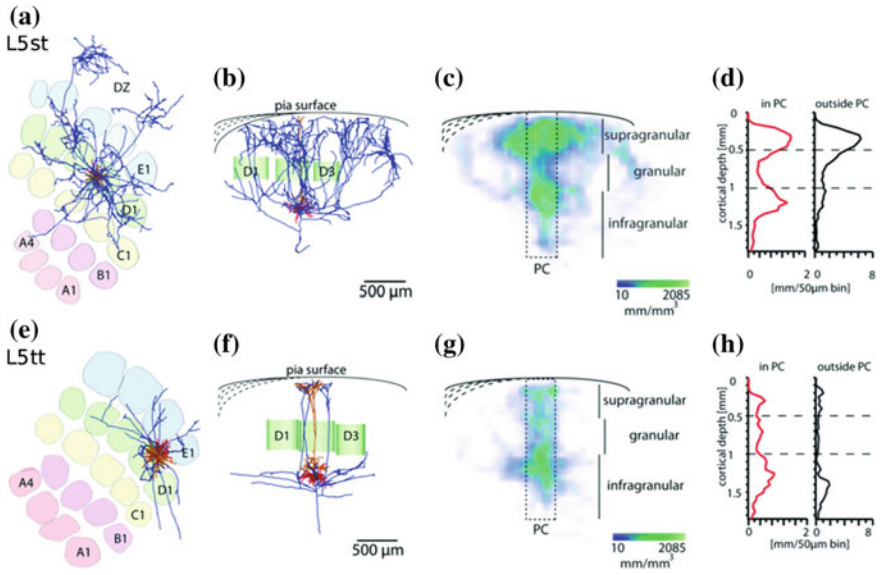


Fig. 2 3D neuron morphology reconstruction (NMR)

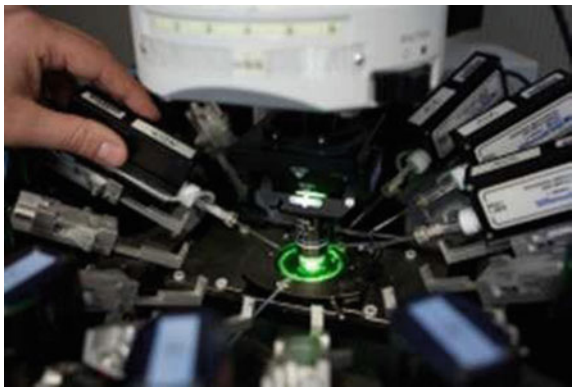


Fig. 3 The 12 patch-clamp close view

minutes to complete a simulated time point. The simulation shows uneven scaling. At present, the crucial intent is biological strength and not presentation. Now, having understood the enormous variables of a given impact, it may be possible to trim the constituents that do not sponsor to improve the presentation. Overflow of the simulation the calculations and requirements are adjusted according to the species [7], age and pathological phase of the simulated animal. Each protein is simulated.

Note: huge numbers of proteins are there in a single cell.

1. Firstly, different types of neurons which are synthesised built the network skeleton.
2. After that, the cells join the rules discovered temporarily.
3. Lastly and finally, the simulation brought to life due to the functions of neurons.
4. Visualization of results.

3.3 BBP-SDK

The Blue Brain Project, the software development kit, a gathering of utilization programming interfaces, enables scientists to utilize and review models and recreations. Blue Brain Project-SDK can be a C++ library incorporated in Java and Python. The main programming bundle utilized by this technique for neuronal reenactments is a nerve cell. Lead celestial host Hines and John Moore of Yaleand in the college created it in the mid-nineties [8]. Use c, c++ and fortan. It is an open-source programming bundle. The site does everything that is accessible, just as the code and, in this way, the paired data openly. In 2005, Archangle Hines, in participation with the BBP group, incorporated the bundle into enormous and parallel (Fig. 4).

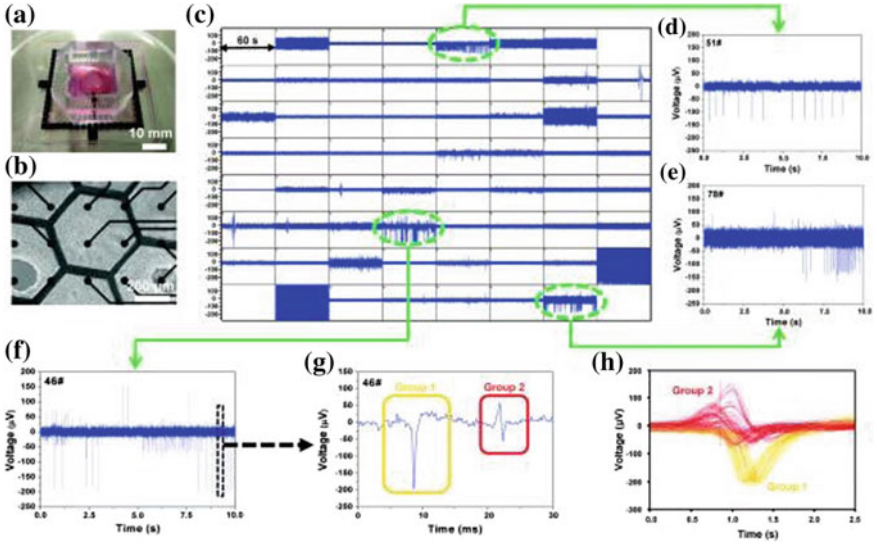


Fig. 4 NEURON (cell binder window)

4 Visualization of Result

See Fig. 5.

Fig. 5 Visualzation of neuron

4.1 RT Neuron

The blue mind venture utilizes the RT neuron as the best application and the blue brain utilizes it for the visual of neuronal recreation. This undertaking was created in-house. It is coded utilizing c ++ and OpenGL. It is specially appointed programming and composed fundamentally for neural [9] reproductions (it can not be summed up to different sorts of recreations). RT neuron utilizes the execution of Hodgkin–Huxley diversions as a commitment to neuron and transmits them in 3D. This enables engineers and investigators to see inception openings spread crosswise over or between neurons. Moves can be postponed [10], ceased, began and zoomed, enabling investigators to speak with the model neurons or a whole cortical area).

5 Hardware/Computer Used

1. BlueGene/L Supercomputer (untill 2009)
2. BlueGene/P Supercomputer (untill 2011)
3. Blue Gene/P specifications:

- More than 4000 nodes with quad-core, each with power PC of 5.5, 7.5 GHz
- It has more than 7×10^{12} flops, more than 15 TB memory

4. Petabyte of disk space and parallel file system (PFS)
5. O/S Linux 10 SLES (Figs. 6 and 7).

Fig. 6 BlueGene/P processing system outer view 3.JuQUEEN (Blue Gene/Q) Supercomputer

Fig. 7 JuQUEEN

6 Funding

The venture was subsidized primarily by EPFL, to which Swiss government donates in turn. EPFL and ETH are the main two governmentally financed universities in Switzerland. This project has likewise been supported by different associations or organizations like EU research grants and other entities and individuals.

In March of 2012, the ETH board mentioned a sum of CHF approx.85 million from the Swiss government to support the Blue Brain Project amid 2013 to 2016. IBM really is not subsidizing the project; however, they gave their supercomputer named Blue Gene to Ecole Polytechnique Federale De Lausanne at an insignificant cost. IBM was really keen on assessing and inspecting the super PC on various fields and BBP was one of them.

7 Advantages and Disadvantages of Blue Brain Technology

1. The blue brain is a way of dealing with the world.
2. The stored knowledge and memory in blue brain can sustain for a long period of time.
3. Review of activities, meetings, information to be provided, etc. These are exceptionally huge capabilities that a smart machine can achieve reliably.
4. It tends to be utilized as an interface between the person and the creature soul. The BBP has been intended to be viable and has diverse animals, which is an indication of advancement.
5. Properly heal a human disability such as a hearing aid.

7.1 Disadvantages of the Blue Brain

1. Human dependence on the blue brain is increasing every time.
2. Once a blue brain identified with the neuronal composition of a specific individual is hacked, the brain can be used against the individual.
3. As this is a way of managing smart and well-thought machines, it is dangerous for machines to show the way against the world (like Terminator, Universal Fighter, etc.).

Acknowledgements The authors express their deep sense of gratitude to the founding President of Amity University, Mr. Ashok K. Chauhan, for his great interest in promoting research at Amity University and for his motivation to reach new heights.

References

1. de Camargo RY (2011) A multi-GPU algorithm for communication in neuronal network simulations. In: 2011 18th International conference on high performance computing (HiPC), pp 1–10
2. Sandberg A, Boström N (2008). Whole brain emulation: a roadmap
3. Johanson C, Lansner A, Towards cortex estimated fake neural frameworks. Neural Netw
4. https://www.theglobaljournals.com/ijar/val=August1374511934_1c167_50.pdf
5. https://archive.org/stream/SingularityWikibook/Singularity-Wikibook_djvu.txt
6. Farahini N, Hemani A (2013) A conceptual custom super-computer design for real-time simulation of human brain. In: 2013 21st Iranian conference on electrical engineering (ICEE), pp 1–6
7. Painkras E, Plana LA, Garside J, Temple S, Galluppi F, Patterson C, Lester DR, Brown AD, Furber SB (2013) SpiNNaker: a 1-W 18-core system-on-chip for massively-parallel neural network simulation. Solid-State Circuits IEEE J 48(8):1943–1953
8. Preissl R, Pallab T, Flikner M, Singh R, Esser SK, Risk W, Simon H, Modha DS Compass: a scalable simulator for an architecture for cognitive computing
9. Wang M, Yan B, Hu J, Li P (2011) Simulation of large neuronal networks with biophysically accurate models on graphics processors. In: The 2011 international joint conference on neural networks (IJCNN), pp 3184–3193
10. Claton K, Rae B, Nancy, Charbn E, Hendeson RK, Leng G, Murray A (2011) An implementation of a spike-response model with escape noise using an avalanche diode. Biomed Circuits Syst IEEE Trans 5(3):231–243

A Model for Real-Time Biometric Authentication Using Facial and Hand Gesture Recognition

Astitva Narayan Pandey and Ajay Vikram Singh

Abstract Facial recognition is the process of identifying and/or verifying distinct facial characteristics of an individual in an image or a video stream, pre-recorded or in real time. Hand gesture recognition refers to the process of identifying the configuration of an individual's hand posture in an image and can be used to verify concurrency of it with respect to a pre-set randomized prompt example to use it in a way similar to CAPTCHA. This paper aims to unify these two similar, yet varying image processing technologies in order to be able to provide a multi-factor authentication system for web applications which cannot be tricked using pre-recorded footage. The face would be identified in the image using convolutional neural networks and then be masked from the image for the hand to be isolated by identifying them using the skin tone. Once the hand has been isolated, SIFT points identified would determine the gesture being performed by the subject, followed by matching the face with the requested credentials if approved. The facial recognition would act like a password and the hand gesture recognition as a means to verify the authenticity of the facial credentials provided.

Keywords Facial recognition · Hand gesture recognition · Authentication · CAPTCHA · Image processing

1 Introduction

There has been an uprise in the adoption of biometric technologies in the recent years with popularisation of its application in biometric attendance systems, state-maintained citizen databases or for smartphone security. Biometrics analyse specific human features, unique to every individual, as a means of identification. Facial recognition has been in the spotlight the most due to its passive and non-intrusive nature, and the lack of requirement of specialised equipment in most cases. One of the major

A. N. Pandey (✉) · A. V. Singh
Amity Institute of Information Technology, Amity University, Noida, Uttar Pradesh, India

A. V. Singh
e-mail: avsingh1@amity.edu

H. S. Saini et al. (eds.), *Innovations in Computer Science and Engineering*,
Lecture Notes in Networks and Systems 103,
https://doi.org/10.1007/978-981-15-2043-3_12

drawbacks of this 2D image approach is that it opens up the possibility for the information being fed into the system being altered as there is no inherent way of verifying the input to the sensor due to it being based on flat visual information that can easily be forged, like for example with a printed-out photograph. This has led to the use of various proprietary equipments that sense depth in an image as work arounds to avoid this.

In this paper, we discuss how we can eliminate this weakness of the system without compromising with the ease of use and implementation of it through the use of hand gesture recognition. We would also explore different facial and static hand gesture recognition algorithms and techniques to find out the optimum combination for this hybrid, multi-factor authentication system.

2 Facial Recognition Timeline

L. Sirvoich and M. Kirby came up with the concept of eigenfaces and used principal component analysis (PCA) for dimensionality reduction in 1986 [1–3], following which was the use of linear discriminant analysis (LDA) to minimise within-class scatter and maximise between-class scatter. The use of discrete Fourier transform (DFT), discrete wavelet transform (DWT) and discrete cosine transform (DCT) for face recognition has seen widespread adoption recently.

Until now, these feature-based approaches to facial recognition had been handcrafted and hence failed to address challenges like uncontrolled facial or environmental changes that deviate from the premeditated considerations. Early 2010s saw a learning-based approach emerge which resulted in higher levels of distinctiveness, yet these single or dual layered models were not too effective against nonlinear facial variations. In 2012, a deep learning-based model called AlexNet caught the eye of everybody when it won the ImageNet competition by a large margin. Through these multi-layered learning models, we were able to parallel human performance (DeepFace 97.35% vs. Human 97.53%), with it not taking more than just three years to reach the unprecedented level of accuracy at over 99.80% [4].

3 Deep Learning Facial Recognition

Three modules work together to achieve recognition of faces using deep learning convolutional neural networks. The first step is detection and localisation of faces in the input image or video. This is followed by normalisation of these attributes to eliminate disparities caused due variation in pose, occlusions, expressions, illumination etc., by reducing intra-class differences to the minimum. This normalised data set is then used inputted into the third module for facial recognition. The third module can be used for either facial verification or identification. This is done in two phases: learning and testing [5] (Fig. 1).

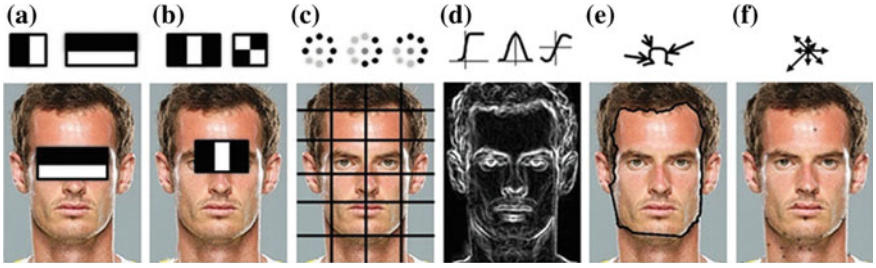


Fig. 1 Various feature modelling techniques [12], **a**, **b** Haar-like features, **c** binary linear patterns, **d** edge detection, **e** shape detection, **f** SIFT points

The facial recognition module further comprises of three functions: face processing, deep feature extraction and face matching. If I_i and I_j are two face images, P is face processing, F is feature extraction and M is face matching, then the process can be described as:

$$M[F(P_i(I_i)), F(P_j(I_j))] \tag{1}$$

3.1 Face Processing

This is the step where the visual information of a face is normalised to get rid of intra-class variations such as illumination disparities, pose, occlusions and expressions [6, 7]. Face processing for compensation of pose variations can be carried out either using a one-to-many approach where different pose variations are created by analysing a single image or using a many-to-one approach where many variations are processed to obtain a singular frontal representation of the input to perform further tasks as if it were under controlled conditions.

3.2 Deep Feature Extraction

A set of known subjects is initially sent through the system according to which the system tunes itself and comes up with a set of weights that is optimal for that set of data. This is achieved by running through different combinations of weight values and calculating their effectiveness via the use of a loss function. One of the most commonly used loss function is the softmax loss in object recognition, however it is not as suited in facial recognition applications in FR intra-class variation can often be greater than inter-class variation, and softmax loss works on separability of

features. Some of the commonly used loss functions for facial recognition are cosine-margin-based loss, Euclidean-distance-based loss and softmax loss with variations [8].

4 Challenges

One of the still remaining major challenges surrounding the field of racial recognition is facial spoofing. Real-time face recognition systems can be tricked into accepting a redirected pre-recorded stream of data bypassing any sort of authentication mechanism that may have been implemented using it. In this paper, we propose a model to eliminate this lapse in this otherwise highly secure system via a system to verify the congruency in time of the input with that of the request by using hand gesture recognition as a means to prove that the input is purpose specific to the situation and is not pre-recorded.

5 Hand Gesture Recognition

Gestures can be static or dynamic, but in this paper, we would only be dealing with static postures. We would also be limiting ourselves to recognition using a 2D image without any specialised hardware. Appearance-based models enable us to detect hand gestures using the skin colour to isolate them from the rest of the image [9]. Hand gesture/posture recognition can be essentially segmented into three steps, namely isolation, feature extraction and classification. In case of a static image, isolation is mainly carried out by segmentation. This is followed by feature extraction. Different regions of the hand such as the palm, its centre and the hand slope are differentiated [10, 11] (Fig. 2).

A series of convolutions for SIFT algorithm are performed on this isolated skin region. Different parts and scales are identified in different views of the object using scale space function. The scale space function is given by:

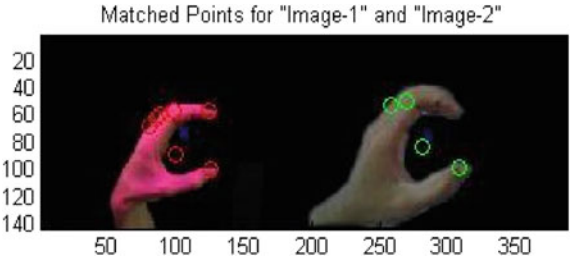


Fig. 2 Extraction for SIFT points demonstrating detected similarities amidst the input image and the reference image using key points [10]

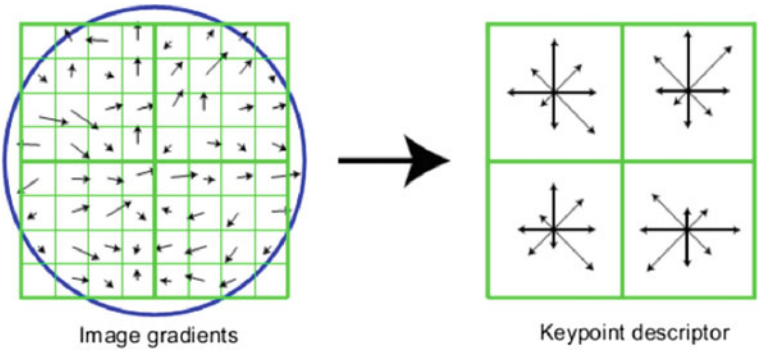


Fig. 3 Orientation based on local image gradient is assigned to each SIFT-feature location

$$L(x, y, \sigma) = G(x, y, \sigma) * I(x, y) \tag{2}$$

where G is a variable scale Gaussian, I is the input image and * is the convolution operator. Difference of Gaussians technique is used to identify stable key points in the scale space. Second order Tylor expansion is performed on the maxima of these key points having origin at the sample point. Classification algorithms use metrics such as Euclidean distance and statistical tools (Fig. 3).

6 Proposed System

The proposed system will unify two image processing techniques into one package to be able to provide secure authentication which is immune to time-shifted spoofing. At the time of sign-up, a deep feature extraction of the user's face would be recorded and stored by a learning program which would store it securely in the database. At the time of request for authentication, the user would be prompted to perform a hand configuration chosen at random from a set of known configurations. There is no need for any additional verification for video re-routing or falsification.

The video feed is fed into a convolutional neural network which then recognises the face present in the frame. This frame of the video is isolated and since the hue saturation value (HVS) model detects hands via skin colour, we would mask the detected face in the image to avoid it interfering with hand detection. Now the system would compare these isolated skin regions in the image to the prompted hand gesture using SIFT algorithm, and if a match is detected would handover the control to the face recognition module.

A match in the hand gesture prompted signifies that the input image to the system was specifically captured for the purposes of this particular session of authentication and that it is not pre-recorded. This enables us to directly use almost any means of video input to the computer without having to consider additional security concerns.

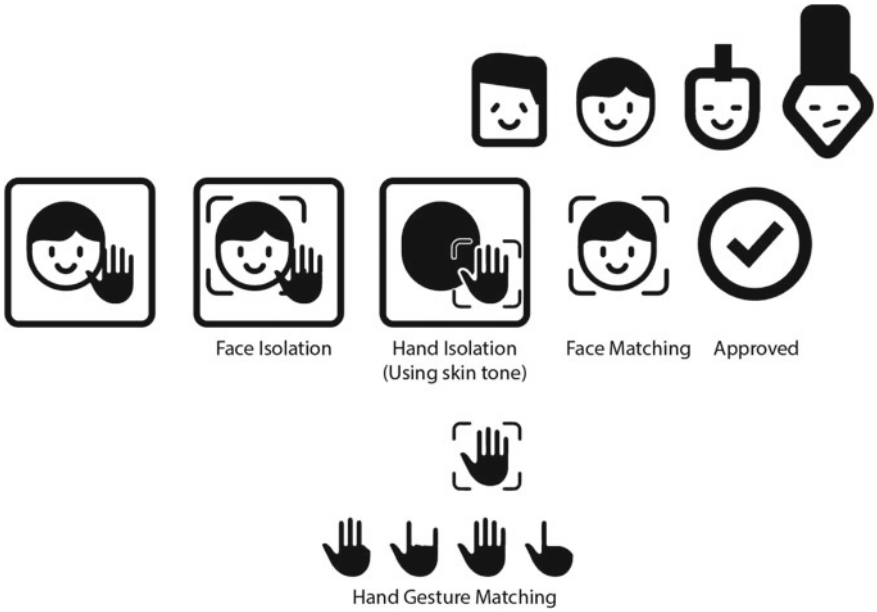


Fig. 4 Visual representation of the model proposed

The facial recognition algorithm would now extract deep feature extraction on the query face detected in the previous step and perform face matching to find a suitable match in the database (Fig. 4).

7 Conclusion

The adoption of deep learning techniques in the area of facial recognition in the recent years has greatly advanced the field as it is now viable for it to be used in real world applications with a dependable accuracy. Facial recognition has become a preferred system for biometric authentication due to its non-intrusiveness, greatly passive nature and the lack of the need for specialised hardware in most cases. While very popular, facial recognition has its shortcomings when it comes to resilience to spoofing. Measures are being taken and the technology is been improved upon to make it more resilient to these types of attacks. The proposed methodology is in its infancy at best and seeks to pave way for future advancements in this vast landscape of research possible on this topic.

References

1. Chen G, Shao Y, Tang C, Jin Z, Zhang J (2018) Deep transformation learning for face recognition in the unconstrained scene. Mach Vis Appl 1–11
2. Abdalmageed W, Wu Y, Rawls S, Harel S, Hassner T, Masi I, Choi J, Lekust J, Kim J, Natarajan P (2016) Face recognition using deep multi-pose representations. In: WACV, pp 1–9
3. Bansal A, Castillo C, Ranjan R, Chellappa R (2017) The dos and donts for cnn-based face verification. arXiv preprint, arXiv:1705.07426, p 5
4. Bansal A, Nanduri A, Castillo C, Ranjan R, Chellappa R (2016) Umdfaces: an annotated face dataset for training deep networks. arXiv preprint, arXiv:1611.01484
5. Bodla N, Zheng J, Xu H, Chen J-C, Castillo C, Chellappa R (2017) Deep heterogeneous feature fusion for template-based face recognition. In: WACV. IEEE, pp 586–595
6. Cao Z, Yin Q, Tang X, Sun J (2010) Face recognition with learning based descriptor. In: CVPR. IEEE, pp 2707–2714
7. Chen B, Deng W, Du J (2017) Noisy softmax: improving the generalization ability of dcnn via postponing the early softmax saturation. arXiv preprint, arXiv:1708.03769
8. Agarwal A, Singh R, Vatsa M, Ratha N (2018) Are imageagnostic universal adversarial perturbations for face recognition difficult to detect. IEEE BTAS
9. Bowyer KW, Chang K, Flynn P (2006) A survey of approaches and challenges in 3d and multi-modal 3d + 2d face recognition. Comput Vis Image Underst 101(1):1–15
10. Dorner B (1993) Hand shape identification and tracking for sign language interpretation. In: IJCAI workshop on looking at people
11. Cui Y, Weng JJ (1996) Hand segmentation using learning based prediction and verification for hand sign recognition. In: Proceedings of international conference on automatic face and gesture recognition, Killington, Vt., pp 88–93, Oct 1996
12. Olszewska, JI (2018) Chapter 4: Automated face recognition: challenges and solutions. Pattern recognition-analysis and applications. IntechOpen, pp 59–79. https://doi.org/10.5772/66013

Network Quality of Service

Dherya Gandhi and Anil Kumar Sajnani

Abstract Quality of service is known to be the feature of network to yield the service that is better for the selected traffic over other technologies like IP-routed networks, frame relay and Ethernet that maybe using any of these or other technologies like this. The basic aim of the quality of service is to provide a dedicated bandwidth, controlled jitter and delay, and it also provides good results on loss features. The other main duty of QoS is to make sure that the priority selected traffic does not significantly affect the flow of other and fail other flows. QoS technologies also provide the primary constructing blocks which will be widely efficient for the application in business area, campuses, wide area network areas as well as the service provider network.

Keywords Quality of service · RTMP and RTC · Network traffic

1 Introduction

Quality of service (QoS) is basically used to prioritize the traffic on the network with various users. So if the user is going out and they are dealing with other network, what they going to realize is that some network protocols need much more traffic and priority than other network protocols, so if users are dealing with Simple Mail Transfer Protocol (SMTP) or File Transfer Protocol (FTP), they can be avoided by using QoS. Basically, if the user is dealing with FTP or SMTP, it does not affect the network that is noticeable, but on the other hand, if users start to deal with Real-Time Messaging Protocol (RTMP) or any other RTC or real-time communication protocols, those need a lot of care and attention because there are issues with things like latency, speed the rest of it so if the users are sitting there and doing a voice-over IP call, users need to make sure that the voice that the traffic is getting from one user to the other person is as quickly and as reliably as possible so when users are having a call, it is very important that they do not have delays because if users are having

D. Gandhi (✉) · A. K. Sajnani
Amity Institute of Information Technology, Amity University, Noida, India

A. K. Sajnani
e-mail: asajnani@amity.edu

H. S. Saini et al. (eds.), *Innovations in Computer Science and Engineering*,
Lecture Notes in Networks and Systems 103,
https://doi.org/10.1007/978-981-15-2043-3_13

call and all of certain, there is a delay for the communication for like half a second or a second that can cause a lot of problem well realistically; if users are dealing with SMTP or FTP or any other protocol, it does not really matter. If users are sending file from point A to point B, it takes an extra second and gets ignored, and if it takes an extra 10 s to move a file from system A to system B, then user might be thinking that this seems like it is taking a little too long but before say it is already done and then users forget about it Because it doesn't really matter it's FTP if user email it takes an extra couple of seconds to come in does that matter probably no, on the other hand voice over IP conversation and user asks a question and it takes 10 s for the other person respond the user is going to have a lot of issues (Figs. 1 and 2).

The modern networks and applications are used to transfer large files and media information over network with this in transit if the user treated all network protocols equally i.e without any priority consideration the user would run into a problem which may also result in lost of data. For instance if FTP was competing with RTMP for the

Fig. 1 Importance of QoS

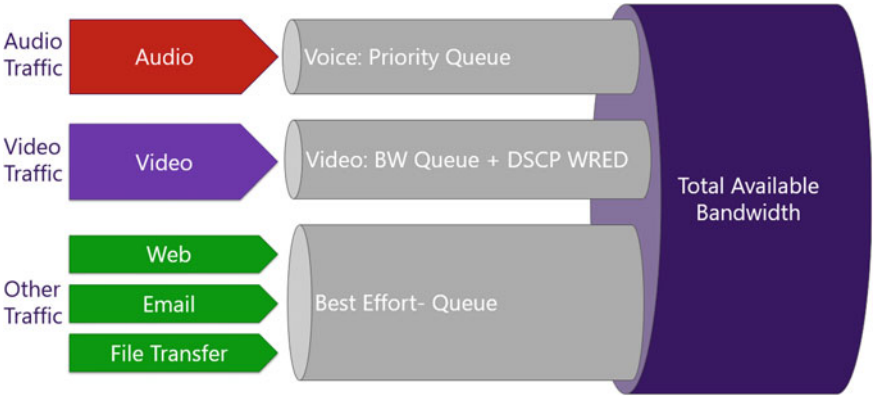


Fig. 2 Implement QoS in teams

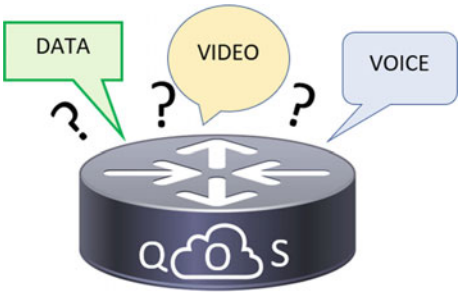


Fig. 3 Quality of service need

various tasks to be sent over the network the protocols may over go the bandwidth and the process gets intervined with issues [1].

2 About QoS

QoS users don't have to worry much about this word back in the days mainly because back in the days the only things were running on are TCP/IP, Ethernet network were basically these very robust protocol so FTP as simple network management protocol, Simple mail transfer protocol SMB server message blocks for windows file transfer so back in the days those were the type of protocol that used on the network and so user don't really have to worry about Quality of service because all of the protocols that are being used were relatively robust it didn't really matter basically the user clicked on link or wants to download or upload and when it's finished it's finished user don't really have to think about it but something has been happening over the last 15 years cold convergence so back in the day user had their computer network and telephone network which was entirely different users had a PBX and users had a voicemail system that used a cat 3 cable not cat 5 cable it was as analog and digital system not TCP/IP then users also had video surveillance systems those were over here everything was separate now the individual servers like PBX for telephone system and DVR for surveillance system that may be able to connect into the network so that itself may have a network connection but all of that individual devices were on their own so if somebody is downloading a lot of files from the internet it's simply did not affect the telephone calls because it was an entirely different system if something was going on the telephone or the video system it didn't affect anything else [2] (Fig. 3).

3 Proposed Model

Quality of service is all about the traffic priority and traffic distribution on the basis of user needs, so the idea of convergence is now all of these different devices use the exact same network so a network with switches, routers and computers also now

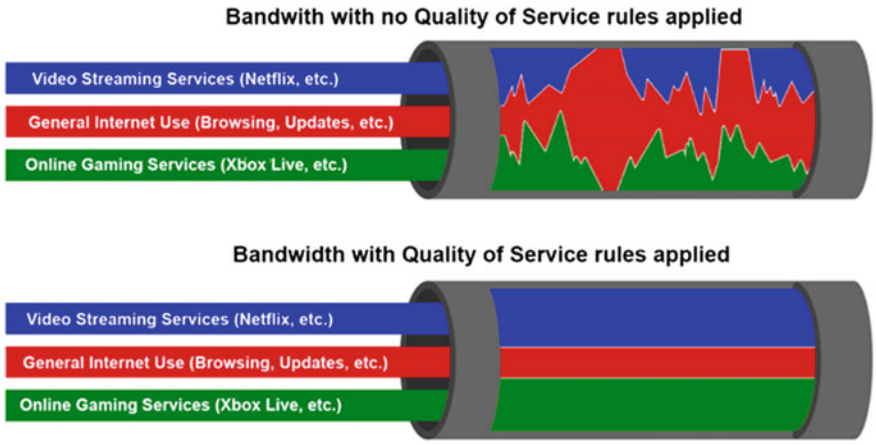


Fig. 4 How to use QoS

have voice over IP telephone; they also have the digital surveillance system, so all of these different types of traffic are now using the same network, and the problem is that these different types of network require different care on the part of the network again voice over IP traffic needs to be very reliable needs to be very fast whereas FTP traffic isn't so much so what quality of service does is allow to prioritizes the different traffic so certain traffic has priority over other traffic so everything goes faster [3].

So, basically, quality of service is to make sure all real-time communication protocols have higher priority than these lower-level protocols. Now, for the most part what user has to realize is that a lot of time, quality of service does not get used a lot so again all have gigabit connections in a network and all of the switches are gig switches, where all of the wires are hard-wired gigs [4] (Fig. 4).

Well the reason is especially in a business environment is the number one problem users are always going to have in any kind of business environment is there are going to be different users with different needs and sometimes they may have the priority of the traffic circulation which could cause issue in the more important work like had somehow that other user is going to try to back up two terabytes of video files to the servers right they are going to connect and then some weird script that somebody two years ago try to do a backup routine to make sure their computer is backed up even though that shouldn't happen and now all of sudden that computer that is trying to backup all it's video files to the servers over gigabyte connection now if one user have that going on with one person or maybe two people or maybe three people all of sudden they start trying to use a lot of utilization for a reason this is not something that's happening all the time but again if users are in an environment with 20 people or 50 people or 100 people or 1000 people put 100 people in the room of course there will 4 or 5 people doing something unimportant or which requires less traffic attention with a network at any one time and so the problem is that although other should have more than enough bandwidth for all the normal traffic and all the

normal voice over IP staff there is going to be a point when the network gets saturated because somebody does something unimportant so if the quality of service turned on for the network when those mishandling event happen at least it is not going to shut off the phone lines because phone are important nowadays there are sales department, customer support department and if the CEOs of a companies are trying to have a conversation, what if the CEO in on the phone with debt collection company trying to solve the debt problem and all of a sudden right at the time look at the users decides to back up their entire two terabytes of movie files to the server. So, if the quality of service turned on what will happen is when those two terabytes of data start getting moved from the client computer to the server computer, there are going to be overall network issues that will start to occur, so that system administrator, the network person, will need to go figure out what is going on but what will not happen is that all those telephone calls will basically get shut off because all the bandwidth is used, so that is where quality of service comes in and that is why it is important [5].

4 Problems with QoS and Its Alternatives

- Problems:
  Does not actually increase bandwidth
  Real-time communication (RTC) can use massive bandwidth.
- Alternatives:
  Upgrade equipment and services
  Reduced network traffic
  Schedule Sync/Updates
  Catching
  Optimize network usage
  Parallel networks.

5 Conclusion

Quality of service is considered as a solution to the disturbed and unsaturated traffic in a busy environment. QoS is basically a better yielding of provided network traffic for any organization. As there are always going to have users doing something different, so this is something that users should use to keep the back-end different users from shutting down the network causing problems like say voice-over IP traffic. Quality of service doesn't actually increase bandwidth it only prioritizes traffic so the issue is if users don't have a lot of bandwidth and continually add users those users start using more and more bandwidth hungry protocols, then the owner or the main user still run into issues again if user has got 100 switch or whatever else would much prefer up

that to a gigabit switch that gigabit switch is being almost entirely utilized then that's where user would look at creating parallel network again quality of service is just a luxury and helps to provide better and prioritized traffic which helps any organization to have efficient network requirements and better user grip over the network [6].

References

1. Arampatzis T, Lygeros J, Manesis S (2005) A survey of applications of wireless sensors and wireless sensor networks. In: Proc. 13th Medit. Conf. Control Autom., Limassol, Cyprus, pp 719–724
2. Cisco Systems et al (1999) Quality of service (QoS) networking. In: Internet-working technology overview. Cisco Press, Indianapolis, IN, USA, pp 46–61
3. Balasubramanian D (2004) QoS in cellular networks. Dept. Comput. Sci. Eng., Washington Univ. St. Louis, St. Louis, MO, USA, Tech. Rep. cse574-06, pp 1–24
4. Yick J, Mukherjee B, Ghosal D (2008) Wireless sensor network survey. Comput Netw 52(12):2292–2330
5. Padigala JB, Umar S A review of QoS in wireless sensor networks
6. Akyildiz IF, Su W, Sankarasubramaniam Y, Cayirci E (2002) Wireless sensor networks: a survey. Comput Netw 38(4):393–422

A Survey of Social Media Techniques in Tourism Industry

Manasvi Sharma, Rinkle Das and Sonia Saini

Abstract The developing functioning of social media in the field of the travel industry has been expanding on rising investigations of different topics lately. This takes a look at reviews and analyzes the study courses specializing in the world of social media in tourism. Through an in-depth literature assessment, this paper identifies with what we realize approximately social media in tourism and recommends a destiny research schedule on this very phenomenon. The paper indicates that the study on social media in tourism continues to be in its very early stages. And therefore, it is vital to inspire comprehensive research into the influence and the effect of social media (as part of tourism management/advertising and marketing approach) on all aspects of the tourism enterprise that consists of neighborhood communities and to illustrate the financial contribution of social media to the tourism industry.

Keywords Social media · Travel industry · Importance · Impact

1 Introduction

The utilization of the Internet and different data verbal exchange technologies has led to a new era of tourism financial system [1]. The social platform is now regarded as the strongest and most influential online networking gear the world has ever seen, it has been integrated into parts of social and monetary existence within the actual world. Wikipedia defines social media as a group of people interacting with each other over social networking Web site or application where they make, offer, change, and remark substance among themselves in virtual gatherings and system. It includes various social networking sites such as Twitter, Instagram, blogs, microblogs, vlogs,

M. Sharma (✉) · R. Das · S. Saini
Amity Institute of Information Technology, Amity University, Noida, Uttar Pradesh, India
e-mail: manasvi.sharma@student.amity.edu

R. Das
e-mail: rinkle.das@student.amity.edu

S. Saini
e-mail: ssani2@amity.edu

H. S. Saini et al. (eds.), *Innovations in Computer Science and Engineering*,
Lecture Notes in Networks and Systems 103,
https://doi.org/10.1007/978-981-15-2043-3_14

purchaser review Web sites, content material community sites, wikis, Internet boards, and location-based social media. Social media has emerged now as the brand-new manner wherein people connect socially, by means of integrating statistics and conversation generation (such as mobile and Internet-primarily based technologies), It is absolutely extra than a brand-new manner to speak but refers to a wholly online surrounding constructed on human being's contributions and interactions. Social media creates brand awareness and it is considered to be the best location to be remembered by the costumers about what you are promoting as a page or a Web site and to view the various attractions that are offered [2]. The main social media presently being Facebook has now on an average of approximately 2.32 billion members. Social media has seen tremendous growth in 2018, with more than 68% people, especially of age around 18–25 years started using social media as a part of their daily life and routine [3].

1.1 Importance of Social Media in Travel Industry

The purpose of social networking in the travel industry has been seen to be increasingly talked about and researched and studied as an emerging subject topic. Social media hence plays an increasingly an indispensable purpose in a lot of the elements of tourism, particularly in the field of data seeking and decision-making behaviors, and tourism advertising focusing on excellent practices for interacting with customers through social media channels. Therefore, with the perfect marketing strategy, social media can turn to become an advantage in getting the destination to be noticed [1]. Leveraging off social media to market tourism products has been seen to be demonstrated in a quite remarkable method. Several nations have regarded social media as an important and valuable device to promote their tourism industries [4]. Tourism Indian is encouraging the Indian tourism enterprises to positively epitomize and incorporate social media in selling their businesses to customers all around the world. Indian operators are given the means to be presented with the chance to sell their tourism business by using various mediums of technologies and by getting involved in the "activities" segment on its Facebook page. Or an advertisement pop-up on their Instagram and Twitter as well. Meanwhile, the Indian National Online Strategy Committee has evolved the "tourism e-package" tutorials bundle, wherein "social media for tourism" is the core and central factor. The contents of it include the steps to promote India's tourism, a one by one step of ways to get involved with the various social networking sites like Facebook, YouTube, Pinterest, Twitter, Group Buying, and apps to attain clients on their mobile devices, in addition to extended analyzing substances. India Tourist Board has organized a sequence of Facebook campaigns for key markets, which resulted in excessive cognizance, income turnover, and associate satisfaction. Social media has also made it much easier and convenient for both the demand and supply of the sellers and buyers. It has also given tremendous influence in the decision-making processes of the tourists and on the whole industry. Sites like "MakeMyTrip" or "Yatra" or "TripAdvisor" has had a humungous search by people

to check out the places and search for hotels and at the same time check reviews that have been written regarding the stay of other people and then come to a decision at the end and choose the best option available along with various packages offered.

However, it is important to keep note that all the advertisements that are seen on various social media sites are sometimes not authentic and are fake and are made to rip the person off with false deals and attractions. Since payments are also done online, it is vital to keep in mind that one should follow the basic routine for payment and not agree to pay anything that does not look proper since the "legit" sites do not ask for any extra information regarding your personal information. So far, there have been some statutes and orders that have been kept in place by some legal authorities and there are some models of restriction that can be used to limit such behavior by the various major Internet companies and educate the users regarding their privacy and rights.

2 Social Networking in Tourism

Online life is a collaborative accumulation of data-based applications which promotes itself to the fabrications of ideas, principals, and high-tech structure of the second generation Web. Promotion via social network has become an up-to-date procedure of market place communications by the means of the various tools of social network like Instagram, Facebook, Twitter, Web journal, YouTube, etc [3]. Further types of social platform incorporate email marking, Google engine, event promotion, news updates, advertisements, Spam advertisements, Web seminars to name a few. There is a whole range of techniques in social networking marketing. Tourism has been one of the platforms to have boomed over the past few years due to the huge influence and impact of social media [2]. Different social systems administration stages build up a virtual or online network, for individuals who share a common background, condition, passion, and standard of life, and hence, it creates various associations [5]. An online network platform has been defined as an unbound attachment or connection of individuals who on a daily basis connect, communicate, and distribute information with each other. Various companies have to manage an online platform administration in order to develop its uses for their user needs. A social stage engages and permits clients in things like posting, altering, arranging, co-making, and sharing an assortment of substance inside a Web stage. Along these lines, it permits in correspondence certainly with a particular individual or communicates with everybody. More highlights are utilized in including companions into the system, setting security controls, and so on [6]. In a mechanical field, a social stage comprises of measurements of social increase language for making local applications, an application programming interface for outcast application blend and a backend administrator reassure for the administration of the whole client bases and inclinations, it gives consistent permeability and diligence to its kin and substance. As you can see at the bottom of this page, this image shows the applications used during the vacation period. Google maps a well-known application has been used

the most for find the fastest routes to tourist places and applications, like Google Chrome and other Web browsers, are also used to find their way and learn about the tourist places. Local weather applications are used to check the weather of different places and also apps like Zomato, Swiggy and Foodpanda are used to find amazing restaurants. Uber is the best transport finder application that helps you book cabs and take you places at very affordable prices.

3 Social Media Techniques

A social or a Web stage empowers us in making Web-based life sites and administrations with complete and full Internet-based life arrange alongside specialized, client explicit, and social usefulness. These are the second era that the clients with the capacity and the instruments to make, assemble, and distribute their very own sites or Web site pages utilizing the "bottom-up" approach. Such stages give the chances to give highlights, for example, the client made substance, high level of client investment in networks of training and capacity to coordinate and line up with different destinations or systems [7]. Along these lines, a social stage incorporates things like informal communication (Facebook, Google, and Twitter), photograph and video sharing destinations (Instagram, Facebook, and YouTube), Web journals (e.g., Tumblr, Wattpad), and news sharing (Daily mail, Buzzfeed) [7]. The long-range informal communication stages can pull in rush hour gridlock by overseeing contacts of the 4Ps; personal, participatory, physical, and plausible [8]. Different organizations have been believed to utilize social stages for their inside and outer correspondence and promotion. Its expanding use can be ascribed to the demand side and supply side. To get the full preferred standpoint of online life, organizations need to create and bridle their social system in an arranged and appropriate way [9]. Over more than 1.7 billion individuals utilize social stages on the Internet everywhere throughout the globe for individual uses or formal employment. Diverse stages have certain particular highlights. For moment stages, for example, Twitter and Facebook empower "outsiders" to associate (Fig. 1).

Jeevansathi and Tinder let get individuals to get together for relational unions or connections. LinkedIn encourages one to extend business connections. Truth be told, Facebook flaunts a stunning 1.74 billion clients and valuation in an overabundance of $100 billion [9]. Distinctive Internet-based life destinations have diverse sorts of confinements to its client's decisions and their employment. Stages like Tinder (dating site), WhatsApp (social coordinated messaging on the telephone), and so on are fruitful even with prohibitive access and a client expense. Then again, stages like Facebook (long-range informal communication), Yatra or MakeMyTrip or TripAdvisor (travel and the travel industry), YouTube, and so forth that provide vast free access are in like manner viable. The comprehension turns out to be increasingly perplexing when stages with focus grounds on access like Twitter (compelled in words with a boundless approach to the system) and LinkedIn and so on are likewise developing. In this manner, it tends to contend that the estimation of taking an interest

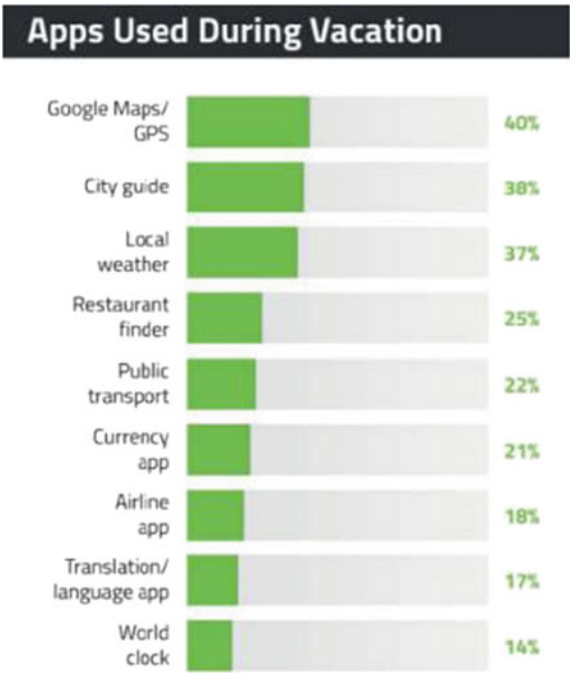


Fig. 1 Applications used in the vacation period. *Source* www.text100.com

in a social stage regularly relies upon the aggregate of decisions provided, moreover stage offering unhindered access (yet in client's control) could rapidly uproot a stage that confines decision or gives limited access.

4 Social Network Sector

Web-based life stages have been positioned by a far-reaching normal of coordinating rankings from other positioning evaluators [10]. In a recent study done in 2017, it has been discovered that clients sections of various stages are particular and in some cases copy. Facebook is favored by means of a differing mix of statistic sections and who furthermore go to the site on an everyday premise. Pinterest has four times greater of an excessive enchantment to its female customers; LinkedIn has greater university under and postgraduates belonging to better profits households. Alternatively, the sections of Twitter and Instagram are covering with progressively energetic grown-ups [11]. Similarly, studies have found ninety percent of its Twitter users, ninety-three percent of Instagram, and eighty-three percent of LinkedIn customers additionally use Facebook. A small quantity of customers uses the best one sort of platform; 8% utilize best LinkedIn, 4% use Pinterest, and 2% Instagram or Twitter least complex [11]. This sample indicates a high state of similitudes between clients wishes to go to social structures on one hand and additionally recommend a question that why

human beings visit many platforms if one platform can meet to their social wishes. Do some individuals have extraordinary reasons at each platform or do they have a whole one of a kind network of connections at each platform or do they need to showcase distinct identities and jobs at numerous structures? Advertisers can objective clients as 'verbal' advertiser, in keeping with their attributes or Internet-based life alternatives, and there can be six styles of Web-based life clients. 1—the "deal seekers'" constantly hunt for a good buy or a fee deals from their entrepreneurs, so companies usually provide them with a deal together with a request to refer extra buddies and pals to the brand; 2—the "unhappy purchaser" causes harm to an agency by method of making a circulate of terrible words or remarks, so groups with this sort of costumers ought to clear up their issues right now; 3—the "unswerving fanatics" who are valuable to spread advantageous words of mouth or even guards their image every so often, so the employer ought to praise their behavior; 4—a "quiet follower" is neutral and is simply there due to the fact her/his pals are there or has been "forced" to sign up for, so the agency ought to put various efforts for them to have interaction as active customers inside the Web page; 5—the "cheerleaders" called the pinnacle-magnificence lovers of the logo and likes the whole thing and something a corporation does, therefore, the employer needs to preserve them up-to-date and inspired; and ultimately 6—the "ranters" they could combat or criticize absolutely due to their sturdy critiques about the whole lot they see, so the organization should react in a completely careful manner and really selectively to their opinions [12]. In this way, in by and large, the association ought to have a tweaked social stage technique and the substance of the messages must lure with an affair of network, inclusivity in motion, newsworthy, and the contents be it both advantageous or bad critiques from every one of their adherents be permitted and perceived and make ensure to make the site higher.

5 Types of Social Networking Techniques

5.1 Online Social Sites and Applications

Discovered that person to person communication locales which incorporate Facebook, Google+ enables clients to associate and impart to individuals who have comparable interests and have a place with similar foundations. Clients' fragments of various stages are particular and now and then copy. The most acclaimed case of interpersonal interaction is Facebook, Twitter, Instagram, LinkedIn, and so on. These destinations empower the sightseers to viably impart and associate with different individuals from an interpersonal organization like companions, family, and colleagues and the entire world on the loose. For utilizing Facebook as an instrument, the business pages need to develop their picture profile through making a Facebook page and offer fascinating, and newsworthy data with its watchers and customers. The organization needs to enable the purchaser to meet their social needs and let them

accomplish and fulfill each other's needs and guarantee that they do not barge in, infringe or be pushy like a sales rep in a shop, and simply go about as a facilitator for producing and building a social nearness. Depending upon what kind of users a business page can provide for customized communications. For example, does an offer include incentives, motives or recognition for new needs for the "deal seekers"? They react to remarks made by whiners or fans who mesh into the remarks and presents on constantly expand this. They can likewise make a stage for dialogue gatherings to have criticism or audit section about their items and administrations [13]. Another social stage is LinkedIn, which has about approximately 225 million enlisted clients and on the normal, 110 million remarkable month to month guests, the site makes sure to pursue the viable correspondence rule of AIDA—Attention Interest-Desire and Action. Solicitations are made to the team promoters and the assessment heads for their significant tributes. They support or advance their organization through the methods for a "pursue" catch and make sure to interface your other Internet-based life records to your LinkedIn company page and make the data which is transferred—drawing in and shifted yet, in addition, recollect pictures that are transferred express more than words.

5.2 Area-Based Services

Updating on Facebook, Instagram, Twitter, Snapchat, and so forth are a portion of the applications that are effectively accessible and the absolute most supported Web-based life locales on contraptions and mobiles that utilizes the land area (GPS) of an individual and connection it with valuable information, sight and sound, or online networking administration that is accessible in the close-by area. They demonstrate the different well-known tourist spots or eating joints that are adjacent [14].

5.3 Photograph Uploading Sites

Facebook, Pinterest, Snapchat and Instagram and so forth empower clients to transfer, change, alter, include channels, distribute and share their photos and recordings, and so on for others to see [14]. Instagram has become one of the most used applications for photographs and recordings sharing and as of late has been obtained by Facebook. It has on a normal 130 million dynamic month to month clients. The site page can transfer photographs or recordings of their brands or distinctive issues of interests and can associate with other social stages and welcome individuals to click for most loved ones. To dependably make a point to remain in the present pattern, make sure to ceaselessly transfer new photographs about your activities that would intrigue the clients to addresses their social, discerning, enthusiastic, and epistemic necessities [12].

5.4 Personal Broadcasting Tools

Livestream, Tumblr, WordPress, and Wattpad are some of the platforms which recommend a method for participatory news coverage and a type of individual distributing.

5.5 Search Engine

Web sites like Yahoo, Google, Quora, and so on are utilized by vacationer to locate the different spots or goal data and the manner in which an Internet searcher is streamlined it can bring a specific Web site at the best query items [2].

5.6 Bulk Mail

Sending messages to leaving or potential travelers is a standout among the best type of Internet promoting. Sites such as Make My Trip and Yatra, to name a few, send emails to the users registered on their sites to inform about various packages and deals to promote their sales.

6 Conclusion

Due to digital mobility and social media activities by the masses, it has enabled the tourism industry to have an apt and suitable awareness and an eye opener in the world of tourists. Marketing communication strategies will lie mostly on concentration on the improvement of the relationships in social media and accommodate and adjust to the needs of the tourists. Social media has, in recent years, seen to be recognized or looked at as one of the most important competitive tools along the lines of tourism marketing across the globe. Tourism sites need to encourage or influence their tourists with various multi-channel integrated communications and persuade them to talk about the experiences that took place with them and recommend a good review to ensure that other people would experience a good time. Engaging with the tourists on real-time social media has seen to have a hugely positive result for the travel industry as a whole.

Today travelers encounter themselves with the newest digital technologies that help them to enhance and refine their services and make their online experiences more customized to a personal level and make it more relevant. Besides, there are many more advantages and benefits of the next-generation technology, and the only

big challenge for advanced ICT in the coming future will being faced with privacy issues and information reliability.

References

1. Manap KHA, Adzharudin NA (2014) The role of user generated content (UGC) in social media for tourism sector
2. Ernest V (2014) Social media marketing from a bottom-up perspective—the social media transition
3. Stelzner M (2014) Social media marketing industry report how marketers are using social media to grow their businesses
4. Safko L (2010) The social media bible. John Wiley and Sons, New Jersey
5. Bolotaeva VA (2011) Marketing opportunities with social networks. J Internet Soc Netw Virtual Communities
6. Etlinger S (2011) A framework for social analytics: six use cases for social media measurement. Altimeter Group Publication
7. Campbell A (2014) Social media—a definition
8. Conrad J (2010) Guerrilla social media marketing. Entrepreneur Media Inc
9. Piskorski M (2014) A social strategy: how we profit from social media
10. EbizMBA (2014) Top 15 most popular social networking sites
11. Duggan MS (2014) Social media update
12. SEOPressor (2014) Social media marketing
13. Treadway C, Smith M (2010) Facebook marketing: an hour a day. Wiley Publishing, Indiana
14. Decidedly social (2014) 13 types of social media platforms and counting

Comparative Study of Clustering Techniques in Market Segmentation

Somula Ramasubbareddy, T. Aditya Sai Srinivas, K. Govinda and S. S. Manivannan

Abstract This is a comparative study of clustering techniques, but focused in the area of market segmentation. By understanding the potential benefits of clustering large amounts of data, the work is to relate clustering into the field of competitive marketing. This is achieved by gathering data from the Twitter using necessary tools and then cautiously applying various clustering algorithms. From these algorithms, we are able to build graphs based on the output, and from these graphs, useful information can be advantages from a strategic marketing point of view. From the clustering of Twitter data, it is easy to identify potential social media influencers. For future implementation, one method is that the companies that are struggling to grow in terms of online marketing can benefit from this study, allowing them to identify their own social media influencers, identify social media trends and determine the online social media market segmentation. All of which will provide them an advantage in further promoting their company more effectively and efficiently.

Keywords Business analysis · K-means · Clustering techniques · Customer relation

1 Introduction

Clustering is the gathering of a specific arrangement of articles depending on their attributes, amassing them as indicated by their similitude. Regarding data mining, this methodology partitions the data implementing a specific join algorithm, most suitable for the desired information analysis. This clustering examination permits an item not to be a piece of a cluster, or carefully have a place with it, calling this sort

S. Ramasubbareddy (✉)
IT, VNRVJIET, Hyderabad, Telangana, India

T. A. S. Srinivas · K. Govinda · S. S. Manivannan
SCOPE, VIT University, Vellore, Tamil Nadu, India
e-mail: kgovinda@vit.ac.in

S. S. Manivannan
e-mail: manivannan.s.s@vit.ac.in

H. S. Saini et al. (eds.), *Innovations in Computer Science and Engineering*,
Lecture Notes in Networks and Systems 103,
https://doi.org/10.1007/978-981-15-2043-3_15

of collection hard parcelling. Then again, delicate apportioning states that each item has a place with a cluster in a decided degree. Progressively, explicit divisions can be conceivable to make like articles having a place with different clusters, to drive an item to take part in just a single cluster or even build various levelled trees on gathering connections. When it comes to clustering, i.e. hierarchical, groups have a tree-like structure or a parent–kid relationship. Here, the two most similar clusters are combined together and continue to combine until all objects are in the same cluster. K-means is a collection of objects which are "similar" between them and are "dissimilar" to the objects belonging to other clusters. It is a division of objects into clusters such that each object is in exactly one cluster, not several. The global market keeps on expanding as every region of our world slowly join it through the Internet. From large, globally established companies to small, local upcoming companies, all require extensive advertising of their products to persuade the public to buy these products. This has been the case for almost past 100 years; companies and for-profit firms have introduced adverts in different forms of media from newspaper to walls on a street to movies, etc. But with the advent of Internet in the twenty-first century, the marketing options have become numerous and beyond and so has the group of audience to market to. But our population is large and so is the diversity in it, so a generic advertisement has low chance of attracting customers from different niches. If handled incorrectly this can lead to loss in potential customers and increased revenue. To target this problem, a lot of companies employ marketing divisions specifically to create marketing campaigns to attract new customers as well as keep the present ones loyal. Some companies have employed the use of analytics tools which segment and analyse the markets present on various social platforms which are still in their infancy stage and need further improvement and study that needs to be conducted on them to improve their accuracy and implementation.

2 Literature Survey

In this paper, the method of query reduction, to differentiate between the two algorithms, has been specifically outlined. This procedure gives an instrument to BI server to decide the arrangement of logical table sources (LTS) appropriate to an intelligent solicitation at whatever point a solicitation can be fulfilled by more than one LTS. The BI archive delivered in Oracle Fusion applications contains metadata content for ongoing detailing investigation (utilizing Transactional Business Intelligence) and authentic announcing (utilizing BI Applications). The proposed work speaks to inquiry redirection technique that improved K-implies bunching calculation execution and precision in circulated condition. In this paper, they have appeared on k-implies and progressive calculation by applying approval estimates like entropy, f-measure, coefficient of fluctuation and time. The consequent test results demonstrate that k-mean calculation performs better when contrasted with various levelled calculation and sets aside less effort for execution [1].

The k-means algorithm, although well known for its efficiency in clustering large data sets, has been restricted to working only on numeric values and therefore has been relatively unexplored when it comes to clustering real-world data containing categorical values. In this paper, two algorithms that extend the k-means algorithm to categorical domains and domains with mixed numeric and categorical values have been outlined. The k-modes calculation utilizes a straightforward coordinating disparity measure to manage unmitigated articles, replaces the methods for bunches with modes and utilizes a recurrence-based strategy to refresh modes in the grouping procedure to limit the bunching cost work. With these augmentations, the k-modes calculation empowers the bunching of straight out information in a manner like k-implies. The k-models calculation, then again, through the meaning of a joined difference measure, further coordinates the k-means and k-modes calculations to take into account bunching objects depicted by blended numeric and straight out properties [2]. The data sets of the well-known soya bean disease and credit approvals have been used to demonstrate the clustering performance of the two algorithms. The two certifiable informational collections with a large portion of a million articles demonstrate that the two calculations are productive when bunching vast informational indexes, which is basic to information mining applications and consequently fulfils our goal.

In today's age of social presence, it is important for a lot of leading companies to gauge their social network presence. This paper presents a method for clustering the existing consumer base of a company using social media data from Twitter, and hence, is extremely relevant. Large enterprises often base their retail and market analysis on data gathered from their social media channels. Applications incorporate modifying promoting efforts, confining unexplored market portions and anticipating deals patterns. The strategy delineated in this paper rub freely available Twitter information and develops highlights. These highlights are bunched utilizing a comparability measure to create groupings of clients. This method performs well using the sample data set provided and exhibits potential to further improve given access to more data [3] (Table 1).

Table 1 Comparison of approaches

Author/year	Title	Contribution
Kaur and Kaur [1]	Comparison between k-mean and hierarchical algorithm using query redirection	Improved k-means clustering algorithm performance and accuracy in distributed environment
Friedemann [4]	Clustering a customer base using Twitter data	Clustering using a similarity measure to produce groupings of users
Huang [2]	Extensions to the k-means algorithm for clustering Large data sets with categorical values	Algorithms which extend the k-means algorithm to categorical domains and domains with mixed numeric and categorical values

3 Proposed Method

The plan here is to collect demographic data from a company with a high enough presence on social media use of the data to measure the ability of the selected algorithms to segment a market. Airtel is one of the biggest telecom companies in India with a following of 2.3 million people. We collected the list of a small portion of Airtel's following and then extracted the data that was relevant to our research. We then pre-processed the data to make sure it was structured in the exact manner we wished to feed it our clustering technique. After doing that we cleaned the data to remove an unnecessary or redundant or wasteful data. After pre-processing and cleaning the data, we handed the data to the algorithms. Using the clustering algorithms, we created several visualizations for different types of data. Using the visualizations, we were able to make out all the clusters of each algorithm which was able to produce. Since our aim was to study the behaviour of a clustering algorithm's ability to segment a customer market, we evaluated each of the visualization made by all the types of clustering algorithms. Then, we noted down all the observations we made; the clarity of the clusters formed, the amount of processing power taken up by the algorithms to process the large amount of data given, the amount of input needed from the user's end. And with these variables, we ranked which algorithm performed the best [5–8].

In our aim to collect and study the difference in the ability of different clustering algorithms, we choose Twitter as the platform and the Airtel India as the company whose demographic we wanted to segment. Twitter gives an option for extracting data on a very large scale but only on a paid basis. Since the amount of money that was required to extract information for all the users following Airtel, we decided to take the route of only collecting a small portion size of the Airtel's following.

3.1 K-means Clustering

K-means is a very popular and very easy-to-use algorithm. It is an unsupervised algorithm which means it only makes inferences using vectors that are inputted from data sets without actually knowing any of the labels or results. The main aim of the k-means clustering algorithm is to group together sample points and hence identify any emerging patterns. K-means clustering forms clusters based on a fixed number, no more, no less. The number of clusters the algorithms use is the same as the number of centroid. Centroids are point in space on the graph that represents a cluster. Hence, the number of clusters that will be formed is equal to the number of centroids.

All the sample points inputted from the data are assigned to one or another cluster. This way now we know which sample point belongs to which cluster.

$$\text{Minimize} \sum_{j=1}^{k} \sum_{i=1}^{n} \left(x_{ij} - c_j\right)^2$$

K-means works by assigning random sample points as centroids and works its way from there; these first and random points operate as the beginning points for each cluster. Then, using the randomly assigned centroids, it starts an iterative process where the algorithm allocates each point that is part of the data to one of the beginning centroid and together they form a cluster. By the first iterative step, all the sample points have been assigned to a cluster. Then, the algorithm chooses a new centroid in the newly formed clusters by computing the mean of the samples and assigns the new centroid to its respective cluster. The algorithm repeats this process in iterations until all the centroids of their respective clusters have the smallest Euclidean distance to each sample body.

The following results are our anticipated clusters.

To follow the above procedure, we first need to tell the algorithm how many clusters it needs to form as it by itself cannot decide so. We can approach this with a trial and error method, but that method can lead to lot of errors; there are much better methods out there which can be used to calculate the number of clusters needed. We used two models to find out the number of clusters that are needed (we did so to make sure we on the right path):

The methods we used are:

Using Silhouette coefficient:

Here we select the optimal number of clusters by achieving the highest silhouette score. This helps us in figuring out how properly a sample point lies within its own cluster

$$s(i) = \begin{cases} 1 - \frac{a(i)}{b(i)} & , a(i) < b(i) \\ 0 & , a(i) = b(i) \in [-1, 1] \\ \frac{b(i)}{a(i)} - 1 & , a(i) > b(i) \end{cases}$$

Here $a(i)$ represents how properly a sample point fits inside its own cluster.

Here $b(i)$ represents how properly a sample point may fit another cluster or how close a sample point is to all the other clusters. Ultimately, the aim is to select the optimum number of cluster such that a sample point may only best fit its own given cluster and be less fit for its next best cluster suited to it. One of the disservices with silhouette coefficient is that if we wanted to choose a lesser number of clusters.

3.2 Elbow Method

This method is useful for calculating the number of clusters, it does so by fitting the model with various numbers of values (k), and for that each value of that k, it also calculates the sum of squared errors. Then, the value of k is plotted against its respective values of sum of squared errors (SSE).

If an elbow shape is formed like shown above, then we have the correct graph. From this, we have to choose our k value such that it is small and keep a low SSE as well.

Usually, the elbow point is considered to be the value for *k*.

After we are done calculating the value for the most optimum number of cluster, we need to feed the data we have collected into the model to form the clusters. Since k-means is an unsupervised learning algorithm, the pattern of clusters that will emerge will be unknown to us and hence give us better knowledge about the topic at hand.

3.3 Hierarchical Clustering

Hierarchical clustering is involved in the creation of clusters that need no external input for the value of *k* as the algorithm itself predetermines the number of clusters that will be necessary.

This clustering is divided in two types:

- Agglomerative
- Divisive.

Agglomerative clustering

Here each sample point is considered as a singular cluster, and then as the iterative process takes place, each of these clusters merge to become one; this process keeps on repeating until only one cluster remains or k number of clusters are created.

Stage 1: In this stage, the algorithm first computes the closeness of individual sample points and considers all the singular points as singular clusters, as shown in the example below.
Stage 2: In this stage, the algorithm combines similar clusters to form singular ones. In the example given above, we can see that B and C merge together to form BC and D and E combine to form E.
Stage 3: In this stage, all the new clusters are once again subject to merging based on their closeness by the algorithm.
Stage 4: This process can repeat until all the cluster combines to form one giant singular cluster, like in the example given above ABCDEF is the last singular cluster formed.

This process is visualized in a dendrogram.

Now that the value of *k* (no. of cluster required) is known and we can proceed to fit the data collected and form the clusters on a scatter plot.

3.4 DBSCAN (Density-Based Clustering of Applications with Noise)

This is a commonly known clustering algorithm that is used widely by a lot of people working with data mining and unsupervised learning. Basic principle on which DBSCAN works is by grouping sample points together which it thinks close to each other based on the Euclidean distance and a set number of minimum samples. It marks all the outlier points as low-density regions.

4 Results and Discussion

Comparative analysis of various methods in clustering has shown that one clustering algorithm is better than the other. We can interpret useful data to develop targeted marketing strategies.

For our results, we have obtained three types of measurements for the clustering techniques that we used:

1. When comparing the no. of friends with no. of followers
2. When comparing the no. of followers with no. of statuses posted
3. When comparing the no. of friends with no. of statuses posted

Figures 1 to 2 use $K = 4$ and as we can see the four clusters are produced, along with their centroids for good measure. We can analyse data of how many friends a particular person has and how their posting of statuses varies. This graph shows

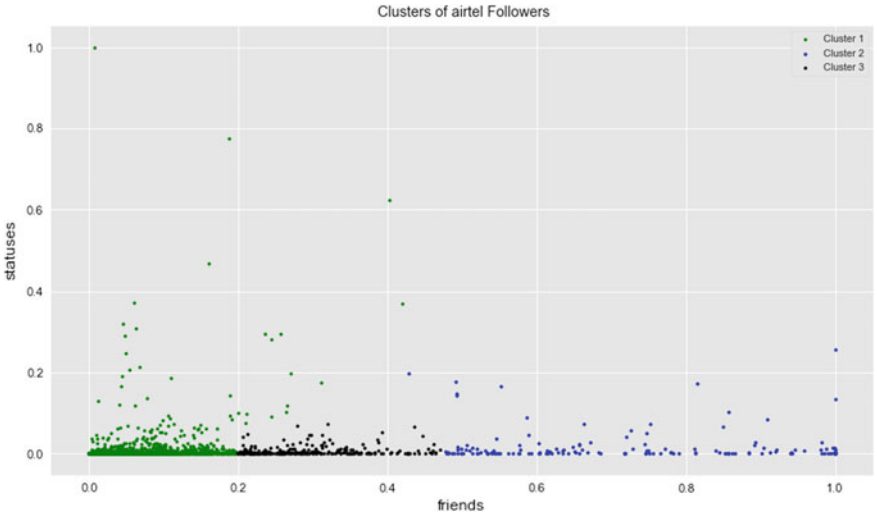


Fig. 1 Agglomerative clusters of friends versus statuses

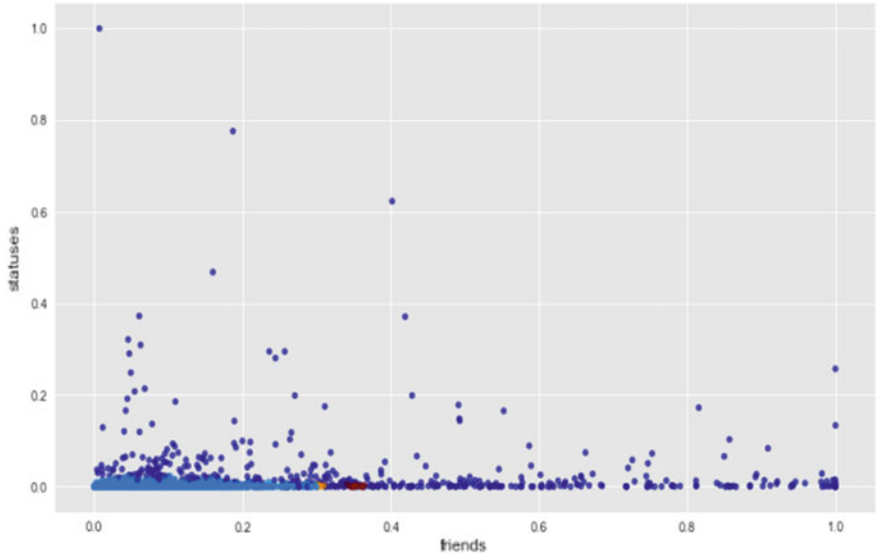


Fig. 2 DBSCAN clusters of friends versus statuses

that those will tell number of friends (the people they are following) and tend to post more and be more active, whereas those with more friends (this means they are following more people) tend to post less. These people are watchers and consumers. We turn to the ones that are in the cluster for most active if we want to apply strategic marketing.

Here we see again with DBSCAN that the density is not very varied and the algorithm ends up with groups that do not have a lot of meaning. So in a broad sense, we can see that in our results that outputs given k-means are the ones that are most meaningful. In each of the clusters from each sample, a number of meaningful groups emerged with similar behaviour.

K-means algorithm was very fast and was able to process data pretty easily without any hitch, whereas agglomerative clustering was not always very intuitive in creating clusters with meaning, and the clusters they formed was 3 which was not enough to figure proper patterns in the population we had taken.

Agglomerative algorithm took a lot of time to identify the number of clusters needed and did not properly identify any groups. DBSCAN algorithm also was not able to identify any proper groups as the algorithm is based on density, and with variation present in our sample data, the density was majorly focused on a singular place and not distributed. Hence, nothing of meaning was achieved. This may have been due to the nature of our data. Although DBSCAN is very fast, it was not able to properly identify any groups. So with all the above results, we achieved and recognized that k-means overall has worked perfectly as a tool for segmenting a population and hence should be used as the tool for market segmentation.

5 Conclusion

This project was a research study that aimed to take the information about clustering that we do know, in order to get information that we don't know in a particular topic area. So in order to make the study relatable and applicable in today's world, this project is considered a mix of trends; the Internet and social media platforms have played a major role in communication in the last few years. With its ability to reach a large mass audience, the scope for marketing was introduced. Companies began investing in the sector now known as online marketing. By using the existing knowledge of cluster, through this project we have provided an opportunity for marketing using clustering. As we hypothesized, we were able to conclude a certain clustering technique to be better than the other. Hierarchical clustering proved to be slow, struggled to identify patterns and was not able to draw similar groups. DBSCAN is density-based clustering algorithm; it did not suit the data set and the focus we had. It identified noise and failed to provide adequate information that would help online marketing. Hence with our study, we discovered that the k-means algorithm was robust, able to handle the large amount of data, fast and it was able to create similar groups based on the attribute filters we had provided. With this study, future work involving implementations would have a chance to perform well. It will benefit the competitive market, help small businesses and in turn better the economy.

References

1. Kaur M, Kaur U (2013) Comparison between k-mean and hierarchical algorithm using query redirection. Int J Adv Res Comput Sci Softw Eng 3(7)
2. Huang Z (1998) Extensions to an algorithm such as k-means for large data to be clustered with categorical values. J Data Min Data Discovery 2(3):283–304
3. Tripathi S, Bhardwaj A, Poovammal E (2018) Approaches to clustering in customer segmentation. Int J Eng Technol 7(3.2):802–807
4. Friedemann V (2015) Clustering a customer base using Twitter data. CS-229
5. Ngai E, Xiu L, Chau D (2009) Application of data mining techniques in customer relationship management: a literature review and classification. Expert Syst Appl 36(2):2592–2602
6. Ansari A, Riasi A (2016) Taxonomy of marketing strategies using bank customers clustering. Int J Bus Manag 11(7):106–119
7. Ghzanfari M et al (2010) Customer segmentation in clothing exports based on clustering algorithm. Iranian J Trade Stud 14(56):59–86
8. Rygielski C, Wang J, Yen D (2002) Data mining techniques for customer relationship management. Technol Soc 24(4):483–502

Crime Prediction System

Somula Ramasubbareddy, T. Aditya Sai Srinivas, K. Govinda and S. S. Manivannan

Abstract The work implemented here is crime prediction system (CPS). We first created hypothetical datasets samples of major city areas and different crimes taking place and then we used the algorithms to analyze it. We used HTML and CSS along with PHP, while wamp as a Web server to this application. The objective of the proposed work is to analyze and predict the chance of a crime happening using apriori algorithm. In addition, we used decision tree as a searching algorithm and naïve Bayesian classifier to predict about the crime in particular geographical location at a particular point of time. The result of this can be used to raise people's awareness regarding the dangerous locations and to help agencies to predict future crime in a specific location within a particular time.

Keywords Machine learning · Apriori algorithm · Decision tree · Naïve Bayes classifier · Prediction

1 Introduction

Crime is a typical society issue influencing the worth of life and the financial development of society. It is a fundamental factor that decides whether individuals move to a new city and tourism spots. With the expansion of violations, law requirement organizations are proceeding to request progressed geographic data frameworks furthermore, data mining is a way to deal with crime examination and to better secure their networks.

In spite of the fact that crimes could happen all over the place, usually, hoodlums deal with crime openings they look in most recognizable zones for them. By feeding

S. Ramasubbareddy (✉)
Department of Information Technology, VNRVJIET, Hyderabad, Telangana, India

T. Aditya Sai Srinivas · K. Govinda · S. S. Manivannan
SCOPE, VIT University, Vellore, Tamilnadu, India
e-mail: kgovinda@vit.ac.in

S. S. Manivannan
e-mail: manivannan.s.s@vit.ac.in

H. S. Saini et al. (eds.), *Innovations in Computer Science and Engineering*,
Lecture Notes in Networks and Systems 103,
https://doi.org/10.1007/978-981-15-2043-3_16

the data to data mining approach, we can predict the crime location, time and area and to create the awareness among the individuals to avoid certain area for tourism and which intern create the awareness to police for necessary steps to solve in the society. Besides, this would be valuable for police assets portion. It can help in the resource allocation of police in all probability crime places for some random time, to utilize police assets effectively. By making the data more open to public, the general public can decide for tourism and family life.

1.1 Problem Statement

We aim to find the crime location using a hypothetical data of the city Vadodara. We will try to find the type of crime that can happen in a certain area and the chances of it to actually occur. The algorithms we will be using for the project are apriori, decision tree, and naïve Bayes classifier.

2 Literature Survey

There has been an incalculable of work done regarding crime. Extensive datasets have been reviewed, and data such as area and the kind of crime have been analyzed to enable individuals to pursue law authorizations. Existing techniques have utilized these databases to recognize crime hotspots depending on areas. Despite the fact that crime areas are recognized, it is difficult to find data that incorporates the crime event date and time alongside systems that is precisely anticipate what crime will happen later on.

We analyzed some of the past work and the research papers regarding crime prediction. Below is a brief description of some of the past works.

2.1 An Overview of Crime Prediction Methods

This paper has introduced various crime prediction methods. It discusses "support vector machine," "fuzzy theory," "artificial neural network" and "multivariate time series." The proposed work reviews the crime analysis which can be used for law and to handle the crime, and the SVM can be used for analyzing time series data in a suitable way. SVM can be applied to predict crime hotspots resulting in a global solution. Fuzzy theory modeling requires numerical data and uses IF-THEN rules to form vague predictions and the quadratic combination of the presumptive variables. It requires less computational complexity and has well in learning abilities. The fuzzy model can be used to improve efficiency. Artificial neural network (ANN) is used to

develop a model using historical data based on time series to analyze and predict the future [1].

2.2 Crime Rate Estimate and Projecting in Tamil Nadu Using Cluster Techniques

This research implements k-nearest neighbor approach scans through data, when data is given to it. The paper discusses k-means clustering method to provide a large criminal data and simplify the records and ease in handling, searching and retrieving. Agglomerative hierarchical clustering assigns object to cluster and then integrates all clusters to form a larger cluster. DBSCAN is based on the density clustering method. The algorithm improvises areas with accurately high solidity into cluster and to find cluster of random shape in structural database into commotion. It creates a cluster with high density [2].

2.3 Crime Tracer: Activity Space-Based Crime Location Prediction

The proposed approach is based on a certain pattern about the crime rather than analyzing location, frequency and time of crime, the tracer will spot all the details of regular pattern of the people using graph theory. The model is based on finding the offenders behavior using historical data [3].

2.4 A Novel Serial Crime Prediction Model Based on Bayesian Learning Theory

The profile-based geo-location uses a mathematical model which is based on probability distribution in a specific region and dynamic model based on Bayesian approach and it needs to adjust the fitness function based on crime data, specifically in crime location data. The work in this paper shows dynamic algorithm based on Bayesian approach [4].

2.5 *Classify Interval Range of Crime Forecasting for Crime Prevention Decision Making*

A digital system used for decision making with the help of convergence of technologies to develop learning models to build a decision support system to improve the quality of decision making and providing the best solution to varies problems. Crime analysis is done first by identifying crime incidents, victim profile, potential risk, monitoring crime threshold and examine crime trends. The research develops the application tool using input data module, statistic module and crime prevention decision module and uses If-Then rules to forecast and associate qualitative attributes of crime parameters [5].

Hornik et al. [6] presented the R-language extension that provides a computational platform having fixed notation and genetic decoders with associates to associate to external decoders for global cluster. A large-scale standard is implemented to examine the solvers. The authors proposed to get better results with solvers.

Kulis and Jordan [7], the authors studied the DP mixture model to link two models like k-means and Bayes and proposed a hierarchical model, which results in high accuracy and reduced computational time complexity.

Kaur et al. [8] described the overview of k-means and implemented a ranking for k-means, which is contrast to the traditional approach but it gives lesser execution time and better results compared to traditional one.

Li and Juhola [9] proposed a machine learning model called SOM for predicting crime data of different countries with different conditions and concluded that this tool will help in predicting as well processing a large quantity of data.

Malathi and Baboo [10] developed a crime analysis tool in the Indian context using different data mining techniques (k-means and DBSCAN) clustering for analysis and identification of crime. The police department can use this for crime identification. The combined approach produces a pattern to identify and prevent crimes.

Okonkwo and Enem [11] identified different mining models that can be implemented by different agencies to detect and prevent terrorism. Authors also worked on Nigeria data to detect the crime and support the agencies.

Mande et al. [12] developed a new model for identifying crimes using an ensemble approach that uses GMM to identify the criminals based on various parameters and concluded that the presented model is unique and gives the perfect result.

Baboo et al. [13] examine the crime data of police department utilizing the data mining methods such as clustering and categorizing and also identified the crime tendencies and provided that this method can be used to minimize and prevent crime for the future years.

3 Proposed Method

We used data mining techniques, since we assumed that finding a relationship between criminal elements and frequent patterns can highly aid us to predict potentially dangerous locations in the future on time. That is why this proposed method uses three major parameters in dataset, crime type, the crime period (morning, evening) and the crime location. First, for predicting the probability of a crime happening, we found the frequent data item pattern based on variables. Then, the applied classification techniques are used to identify the crime type and the location over a time.

Here, we will explain how dataset is created and how analyzed the data using data mining and machine learning algorithms.

When the crime prediction system (CPS) is started, we are introduced to a basic login page. This is used to prevent any other person except the police to add, change or delete any kind of data prevent.

3.1 Apriori Algorithm

Apriori is the basic data mining algorithm for finding frequent patterns. It will scan the database to find the item sets that satisfy a predefined minimum support. For this project, we have taken support as equal to two. We have used it to find the frequent datasets which help us in finding the probability or the chance of a particular crime happening in a certain area. We limited the probability or confidence to 25%, meaning when the probability of certain crime happening is more than 25% then only it will show in the database.

3.2 Decision Tree

The decision tree approach is used to create a model to identify the class by using basic decision symbols applied to data. Since there is a possibility that the decision tree made might be complex so for this project we have used a predefined statement and have split the root node on the basis of the crime period. This algorithm is basically used as a searching algorithm to find names. For example, the predefined statement is: “Find all males who committed murder at night” and in the result, it fetches the names of people from the database which have the attribute or keywords such as “murder,” “male,” “night.”

3.3 Naïve Bayes Classifier

Naïve Bayes is an effective and widely used algorithm. It predicts class membership probabilities using Bayes theorem. The algorithm assumes all features to be conditionally independent which not always is the case so the prediction might not be hundred percent accurate. This is algorithm is also sort of used as a searching algorithm but instead of giving the no. of crimes or the names of the criminals and it gives us the type of crime that can happen. As an example, when we search "Alkapuri in the evening" we get the result "eve teasing."

4 Implementation

In this paper, while comparing all the algorithms we learned that while the algorithms used are effective they are not fully reliable. First apriori techniques are applied to identify crime and analyze the database to get the possibilities of a crime happening. But, they are not 100% reliable since in one of the examples shows that the chance of vehicle theft in Waghodiya is hundred percent which is impossible to happen. So, we cannot completely rely on the result which gives 100% possibility. Next, we use decision tree as a searching algorithm which helps us in finding names from a large-scale database, and finally, naïve Bayes classifier to find the type of crime that can happen at a particular area at a particular time. The naïve Bayes classifier only gives the type of crime and not the probability of that crime happening, so we can only use it to find the crime type. Another disadvantage of using naïve Bayes classifier in this project is that if a location has registered crime of the same number then the result will only show the most recent crime as output. By comparing the output of all the algorithms, we found that the most efficient and accurate algorithm used is decision tree followed by naïve Bayes and apriori and that the efficiency of each algorithm depends on the type of application it is used in.

4.1 Comparative Study

We compared the main apriori algorithm to another data mining algorithm FP-growth. Although FP-growth is better than apriori in almost all the areas, we used apriori since it is very easy to understand and implement. While apriori scans the whole database to find the frequent item sets, FP-growth creates a tree to do the same. The time complexity which is the time taken to execute is greater in apriori algorithm than FP-growth shown in Fig. 1.

The time complexity of apriori algorithm is O(2d) where d is the number of unique elements.

The time complexity of FP-growth is $O(n^2)$ where n is the number of unique items.

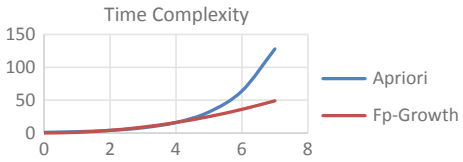


Fig. 1 Time complexity comparison

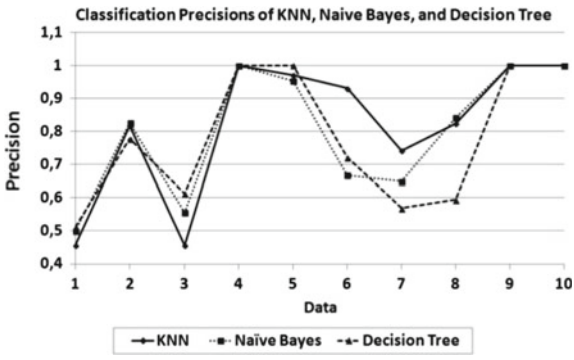


Fig. 2 Classification precision

We also studied and compared the performance between decision tree, naïve Bayes and kNN. Through an example from a reference paper, we learned that the F-measure is harmonic mean of precision, meaning that calculating the value of F-measure (Fig. 2) will tell us which the best classifier is. The average F-measure was largest among others meaning decision tree is best in terms of precision followed by decision tree and kNN.

5 Conclusion

In today's time where crime is increasing day by day, a major challenge faced by law enforcement is predicting crime to protect citizens. Tools of mining and AI are now accessible to the different community. Computers can process a great many directions in seconds, sparing valuable time. Computers use increases the accuracy than human investigators.

The project focus is on developing a crime prediction analysis tool used for local society. This project enables the law department to characterize and analyze the crime data to identify crime patterns and predict possible future crimes. The system can say to be a small prototype but it can still be implemented to the real-world database.

For the future extension of the project, we can combine more classification algorithms to increase the crime estimation accuracy and increase the overall performance of the system.

References

1. Balaid A, Rozan MZA, Hikmi SN, Memon J (2016) Knowledge maps: a systematic literature review and directions for future research. Int J Inf Manag 36(3):451–475
2. Lu B, Tsou BK (2010) Combining a large sentiment lexicon and machine learning for subjectivity classification. In 2010 international conference on machine learning and cybernetics, vol 6. IEEE, pp 3311–3316
3. Alvari H, Hajibagheri A, Sukthankar G (2014) Community detection in dynamic social networks: a game-theoretic approach. In: Proceedings of the 2014 IEEE/ACM international conference on advances in social networks analysis and mining. IEEE Press, pp 101–107
4. Farid H (2006) Digital doctoring: how to tell the real from the fake. Significance 3(4):162–166
5. Stough R, McBride D (2014) Big data and US public policy. Rev Policy Res 31(4):339–342
6. Buchta C, Kober M, Feinerer I, Hornik K (2012) Spherical k-means clustering. J Stat Softw 50(10):1–22
7. Kulis B, Jordan MI (2011) Revisiting k-means: new algorithms via Bayesian nonparametrics. *arXiv preprint* arXiv:1111.0352
8. Kaur N, Sahiwal JK, Kaur N (2012) Efficient k-means clustering algorithm using ranking method in data mining. Int J Adv Res Comput Eng Technol 1(3):85–91
9. Li X, Juhola M (2014) Country crime analysis using the self-organizing map, with special regard to demographic factors. AI & Soc 29(1):53–68
10. Malathi A, Baboo DSS (2011) Algorithmic crime prediction model based on the analysis of crime clusters. Global J Comput Sci Technol 11(11):47–51
11. Okonkwo RO, Enem FO (2011) Combating crime and terrorism using data mining techniques. In 10th international conference IT people centred development, Nigeria Computer Society, Nigeria
12. Mande U, Srinivas Y, Murthy JVR, Kakinada VV (2012) Feature specific criminal mapping using data mining techniques and generalized Gaussian mixture model. Int J Comput Sci Commun Netw 2(3):375–379
13. Baboo SS (2011) An enhanced algorithm to predict a future crime using data mining. Int J Comput Appl 975:8887

Crime and Fraud Detection Using Clustering Techniques

Santhosh Maddila, Somula Ramasubbareddy and K. Govinda

Abstract Criminal attacks have drastically increased over the years which make its detection increasingly vital. Fraud detection is a technique of identifying fraudulent activities. We intend to apply clustering techniques in order to analyze and detect fraud or crime patterns from a large set of data. By using various clustering techniques, distinct areas or clusters can be generated by mapping crime instances (i.e., by identifying the factors that lead to fraud). These are areas which have high probability of criminal occurrences which are derived based on historical crime records. Thus, with the help of results obtained based on clustering analysis of the crime data, crime trends today can be identified. Crime can be divided into different types such as location-based crimes, theft, murder, kidnap, fraud, etc., and slums, residential areas, commercial areas, etc., are different types of areas where criminal activities may occur. Primary database is collected based on the types of crimes, the location, and the physical description of the suspects and also the time period in which felony has taken place including the other available data relevant to the analysis. The available data is then processed and clustered, thereby revealing a general crime pattern which in turn helps detect frauds.

Keywords Data mining · K-means · Prediction · Classification · Clustering

S. Maddila
Information Technology, GVPCEW, Visakhapatnam, Andhra Pradesh, India
e-mail: msantosh@gvpcew.ac.in

S. Ramasubbareddy (✉)
Information Technology, VNRVJIET, Hyderabad, Telangana, India

K. Govinda
SCOPE, VIT University, Vellore, Tamil Nadu, India
e-mail: kgovinda@vit.ac.in

H. S. Saini et al. (eds.), *Innovations in Computer Science and Engineering*,
Lecture Notes in Networks and Systems 103,
https://doi.org/10.1007/978-981-15-2043-3_17

1 Introduction

Data mining is a computing process of extracting hidden predictive information or patterns from a large database, which thereby helps to focus on the most important information in the data warehouse. The dataset used consists of certain criminal activities recorded within the period of 2012 within 12 major states such as Andhra Pradesh, Uttar Pradesh, Tamil Nadu, Madhya Pradesh, Maharashtra, Punjab, Bihar, Haryana, Karnataka, Kerala, Rajasthan, and West Bengal and our capital Delhi. Two of the many data mining techniques are clustering and classification.

Classification

Data classification is a process of categorizing data into different groups by using various standard algorithms. The data can be grouped into multiple predefined classes. The data classification techniques can be used to train the set of objects which are previously formed into groups based on popular existing classes. The structure for groups is formed by training classification algorithms by themselves with reference dataset. The fraud data is grouped into new objects by using different classification techniques.

Clustering

Clustering is another technique in data mining process. Clustering slightly seems to be as classification where actually both are unique. Unlike the classification, clustering is a data mining technique in which the similar data elements are made into single cluster. The data elements which are dissimilar and that cannot be included in the cluster are known as outliers. Clustering in terms classification can be defined as an unsupervised classification. The elements in one cluster are outliers to other clusters which mean every cluster differs from the other clusters. Clustering is mainly used to identify the different data patterns arranged into different clusters.

Recognition of nature of crime before the disbelief comes into the reality can lead to identify the fraudulent. Before categorizing the data into supervised and unsupervised learning, data pattern is needed to be checked to know whether the data is fraud or not. Supervised learning is applied on the fraud data which is labeled. Unsupervised learning differing from supervised learning is applied on unlabeled fraud data which is not actually fraud data because there is no prior knowledge about the data. The data cannot referred as fraud one until it poses the crime or fraud nature. Once the data is verified, the patterns are treated according to their nature.

2 Literature Survey

Advancement has its own frailties and intrinsic worth. A large number of credit card transactions are made each day. Increase in the number of online shoppers provides more opportunities for credit and debit card usage, which in turn is directly

proportional to commit deception. The deficiency in tracking fraudulent credit and debit card transactions is due to the rise in white-collar crimes [1].

Globalization led to the vast development in many aspects such as social networking, industrialization, medical treatment, and pharmacy, although there is a lot of development in many areas, still crime is found at least in some parts everywhere. The vast nature of crime has witnessed a tremendous upsurge in the recent times, and all the facets, economic offenses, being a silent crime, have also increased massively [2].

The process of identifying the suspect through handwriting is very difficult. This kind of analyzing tool plays an effective role. Hence, it is difficult to copy the exact handwriting of a person as there will be at least a slight change in handwriting of different persons. Stylistics is one of the most commonly used applications that uses linguistic tools which can support forensic techniques in eliminating this. It shall be very useful in determining white-collar crimes. Linguistic tools help in finding solutions for any questioned document in white-collar crimes. The white-collar crimes involve forgery, threatening, blackmailing, and theft [3].

White-collar crimes are more often nowadays than the conventional types like burglary, theft, etc. The losses due to white-collar crimes are comparatively higher than conventional crimes. The count of white-collar crimes is rapidly increasing due to the reasons where government is incapable of controlling and because of malpractice undertaken by the officials on higher positions [4].

In the modern days where technology is playing vital role, the usage of Internet around the world is increasing. As Internet users are increasing day by day, the crimes through the Internet called cybercrimes are adding their count. There are many new techniques that are implemented to identify and decline the crime via Internet. Cyber space is also acquiring new methodologies and using different tools to reduce the count. The techniques that are used to detect the fraud must be able to track down the people who are involved in the business through e-commerce sites [5].

Discussions about tremendous increase in bribe and corruption and effective measures in order to reduce the possibility of increase in crimes lead to economic and financial loss to the country. This book concentrated on BRIC countries which were made through anti-bribery enforcement measures [4].

The forensic accountants with honesty, fairness, and transparency in reporting are gradually increasing due to the demand of people. Forensic accountants are persons who must have the skills on finance, accounting, law, and research to find out the criminals and decline the crimes. A continuous check is always made on the activity related to find fraud statements of accountants in order to make personal gain [6].

White-collar crimes can be stated as a moral or ethical violation that follows ideals which inherit from the principles of natural law. People consider it to be violation of criminal law. It can be defined as illegal behavior committed by upper-class individuals during their occupation. It has been observed that white-colla crimes in Kashmir are increasing day by day [7].

Forensic accounting has come into existence after there is a huge increase in the frauds and white-collar crimes. The aim of the forensic accounting is to detect the fraud and reduce the count where previously it was believed that there are no sufficient resources and time to reduce the number by the law enforcement agencies [8].

This paper includes the qualities that are necessary for ethical hacker along with core elements of information security, effects of breaching, and security challenges. The strategies for reducing the cybercrime must keep the security challenges in mind so that the risk should be maintained while implementing the strategy without being a reason for vulnerability in future. Implementing the strategy should lead not only to reduce the frauds but also to gain the fruitful outcomes from the strategies that are adopted by the ethical hacker. Ethical hackers should pose the qualities along with scope and limitations considering the security issues [9].

3 Proposed Method

We will be using the method of unsupervised learning for our project. The dataset is initially preprocessed followed by the application of the proposed methodology.

Data preprocessing

It is technique which process the data before mining the data from the large databases. This data mining technique involves the transformation of raw data into an understandable way. The data before applying the preprocessing is raw, inconsistent, and irrelevant and may have some errors. Data preprocessing helps in rectifying the problems with raw, incomplete, and inconsistent data.

Data preprocessing steps

- Data cleaning: Data cleaning is a process where the data is made appropriate for the data mining by removing inconsistencies, making the noisy data smoothened, and if there are any missing values those are filled.
- Data integration: It is the process of integrating various views of data to provide users with identical view so that it is easy to solve the issues with the data.
- Data transformation: The raw data before processing may be of different forms. Data transformation process is used to transform the different forms of data into the form which is useful for data mining process.
- Data reduction: Data mining is a process which is done on large amount of data. So it is difficult to analysis such large amount of data. In such cases, data reduction is the technique used to reduce the data by decreasing the data storage and increasing the storage space.
- Data discretization: The technique in which large range of continuous attributes is replaced with small labels to make use of them with ease.

It is important to preprocess the data in WEKA to perform any other operation. WEKA only reads .csv or .arff files. Hence, the .xlsx file has to be either converted to .csv or .arff.

Unsupervised learning

Unsupervised leaning is a kind of machine learning where the learning techniques are applied on unlabeled data. Best example of unsupervised learning is cluster analysis. Cluster analysis is the process of analyzing where similar objects are made into the same group. Euclidean distance and probabilistic distance are the two measures that are useful to calculate the similarity among the data elements in the cluster.

Common clustering algorithms

Hierarchical clustering

The clustering technique is to finding out the similarity between two clusters by assigning the data points to each of the clusters. The one or more clusters which have similar objects in different clusters are combined as single cluster.

K-Means clustering.

The n data elements are divided into k clusters based on the similarity. The centroid of each cluster is calculated to group the objects that are nearer to the centroid into a cluster.

Supervised learning

Supervised learning is another kind of learning in machine learning which slightly differs from the unsupervised learning. Supervised learning unlike the unsupervised learning is applied on the labeled data that is known data.

In simpler words though, we use supervised learning when we have a class label.

Classification and regression are the techniques that come under supervised learning.

Simple k-means

$$J(V) = \sum_{i=1}^{C} \sum_{j=1}^{C_i} \left(\| x_i - v_j \| \right)^2$$

where,

'$||x_i - v_j||$' is the Euclidean distance between x_i andv_j.
'c_i' is the number of data points in i^{th} cluster.
'c' is the number of cluster centers.

K-means clustering aims to partition n observations into k clusters in which each observation belongs to the cluster with the nearest mean, serving as a prototype of the cluster. This results in a partitioning of the data space into Verona cells.

Hierarchical clustering

$$L(r,s) = \frac{1}{n_r n_s} \sum_{i=1}^{n_r} \sum_{j=1}^{n_s} D\left(x_{ri}, x_{sj}\right)$$

Hierarchical clustering is a method of cluster analysis which seeks to build a hierarchy of clusters. Farthest first

$$\text{Min}\{\text{max dist(pi,p1)}, \text{max dist(pi,p2)} \ldots\ldots\}$$

Farthest first is the algorithm which is an alternative for k-means clustering. In farthest clustering, each cluster has center with lot of difference with the other clusters around it. Hence, making the clustering process easy by reducing the necessity to check for the similarity between the each and every clusters surrounding them.

Make Density-based clustering

$$N_\varepsilon(p) : \left\{q \,/\, d(p,q) \leq \varepsilon\right\}$$

Density-based spatial clustering of applications with noise (DBSCAN) is a widely used density-based algorithm. In density-based clustering, starting from an arbitrary point visit all the nodes to find out the neighboring point that are written within the distance. The points that are visited during this process are marked as visited nodes and that are not visited are considered as noisy data. Clustering process is started once there are sufficient neighboring points found.

4 Result

After applying the above-mentioned algorithms, we have come to a conclusion that the state of Kerala has most number of total IPC crimes followed by Delhi and Maharashtra. According to the total number of crimes, Uttar Pradesh has the highest followed by Madhya Pradesh and Maharashtra. The following are the time taken by each algorithm:

Figure 1 depicts all the 28 states of India in the X-axis and total IPC crimes in the Y-axis. Madhya Pradesh has most jitter followed by Uttar Pradesh.

Figure 2 depicts all the 28 states of India in the x-axis and total IPC crimes in the y-axis. Uttar Pradesh seems to have most jitter followed by Madhya Pradesh.

The number of IPC crimes committed state-wise is depicted in Fig. 3.

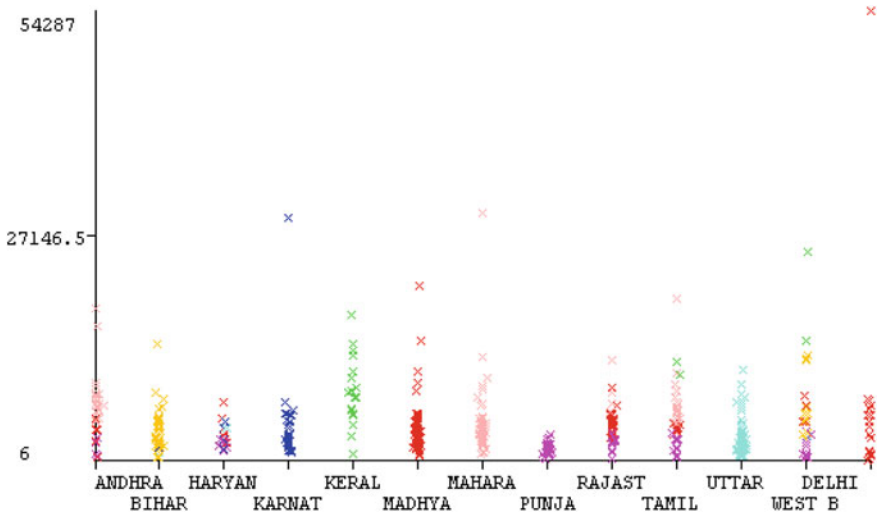


Fig. 1 States versus total IPC crimes

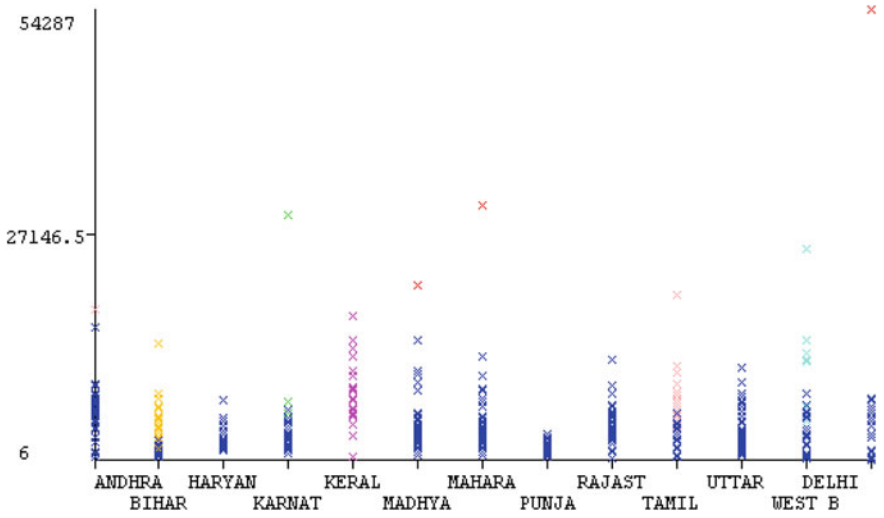


Fig. 2 States versus total IPC crimes

The greatest weight is for the state of Uttar Pradesh (77%) followed by Madhya Pradesh (54%) and Maharashtra (46%). X-axis consists of all the states of India, and Y-axis consists of total IPC crimes.

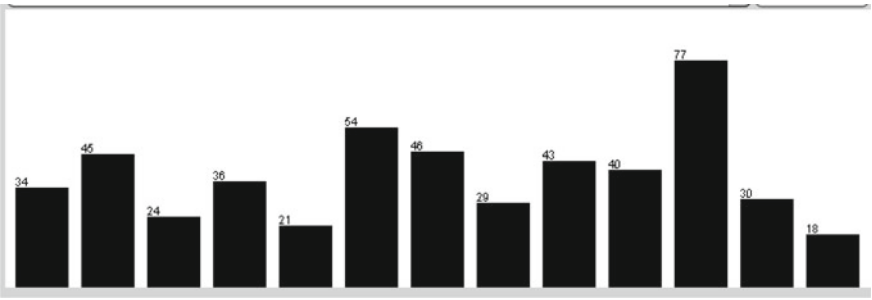


Fig. 3 States versus total IPC crimes

5 Conclusion

Through this project, we have learned about various clustering algorithms such as simple k-means, hierarchical cluster, farthest first, and make density-based clustering. We have also learned how to determine the number of clusters by using the elbow method, and principal component analysis converts a set of observations of possibly correlated variables into a set of linearly uncorrelated variables known as principal components using Python. We have also learned to implement real-life datasets and predict result specific attributes using Weka tool. As per our analysis, the crime rates in India have taken a flight ever since 2006, after dropping in the years from 2002 to 2005. This should be an awakening call for us, and we believe that our government should take critical steps to ensure safety to its citizens, and as the citizens of India, we should be more responsible and cautious.

References

1. Renuga D, Rabiyathul B, Kamaladevi M (2014) Fraud detection in card not present transactions based on behavioral pattern. J Theor Appl Info Technol 61(3)
2. Thakur V, Chaudhary R, Sharma RK (2012) Performance appraisal of economic offence wing of Chandigarh police: an analytical study. ACADEMICIA: Int Multidiscipl Res J 2(5):210–227
3. Yadav S, Jha S (2001) A framework for authorship identification of questioned documents: forensic and linguistic convergence. MJAL 3(1):1–7
4. Mundhe SV (2016) Critical analysis of white collar criminality highlighting judicial precedents in maharashtra
5. Dorminey J, Fleming AS, Kranacher MJ, Riley RA Jr (2012) The evolution of fraud theory. Issues Account Edu 27(2):555–579
6. Dhami S (2015) Forensic accounting: signaling practicing accountants to improve skill set and forming regulatory body for forensic accountants In India. Global J Res Anal Int 4(5)
7. Shekhar C, Showkat G (2014) White-collar crimes in Kashmir. J&K-A Syst Rev Stud White-collar Crime, Crim Behav Consequences 2:602

8. Wadhwa L, Pal V (2012) Forensic accounting and fraud examination in India. Int J Appl Eng Res 7(11):2006–2009
9. Pangaria M, Shrivastava V Need of ethical hacking in online world. Int J Sci Res (IJSR), India Online ISSN, 2319-7064

Server-Less Cloud Computing—An Economical Solution for Business Operations

Alpana Kakkar and Armaan Farshori

Abstract Cloud computing provided computing resources which were not imagined before by any business as solutions for their operations. Since the last five years, a new paradigm of service model has emerged which is Function as a Service (FaaS). FaaS is also referred to as server-less computing where the stateless function is responsible for computation of data. These functions are deployed on Amazon Web Services (AWS) Lambda along with other services like API Gateway and DynamoDB to efficiently run the application. The data is transferred using HTTP which is a stateless protocol and it uses its GET and POST methods to exchange data. In this paper, we analyze the deployment of an API on a conventional cloud computing model and compare it with the server-less model, taking account of all the API calls that generate costs.

Keywords Cloud computing · Function as a Service (FaaS) · Server-less Computing · Amazon Web Services (AWS)

1 Introduction

The inception of cloud computing during the year 2006 was like a long-held dream come true for many. It was believed that finally computing can be used as a utility for which users can be charged. Cloud computing changed the entire business process and information technology sector. It helped to provide numerous jobs and also entirely revolutionized the conventional methods of production load deployments.

It helped businesses to cut down on the expensive server equipment that was required to deploy a production-ready infrastructure. In a conventional practice which was not only expensive to buy in the first place but also the upkeep, maintenance and running costs were to be considered. Cloud computing catered to all these issues by providing a platform for these businesses as PaaS, to use their server farms rather

A. Kakkar · A. Farshori (✉)
Amity Institute of Information Technology, Amity University Uttar Pradesh, Noida, India

A. Kakkar
e-mail: akakkar@amity.edu

H. S. Saini et al. (eds.), *Innovations in Computer Science and Engineering*,
Lecture Notes in Networks and Systems 103,
https://doi.org/10.1007/978-981-15-2043-3_18

than deploying their own servers. This helped businesses to keep a check on their costs and to focus on developing their product rather than maintenance of the servers.

The main objective of this research is to find out the costing of an application deployed on conventional methods of cloud computing and comparing it with server-less architecture of computing. Once an application is deployed, you might not know how many users might land onto your application and start using it. This could generate significant charges for your application. Be it a large corporation or a newly established startup because every business would like to reduce their operating costs. Cost savings would be associated with computational resources, energy resources and the other resources which will help to reduce the overall operating costs of the business.

2 Background and Related Works

The introduction of cloud computing was not only beneficial for businesses but also for technology giants like Amazon, Google, Microsoft, etc. who invest heavily in new innovations to the consumer sphere but also provide solutions to build them [1]. The most prominent solution which disrupted the entire IT industry was the introduction of cloud computing in the consumer sphere. Now finally, these companies were able to charge customers for the utilities that they were providing in the form of PaaS, SaaS, IaaS and recently introduced FaaS [2].

The conventional methods of cloud computing and the resource allocation were entirely dependent on the nature of the business and the product that they wanted to build. In an ideal setup, it was expected that businesses would collectively use the modular resources available [3] on the cloud provider's platform, which must be used to deploy an application which costs a significant amount of money to the businesses.

Yes, it was evident that using the modular resources provided by cloud providers like Amazon was obviously cheaper than the previously available solution to deploy the same services using in-house servers but there was still room for improvement. This empty void was finally bridged by the introduction of server-less computing [4, 5].

Server-less computing opened new opportunities where the businesses could harness the power of the cloud and not worry about the maintenance of the servers. Server-less is a new paradigm where applications can be built without worrying about the heavy pricing of computational instances like EC2 [6], and the actual computation is done on the provided virtual boilerplate environment. Their efficiency and performance are next to that of dedicated compute instance but at a fraction of cost. This has proved to be a huge advantage for different businesses who adopted the server-less architecture [7]. AWS Lambda is a function triggered by computer service where the business using this service is only charged for the time their code is running. The code is functional in nature meaning when the function is called by the endpoints or with the application interaction, then only the logical code which

the developers provide actually works. The business is charged for every 100 ms of execution time [8, 9].

For sure, AWS Lambda proves to be much more advantageous over conventional cloud computing methods. But was cloud industry really the same before the inception of server-less computing? Obviously, cloud computing was not the same [10]. The introduction of server-less architecture was the innovation which was the need of the hour. A solution, which provided further, reduced prices for operations and deployments keeping the integrity of the entire infrastructure.

The most popular use case for server-less computing was in the API and backend development, where developers could create un-managed API's and backend for web applications and mobile applications, which were fully managed by the cloud provider and highly available [11]. Using AWS server-less architecture to create a mobile application's API was fairly simple where using only three services AWS Lambda, AWS API Gateway and AWS DynamoDB, the developers can create a fully functional application which opened doors to new Cloud Computing Service MbaaS (Mobile Backend as a Service) [12]. Since many years, businesses have struggled to entirely consume the prowess of cloud computing and the major reason for them all being the pricing modularity of the different resources available to consume. Yet being cheaper, businesses found them to be expensive [13] as the total cost of ownership always bothered the cloud consumer. There were no definitive tools or research available to find the optimal resource allocation for definitive pricing, there were just too many factors involved with it [14].

No doubt, many researchers, as well as the cloud providers, have tried to build an optimal solution for businesses to cater to the needs for the products that are deployed on the cloud. Techniques like spanning virtual computers over a multi-cloud environment were also introduced for cost optimizations [15]. But as usual, the costing of resources in a cloud environment is just too dynamic [16, 17]. The cloud infrastructure providers have equipped the developers as well as businesses from scarcity of resources to abundance of resources. Providing the tools and platforms was previously not easily available. Giving unlimited access to such tools were creating anything is possible now [18].

Proceeding to the interesting and innovative world of server-less computing, we must understand how conventional commercial computing worked. In an ideal enterprise setup, a business sets up its hardware infrastructure on premise to cater to all different needs like: computing, networking, application server, content delivery, security, etc.

These are just some of the services out of many others which are necessary for any IT components of a business to function properly [19]. Now, deploying all these services in an in-house server requires a huge investment in money, equipment, certified professionals, electricity bills and whatnot. When a company does not need to focus on managing a data center, they can focus on innovating in other areas. Solution to all these primitive and conventional methods was provided by cloud computing. Cloud computing is nothing but deploying your entire infrastructure on the hardware of a cloud service provider. Different services which are modular in nature are collectively used together to create an infrastructure for your requirement.

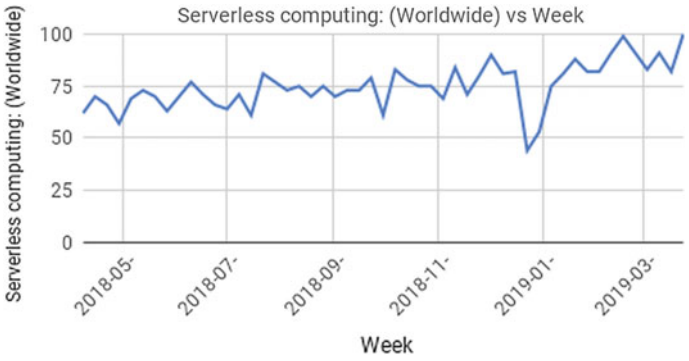


Fig. 1 Google trend for server-less [21]

This infrastructure in practicality is the same as you would deploy in-house but it has significant advantages over deploying and maintaining infrastructure on your own.

The next step into cloud computing was introduced by server-less computing. It has been an emerging and trending search word on Google; for the last few years, the result of it can be seen in the image below. Since AWS introduced Lambda in 2014 and soon other cloud providers followed the suite. This allowed developers to just focus on the development rather than maintenance of their cloud infrastructure. Server-less computing uses the fundamentals of stateless computing. Once the request is made by HTTP to either retrieve or put something on the backend, the function is invoked and the actual computation happens (Fig. 1).

Components of server-less architecture are: event-driven functions, API endpoints service and database service for easy understanding we consider services provided by AWS: (a) Lamda Functions, (b) API Gateway, (c) DynamoDb.

There are many cloud infrastructure providers, industry leaders being: AWS-Amazon Web Services which was the first cloud provider to introduce server-less computing, GCP-Google Cloud Platform, Microsoft Azure, Alibaba Cloud, etc. All these providers have a pay-as-you-go mode of payment which means you are only charged for what you use. Different services have different prices; once combined together to create an infrastructure, the collective billing is generated during any billing cycle [20]. It is no surprise that many of the leading companies and businesses like Netflix, Apple, Pinterest, Evernote, Dropbox, Walmart use the services of these companies to cater their products to the masses. It was this decision of these companies to migrate to the cloud that they have been able to provide the world with more innovations than anyone else [21] (Table 1 and Fig. 2).

Table 1 AWS EC2 and GCP compute engine comparison [17, 19]

Compute instance	Processor	RAM	Price/month
t2.large	2	8	$66.816
n1-standard-2	2	7.5	$48.550

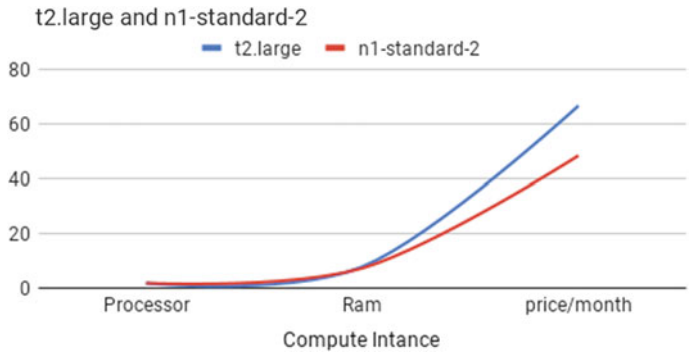


Fig. 2 Price and configuration for AWS and GCP compute instance [17, 19]

The major advantage of server-less computing is that it is highly scalable, highly available and fully managed by the service providers. High scalability means that whenever you start running out of resources, cloud infrastructure automatically adjusts itself to your needs. Highly available means that no matter what the geographic location is of the user your product will always be available with the nearest data center for that particular user. Fully managed means if you are using the services of cloud infrastructure providers, you do not have to worry about the maintenance of the infrastructure as it is taken care of by the provider itself.

3 Model

As the model shown in Fig. 3, we encourage businesses to deploy their Web Application Server to be hosted on AWS server-less architecture. The architecture consists of following AWS services.

AWS Lamda Functions: This is the component where the functional code of the API resides. In other words, we may say this is the service which provides us with the environment to deploy our stateless function which remains idle until and unless it is triggered by an event.
AWS API Gateway: This service provides us with the functionality to create the triggers which would invoke the functions deployed on AWS Lambda. It creates endpoints for our API which would be specifically used to trigger certain parts of our code.
AWS DynamoDB: This service is used to manage the data in JSON format which is the new industry standard for storing the data and can be easily shared across multiple platforms.

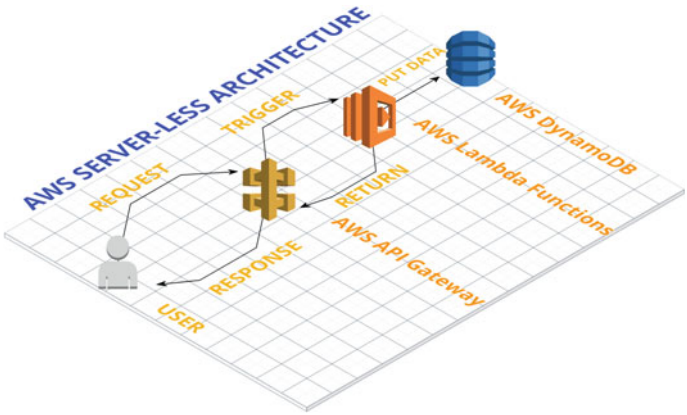


Fig. 3 Server-less architecture

4 Data Gathering and Analysis

4.1 Survey

A survey was conducted within the startup community and general public where we asked them about their familiarity with cloud computing and whether or not they have been using cloud computing for their business purposes. Questions ranging from their use of cloud computing, pricing factors, time since they have been using cloud infrastructure were asked in a manner which provided us a deep understanding of the could migration in real-world scenario.

The survey circulated, consisted of a set of questions where we asked our targeted audience how familiar are they with the term cloud computing. If yes, how have they been using it into their day to day routine? Also whether they have been using it for their personal use or have been using it for commercial purposes.

Their usage of in-house servers was also surveyed which helped us to understand the migration to cloud tools and services. We also asked them about their preferred cloud provider and it was observed that Google Cloud was the most preferred and was used across all the audience. This might be because of the free tools and services that Google provides.

It was also observed that the target audience was very considerate about their expenditure on the use of cloud platforms, and hence, a cloud provider hopping was noticed every 12 months. Since all major cloud providers provide certain free usage quota for at least 12 months.

The most popular reason for the target audience to use cloud computing was found out to be the fact that it provided them with the freedom to work from anywhere, which in today's fast-paced lifestyle is quite important and significantly beneficial.

These questions helped us to understand the shift from conventional computing toward the cloud infrastructure where the combined services of the cloud can be used

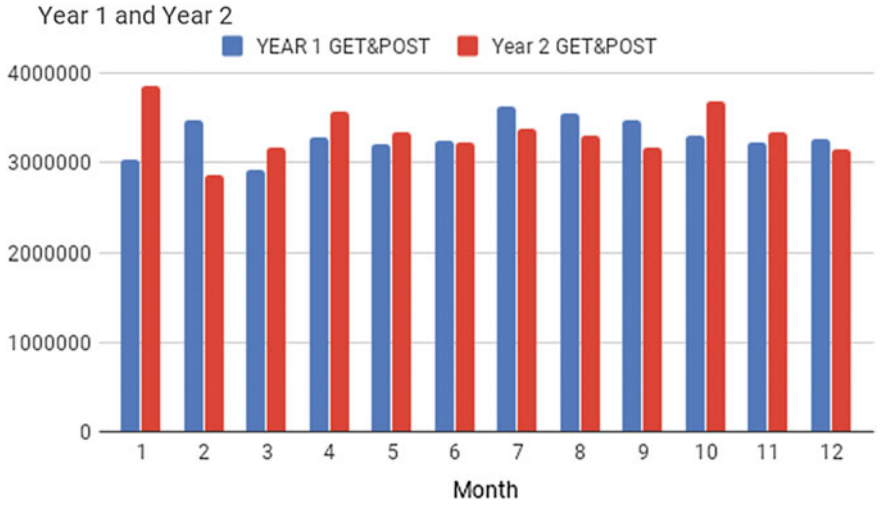


Fig. 4 Yearly hits on openweathermaps API

together to develop different iterations of cloud computing by using different services provided by the cloud providers. Each service has a particular use case which once connected to other services together makes an infrastructure.

This survey was conducted by Armaan Farshori who is the corresponding author.

4.2 Data Scrapping

We consider a hypothetical situation where if this application was deployed on server-less architecture, what could have been the benefits financially. We gathered historical data for HTTP_GET and HTTP_POST requests for an open-source application, namely openweathermap.org for a period of two years. With this data, we would be able to specify how much beneficial it could be for applications to consume the power of server-less architecture. The data collected is illustrated in Fig. 4.

4.3 Findings

It was found out while calculating the cost of deploying the openweathermaps API using AWS server-less architecture. By computing, the amount of bill generated by the HTTP requests and the compute time for the functions which was 0.2 s and using AWS API gateway to serve the API-endpoints. The yearly expenditure was considerably low as shown in (Fig. 5).

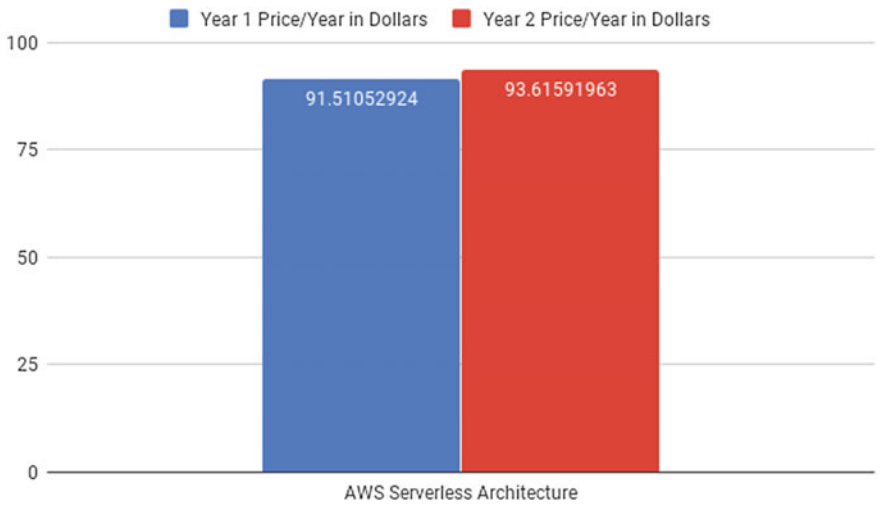


Fig. 5 Yearly price for deploying API on server-less architecture

It was evident that if conventional compute instance was used, then the pricing alone for them would be significantly higher than compared to the server-less architecture on a yearly basis. t2.large is for AWS while n1-standard-2 is for GCP as shown in (Fig. 6).

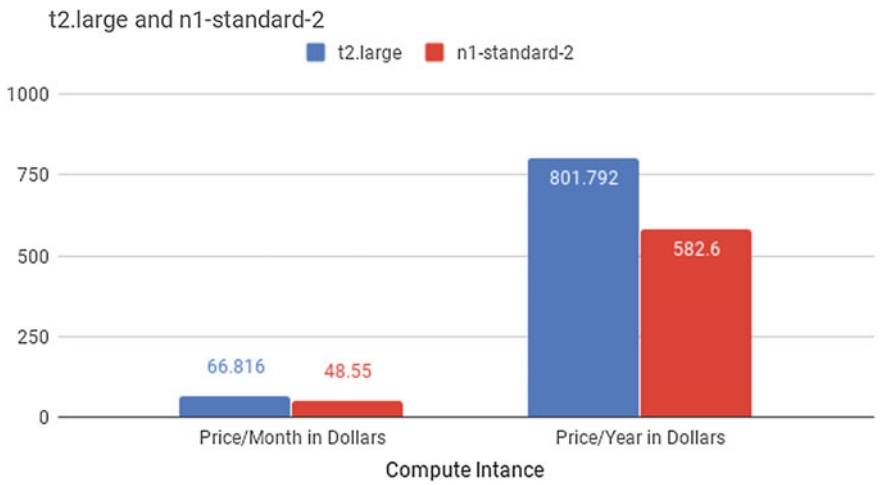


Fig. 6 Price difference of conventional compute instances on AWS and GCP [17, 19]

5 Conclusion and Future Scope

It was evident that server-less architecture had considerable advantages on the financial front as compared to the conventional computation over cloud computing. That is why we would like to encourage businesses to deploy their applications over server-less architecture since it had major economical benefits over conventional cloud computing model.

The future scope of this paper seems very promising as it would provide the cloud administrators to build strategies to counteract sudden shocks of bills generated while using cloud computing. Not only this, it would help to gather analytics to better build tools and services so that with minimal cost better services can be provided.

6 Compliance with Ethical Standards

6.1 Research Involving Human Participants

Ethical approval: All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Committee Members: Dr. Subhranil Som, Dr. Mayank Sharma, Ms. Sonia Saini from Amity Institute of Information Technology, Amity University, Noida.

6.2 Informed Consent

Informed consent: Informed consent was obtained from all individual participants included in the study.

Acknowledgements We would like to express our heartfelt gratitude to the Founder President of Amity Group, Dr. Ashok K. Chauhan, for his keen interest in promoting research in Amity University.

References

1. Chaisiri S, Lee BS, Niyato D (2012) Optimization of resource provisioning cost in cloud computing. IEEE Trans Serv Comput 5(2):164–177
2. Li H, Liu J, Tang G (2011) A pricing algorithm for cloud computing resources. In: 2011 international conference on network computing and information security, vol. 1, IEEE, pp 69–73

3. Martens B, Walterbusch M, Teuteberg F (2012) Costing of cloud computing services: a total cost of ownership approach. In: 2012 45th Hawaii international conference on system sciences, IEEE, pp 1563–1572
4. Simarro JL, Moreno-Vozmediano R, Montero RS, Llorente IM (2011) Dynamic placement of virtual machines for cost optimization in multi-cloud environments. In: 2011 international conference on high performance computing & simulation, IEEE, pp 1–7
5. Baldini I, Castro P, Chang K, Cheng P, Fink S, Ishakian V, Mitchell N, Muthusamy V, Rabbah R, Slominski A, Suter P (2017) Serverless computing: current trends and open problems. In: Research advances in cloud computing, Springer, Singapore, pp 1–20
6. Stanoevska-Slabeva K, Wozniak T (2010) Cloud basics–an introduction to cloud computing. In: Grid and cloud computing, Springer, Berlin, Heidelberg, pp 47–61
7. Marston S, Li Z, Bandyopadhyay S, Zhang J, Ghalsasi A (2011) Cloud computing—the business perspective. Decis Support Syst 51(1):176–189
8. Al-Roomi M, Al-Ebrahim S, Buqrais S, Ahmad I (2013) Cloud computing pricing models: a survey. Int J Grid Distrib Comput 6(5):93–106
9. Aljabre A (2012) Cloud computing for increased business value. Int J Bus Soc Sci 3(1)
10. Mazrekaj A, Shabani I, Sejdiu B (2016) Pricing schemes in cloud computing: an overview. Int J Adv Comput Sci Appl 7(2):80–86
11. Kushida KE, Murray J, Zysman J (2015) Cloud computing: from scarcity to abundance. J Ind, Compet Trade 15(1):5–19
12. Adzic G, Chatley R (2017) Serverless computing: economic and architectural impact. In: Proceedings of the 2017 11th joint meeting on foundations of software engineering, ACM, pp 884–889
13. Anselmi J, Ardagna D, Lui JC, Wierman A, Xu Y, Yang Z (2017) The Economics of the cloud: price competition and congestion. ACM Trans Model Perform Eval Comput Syst 2(4):1–23
14. Yeo CS, Venugopal S, Chu X, Buyya R (2010) Autonomic metered pricing for a utility computing service. Futur Gener Comput Syst 26(8):1368–1380
15. Iyoob I, Zarifoglu E, Dieker AB (2013) Cloud computing operations research. Serv Sci 5(2):88–101
16. Sharma M, Mehra A, Jola H, Kumar A, Misra M, Tiwari V (2010) Scope of cloud computing for SMEs in India. arXiv preprint arXiv:1005.4030
17. Weblink. https://cloud.google.com/pricing/list
18. Weblink. https://aws.amazon.com/api-gateway
19. Weblink. https://aws.amazon.com/ec2/pricing/
20. Weblink. https://aws.amazon.com/lambda/
21. Weblink. https://trends.google.com/trends/explore?q=serverless

Analysis of Success of Digital Marketing Using Vernacular Contents

Agrim Sharma and Neetu Mittal

Abstract The rise of regional languages for digital marketing is increasing continuously. Majority of Indians prefer marketing in local Languages. India is among the fastest-growing smartphone markets in the world. This provides an immense scope of brand development and growth of digital marketing. In this paper, the impact of three languages: English, Hindi and Bengali on digital marketing has been analyzed. The analysis shows that online websites using vernacular languages are preferred and have more impact on the consumer.

Keywords Search engine optimization · Keyword planner tool · Media dark consumer · Digital marketing · Vernacular content

1 Introduction

Digital marketing is expanding nowadays using the use of the latest digital technology. For the usage of products and services. Digital Display Advertising and mobile phones also include to represent these. As the technology develops, the digital marketing or media develop, and they both go side by side. With the India's real estate getting increasingly crowded, it has turned out to be a big mission for developers to differentiate themselves from their competitors. In order to stand out, from developers need to try something unique to gain the upper hand [1]. To promote the digital media with marketing, the business must develop with new strategies that could reach with their customers very easily and understandable. India is a country of villages because 70% lives in villages as a soul of India. This is counted as the second most populated country in the world around 1.3 billion population size [2], and if business needs to be digitalized, it should be in the approach of these villagers also. Promotion, updation and usage of digital media should be in the local or regional languages so that these people easily understand and use these technologies. Tier 2 and tier 3 cities are active

A. Sharma (✉) · N. Mittal
Amity University Uttar Pradesh, Noida, India

N. Mittal
e-mail: nmittal1@amity.edu

H. S. Saini et al. (eds.), *Innovations in Computer Science and Engineering*,
Lecture Notes in Networks and Systems 103,
https://doi.org/10.1007/978-981-15-2043-3_20

on the Internet and most of them using vernacular language to consume [3] contents. A new formulated an innovative vernacular ad strategy to engage with India's next billion internet users. There are several other factors to choose tier-two and three cities such as—(1) There is competitively less competition in tier-two and tier-three cities which is good for businesses establishment [4] and to create an unique identity or acquire leads. (2) Better Ads results due to the high search queries. (3) Good quality leads since the TA is niche and the demand for product is more. With increase in digital regional language consumers [5], the major online marketing companies will be planning to design this website as per the requirement of such consumers. Their main aim will be to make their website user friendly for such [6] consumer. The website will not be in English only rather they will be focused on designing website in multiple languages [7]. Product for sale must be listed in vernacular language. Momspresso Bharat is such a unique website which uses local language to create its website. This paper is organized as follows—Sect. 2 explains the expansion of digital commerce, Sect. 3 discusses about the digital marketing in different languages, and Sect. 4 analyzes the vernacular languages followed by conclusion.

2 Expansion of Digital Commerce Over the Years

The online commerce marketplace was more than Rs. 8000 crores in December 2007, and in the mid of December 2012, it was whooping up to Rs. Forty-seven thousand [8] three hundred forty-nine crores. By December 2013, Indian virtual commerce grew to Rs. Sixty-two thousand nine sixty-seven crores [9]. Table 1 and Fig. 1 show

Table 1 Expected growth of Internet users

S. No.	Year	Number of Internet users (millions)
1	2015	31
2	2016	41
3	2017	46
4	2018	51
5	2019	55
6	2020	59

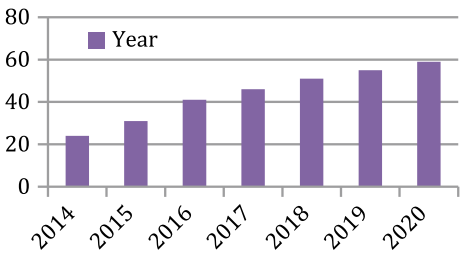


Fig. 1 Chart of expected growth if Internet users

the expected growth of Internet users. In 2015, users were 31 million, in 2016, the figure changes to 41 million, and finally, in 2019, it increases with 55 million. With the growing trend of Internet user, the expected and estimated user will be 59 million.

3 Digital Marketing in Different Languages

Digital Marketing in Non-English Languages

Digital marketing should be in non-English languages. The promotion of digital marketing and the product through digital marketing. One must know the suitable variations to use the language depending upon the location and audience language. Digital marketing providers should take care of the language [10], their audience locality and the area where they want to promote it shown in Fig. 2.

They have to collect the data about the content consumption [11], product buying habits and the usage of particular online channels so that they provide the useful and relevant content to the users [12]. They should focus on the campaigns online based on their different geographical locations to focus their targeted audience.

Urban English and vernacular languages

India is a big country with huge market potential and wide variety in access by consumer. The consumers [13] may be classified into three categories namely—Urban English, vernacular and media dark.

- *Regional Vernacular Content Segment:* This segment targets the regional or local language audience. This type of marketing is done by creating specific offerings for them on traditional platform as well as on a digital platform [14]. There are various brands like Dainik Bhaskar, Sumansa that is for Kannad language by delivering in regional languages through both digital and traditional [15] platforms.
- *Urban English Content Segment:* The Indians or the International consumer may be targeted by offering in separate way.

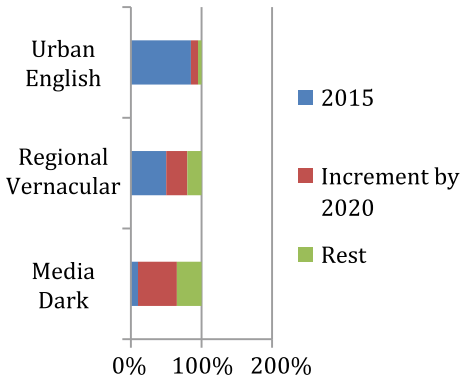


Fig. 2 Digital marketing in different languages

Niche contents and Niche communities

Children, boys and girls engage content material traffic boost over last few years and therefore many marketers are currently trying to create content material [16] on this style. For example, Miss Malini.Com is widely used in Bollywood, style and life-style centric content especially for women.

Various MCNs including Chuchu TV, Appu series and others have emerged with and focused on investor interest: RTL Group owned Canadian media company Broadband TV acquired YoBoHo. The vernacular website [17] called a grim review has some statistics as explained in Fig. 3, Tables 2 and 3.

From the graph, the number of active users is increasing day by day. Most of the user is coming from mobile. 71% of the users are coming from mobile, 27% are from Desktop and rest 1.7 from tablet and television and shown in Fig. 4 and Table 4.

In Fig. 5 and Table 5, line chart of device category and age demographics has been shown, respectively. Regional news consumption [18] is on expansion, more and more people prefer their regional content news because it is relevant to them, and they are likely to be interested in what happened in their regions than that of Delhi or

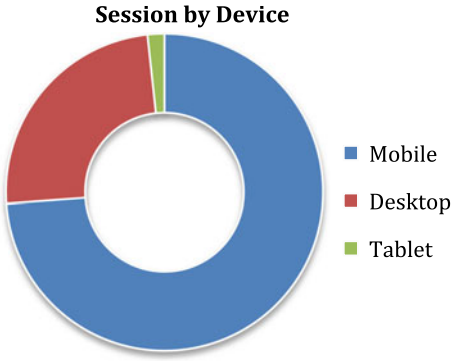


Fig. 3 Chart of session by device

Table 2 Session by device

Mobile (%)	Desktop (%)	Tablet (%)
73.1	24.2	1.7
6.2	5.3	3.3

Table 3 User database with different devices

Date	Mobile	Desktop	Tablet
18-Mar	891	203	36
19-Mar	908	113	28
20-Mar	896	189	22
21-Mar	897	187	30
22-Mar	896	202	32

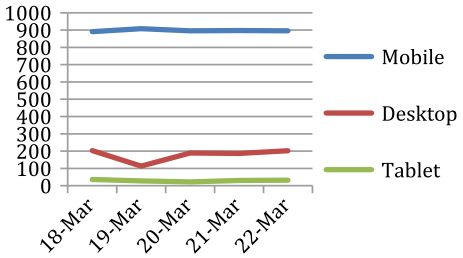


Fig. 4 Line chart of user database with different devices

Table 4 Device category

Device category	User	Session	New user	Bounce rate (%)	Page per session
Total	212	222	206	58.06	1.62
Mobile	152	159	148	52.83	1.65
Desktop	53	56	51	69.64	1.62
Tablet	7	7	7	100	1.0

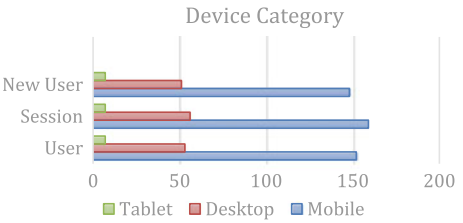


Fig. 5 Line chart of device category

Table 5 Age demographics

Age	User	New user	Bounce rate (%)	Average Ses. duration
	339	327	63.09	00:38
18–24	84	83	63.33	00:50
25–24	186	185	65.05	00:35
35–44	30	29	57.58	00:35
45+	33	30	52.28	00:53

any other major cities [19]. This has given upward thrust to numerous digital media agencies centered on key nearby and vernacular markets. A newspaper like Dainik Bhaskar is largest regional digital news player in India with two-billion-page view.

- OneIndia—Half of its base from tier-two and tier-three cities like Haridwar, Mathura, etc.
- DailyHunt—three-billion-page view every month with 95% of its traffic from regional content.

- Vikant—1.5 lakhs unique page views every day and 200 million pages view every month.

4 Analysis of Digital Marketing with Vernacular Languages

Digital marketing in vernacular language is the innovation in today's world. The Internet users of local or regional language of India increase day by day, and it grows to 536 million by 2021 as per the analysis in comparison with 199 million English language users. One of the great examples is that an Indian YouTube channel is going to be the No. 1 most subscribed channel in the world defeating Pewdiepie.

Use of online content or online traffic increasers is based on their content properties in vernacular language whether it may be YouTube channel, Blog post, FB post, etc. For example, a popular recipe Blog post by Nisha Madhulika becomes much popular among the ladies as its content is also available in Hindi language also. It manages to get more than 5.3 L readers, only through the single post. To encash the popularity of vernacular contents, Google also offers a customized language keyboard, which helps to type customers' query in the language chosen by customers. To promote the business and growth of business in vernacular language, almost all online platforms provide the facility to language and content can be best optimized from a website. The keywords can also be used on Google Adword to run paid campaign which gives the site at the topmost place on Google.

A certain keyword has a very low competition when typed in Hindi, and the amount that we have to pay for that keyword is very less. This will directly go to the costumer who is searching in Hindi and the target audience. The small or big business is bound to face tough competition. As we compete with companies from the globe over, vernacular content could easily become the 'X'-factor that may connect us to user directly. After all, a Bengali person will always prefer to read Bengali local articles than those written in English. This is also the reason why digital marketing in vernacular language is increasing. Digital marketing using vernacular language now becomes vast and grand thing in the digital marketing process. These techniques will help to build an audience more awareness, more loyalty, more revenue and sales. Global and content-based companies like Quora, Daily hunt, 22 languages on vernacular by introducing services in Hindi on their respective platforms. In India, half of the population prefers their local languages for marketing purposes. This population rise as the number of Internet users are growing and the analysis of digital marketing with different languages shown in Fig. 6 and Table 6. To attract the new generation customers. The online digital marketing website should include vernacular contents. The availability of low-cost smartphones and Internet has further increased the awareness in rural area consumers in India. The growth in online transactions is due to various such factors: Excess of Internet at low cost, ease and offers by digital transactions and encouragement of online transactions by regulating authority.

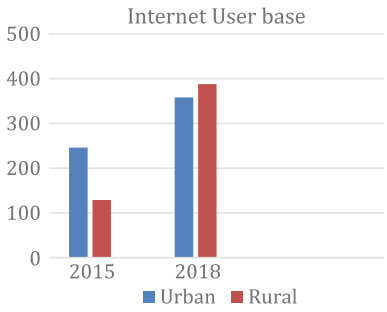


Fig. 6 Internet usage based on urban and rural area

Table 6 Analysis of digital marketing with different languages

Keywords (by relevance)	Average monthly searches	Competition	Suggested bid
पासपोर्ट	8100	Low	Rs. 0.4
एप्प	590	Low	Rs. 10.23
वेबसाइट बनाने की विधि	320	Low	Rs. 2.26
Create new website for free	880	Medium	Rs. 123.12
New website in Google free	590	Medium	Rs. 91.83
Website banane ka tarika	320	low	Rs. 8.07

As per an estimate, the Indians consume about 7% of their time on English video contents, while rest 93% is consumed in vernacular contents. The choice of Indian customers toward regional and vernacular languages is continuously increasing with 93% of the time being consumed on regional languages shown in Fig. 7 and Table 7. The English is being replaced by vernacular languages for Internet access by large

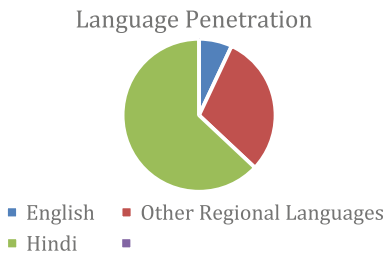


Fig. 7 Regional language content of non-urban areas

Table 7 Internet user base

Year	Urban	Rural
2015	246	129
2018	358	328

number of people. The person need not touch the device and can talk directly, there it is far user friendly. Therefore, voice search is highly powerful. Further, for Internet surfing, the most preferred language due to voice search is Hindi. The local language and Devanagari scripts are preferred by large number of advertisers to brand their products on online platform. Another important aspect of the future of vernacular content is the ease of translating content in all languages, thanks to Google Translate and propitiatory tools. The process could be automated to some measure, and a person who knows the language and the context of the piece of content could easily deal with the nuances of the piece. Vernacular content is an important aspect of social media marketing. All major social media channels are available in several languages. In addition, the one-click translation provided by Google Translate in all browsers is also an important development that significantly removes the issues of language barrier. Skype now offers live in-call translation that further adds a much-needed incentive for working on vernacular content and more focused localization.

5 Conclusion

The use of digital marketing is increasing day by day. Almost everything is linked with online, and promotion is also done digitally. In India, marketing may be beneficial if it is carried out in local languages, as India is a country having different languages. In this paper, the effect of local languages and use of vernacular content has been analyzed. Results show that as the use of Internet growing frequently, the consumer preferably wants their local language and better understandability of promotion.

References

1. Gangeshwer DK (2013) E-commerce or internet marketing: a business review from Indian context". Int J u- e-Serv, Sci Technol 6(6):187–192
2. Reinartz WJ, Kumar V (2003) The impact of customer relationship characteristics on profitable lifetime duration. J Market 67(1):77–79
3. Sheth JN, Sharma A (2005) International e-marketing: opportunities and issues. Int Mark Rev 22(6):611–622
4. Barasch A, Berger J (2014) Broadcasting and narrowcasting: how audience size affects what people share. J Mark Res 51(3):286–299
5. Smith KT Longitudinal study of digital marketing strategies targeting millennials
6. Karakaya F, Charlton TE (2001) Electronic commerce: current and future practices. Manag Financ 27(7):42–53
7. Devi CS, Anita M (2013) E marketing challenges and opportunities, pp 96—105. Retrieved from www.ijsrm.in
8. Boudreau M-C, Watson RT (2006) Internet Advert Strat Alignment Internet Res 16:23–37
9. Dotson MJ, Hyatt EM (2005) Major influence factors in children's consumer socialisation. J Consum Market 22(1):35–42
10. http://www.businessworld.in/article/The-Role-Of-Vernacular-Content-In-Digital-Marketing/03-11-2018-163381/

11. https://nishamadhulika.com/2240-spicy_matar_namkeen.html
12. https://bestmediainfo.com/2018/11/digital-growth-unstoppable-vernacular-videos-and-content-integration-to-lead-advertising-shamsuddin-jasani-isobar/
13. https://www.adgully.com/vernacular-content-to-lead-digital-marketing-growth-61843.html
14. https://analytics.google.com/analytics/web/?authuser=1#/report/visitors-demographics-overview/a105414775w157396384p187328123
15. Anoop TS (2014) Digital marketing communication mix. www.linkedin.com/20141201185
16. Chathurvedula S (2015) Indian ecommerce sales to reach $55 billion by 2018
17. www.livemint.com>customer>research
18. Murthy S (2016) Always keep your customers close and your loyalist closer
19. www. economictimes.indiatimes.com > collections > digital marketing
20. Chaffey D, Smith P (2008) E-marketing excellence: planning and optimizing your digital marketing, Routledge. 4th edn., pp 580–593

Image Enhancement Filter

Alok Nath Jha and Siddarth Pratap Singh

Abstract Digital image processing begins with the acquisition of image which is a start point for further analysis. Whenever an imaging camera takes a picture of some object, more often than not, that particular picture is unusable for the intended purposes directly. Noise in an image is a common phenomenon and is affecting the quality of the image hugely as there is significant amount of deviation in the concentration of pixels of the image. Disturbances and variation in image intensity largely contribute to noising in these images. Image filters are very useful in emphasizing edges or the boundaries between objects or parts of objects in images. Filters provide greater support in the visual interpretation of images. This paper reviews types of noises present in images. It also discusses ways for reducing the quantity of noise and thereby increasing the quality of an image. This paper discusses various filtering techniques and finally how to jointly remove Gaussian and salt-and-pepper noise.

Keywords Filters · Gaussian filters · Salt-and-pepper noise · Quality

1 Introduction

Several methods have been developed to eliminate unwanted markings on the image. One of the important conditions for noise reduction is to soften these markers with high frequency values while maintaining valuable information. Standard median filter is helpful in the elimination of salt-and-pepper noise in image, which is a special case of impulse noise, but the standard median filter does not work effectively at high noise rates. Many studies have been conducted aiming to achieve success in high noise rates. Using a blurred pass median filter as well as salt and pepper, images with around 30% (±10%) intensity noise close to standard median filtering

A. N. Jha (✉) · S. P. Singh
Amity Institute of Information Technology, Amity University, Noida, Uttar Pradesh, India
e-mail: alok.jha3@student.amity.edu

S. P. Singh
e-mail: siddarth.singh@student.amity.edu

H. S. Saini et al. (eds.), *Innovations in Computer Science and Engineering*,
Lecture Notes in Networks and Systems 103,
https://doi.org/10.1007/978-981-15-2043-3_21

results were obtained. In the area of noise reduction or rather whole image processing domain, contrast enhancement has a major role to play. At the end, on the modified histogram, the traditional histogram equalization is applied to produce the mapping function [1]. Convolution is a technique or type of linear image processing. In this technique, the information is stored as well as has an encoding in its spatial domain [2]. This paper reviews different types of noises. Firstly, the transformation of the image to its frequency distribution takes place. Secondly, the black box output is in the form of transformation and not the image. Finally, it is converted into an image after performing inverse transformation which is seen in the spatial domain. Transformation is of primarily four kinds namely (i) Fourier series, (ii) Fourier transformation, (iii) Laplace transform, and (iv) Z-transform. This paper reviews filtering techniques namely average, median, weiner, outlier, mean, and the Gaussian filters [3].

2 Noise in Images

Whenever a picture is taken digitally, there is certainty that some kind of unwanted signals is present. That unwanted signal is referred to as noise. Noise in an image diminishes the color content and brightness of an image which in turn make the image difficult to perceive. There exist various types of noise but we will discuss Gaussian and salt-and-pepper noise.

2.1 Salt-and-Pepper Noise

It is also called impulsive noise. Salt-and-pepper noise is that noise which causes certain disturbances in the signal of an image. It is typically a sharp noise which occurs when there is a type of scattering of black and white pixels in white and black regions, respectively, and thinly distributed throughout the image as shown in Fig. 1 [2].

2.2 Gaussian Noise

The Gaussian noise is inscribed in any digital image while it is being acquired. The image with Gaussian noise is in Fig. 2.

It is a statistical and analytical noise because of its probability distribution function being equal to normal distribution which is inherently the Gaussian distribution function described in Eq. 1.

Fig. 1 Image with salt-and-pepper noise

$$P(x) = \frac{1}{\sigma\sqrt{2\pi}} \mathrm{e} \frac{-(z-\mu)\hat{}2}{2\sigma\hat{}2} \tag{1}$$

Equation describes probability distribution function p having Gaussian random variable x [2].

3 Image Filtering

For the modification and enhancement of the image, it is essential to filter the image. Different types of filters are used to perform the same operation. Image filters are used to carry out operations related to edge sharpening and enhancement as well as smoothing. Filters deal with small pixels of an image. By the help of fitters, one can change the color and contrast of the image which eventually will optimize the image in greater detail. Different types of prominent filters have been discussed in this section [4].

Pictures are frequently debased by irregular varieties in intensity values, called noise. Impulse, Gaussian, and salt-and-pepper noise are some of them. Irregular events of white as well as black intensity values are contained in salt and pepper.

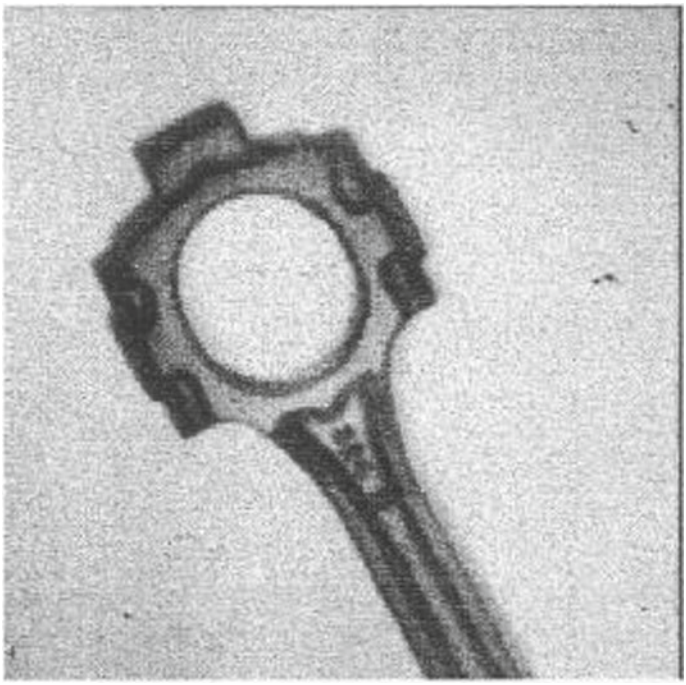


Fig. 2 Image with Gaussian noise

Impulse contains arbitrary instances of white intensity values. Gaussian comprises of irregular instances of white intensity attributes [5]. Filters are time dependent and further grouped into two parts. Those filters which vary with time are linear filters and those do not are termed as nonlinear filters. The linear filters consume less time than nonlinear filters but eventually are unable to preserve edges. In contrast, the nonlinear filters do preserve edges, but have greater processing time than linear filters (Fig. 3).

3.1 Mean Filters

It is referred to as the filter in which there is a local averaging of all the values of the local neighborhood thus replacing the current pixel value [6] (Fig. 4).

$$G[1, m] = \frac{1}{B} \sum_{(i,j)} f(i, j) \tag{2}$$

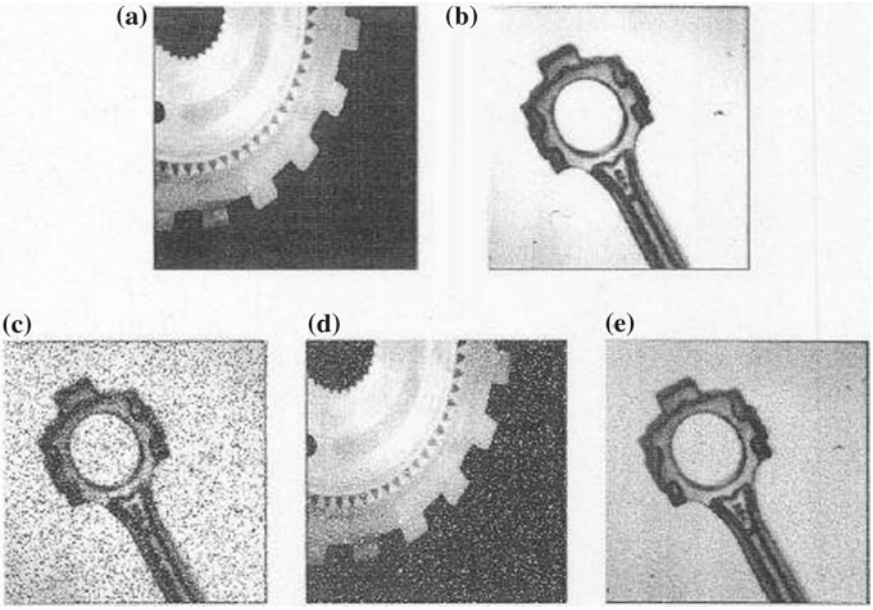


Fig. 3 Figure 3 is an example of images corrupted by salt and pepper, impulse, and Gaussian noise. **a** and **b** show original images. **c** shows salt-and-pepper noise. **d** is impulse noise, and finally **e** Gaussian noise

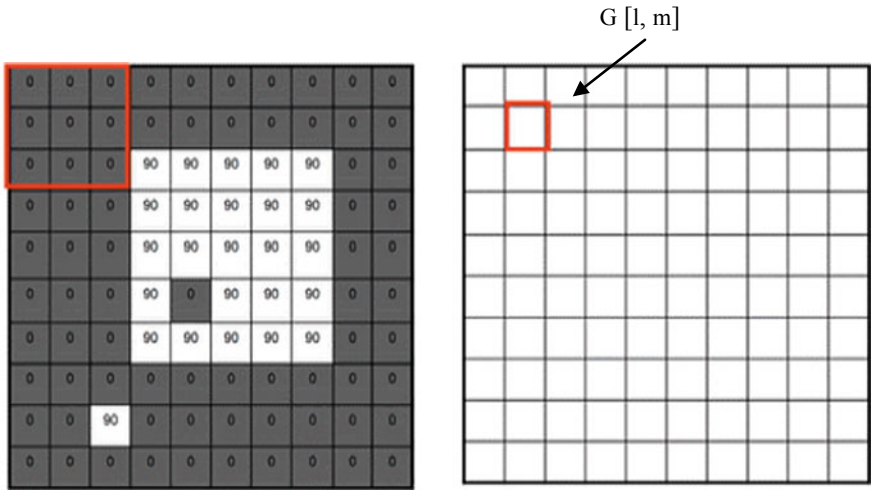


Fig. 4 Shows an example showcasing the mean filtering using 3 × 3 neighborhood

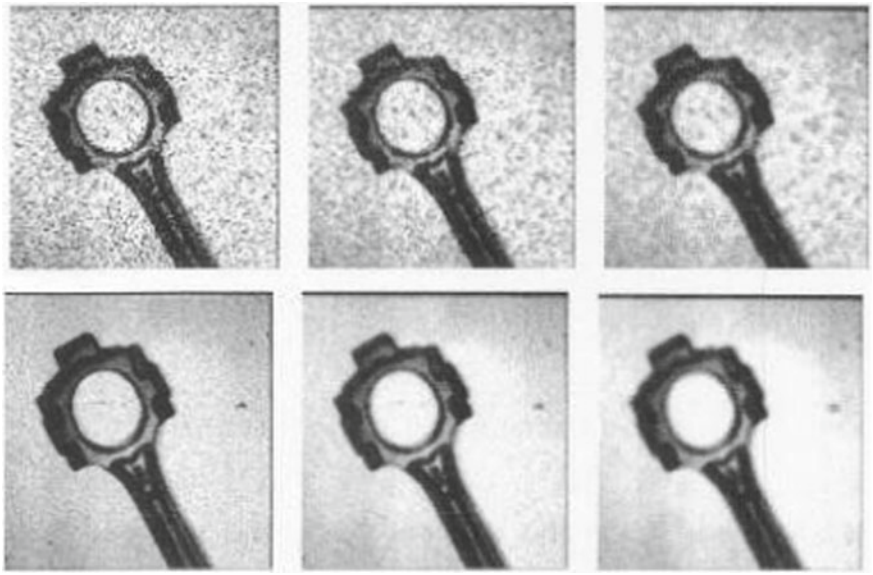


Fig. 5 Shows the results mean filter on the noisy and corrupted images of Figs. 1 and 2, respectively

Here, f is the corrupted image and $B =$ total number of pixels in the neighborhood. i and j belong to row and column coordinates of some neighborhood. $G\,[l, m]$ is the filtered image [6] (Fig. 5).

3.2 Wiener Filter

We see that there is some kind of blurring in the image due to linear motion or unfocussed optics on the image. For overcoming the problem of blur as well as noise in images, wiener filter is used. In this case, this filter uses Fourier transformation to remove the blur and mean squaring method to remove the noise. One important feature of wiener filter is that it preserves more features of the digital image than linear filter but at the expense of longer processing time.

Inverse filtering is used to recuperate the image with blurredness due to the fact that this image is susceptible to additive noise. In order to separate the image and its noise into finer details which was achieved during convolution process. Thus, the equation for the wiener filter is given by Eq. 3 [4, 6].

$$A[1, m] = \frac{g * (l, m) B_{\mathrm{ii}}(l, m)}{(g(l, m))^2 B_{\mathrm{ii}}(l, m) + \mathrm{B_{ij}}(l, m)} \tag{3}$$

Here, B_{ii} (l, m) and B_{jj} (l, m) are the original image and additive noise, respectively. g (l, m) is termed as blurring filter.

3.3 Gaussian Filters

Gaussian filter is a type of linear smoothing filters. Here, the shape of a Gaussian function decides the weights to be taken. Normal distribution noise can easily be removed by Gaussian filtering techniques [5] (Fig. 6).

Zero-mean Gaussian function in 1D is:

$$S(b) = \mathrm{e} - \frac{b^2}{2\sigma^2} \tag{4}$$

Here, σ is the Gaussian width and b is the single-dimensional domain. Zero-mean discrete Gaussian function for 2D is:

$$S[n, m] = \mathrm{e} - \frac{\left(n^2 + m^2\right)}{2\sigma^2} \tag{5}$$

Here, σ is the Gaussian width and $n * m$ is two dimensions.

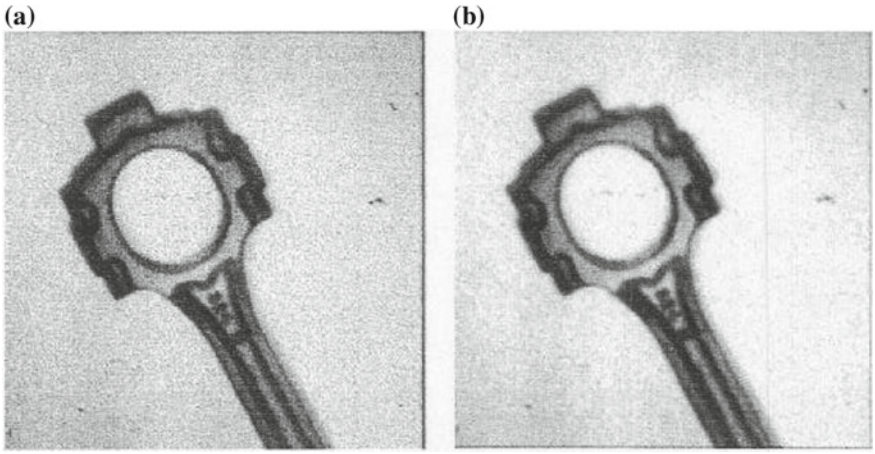


Fig. 6 **a** and **b** show the results of smoothing using the 7 × 7 Gaussian mask. Figure **a** is original image corrupted by Gaussian noise. Figure **b** is smoothed image

3.4 Median Filters

Major concern attributed to mean filtering techniques is that it often blurs discontinuities. Another optimized approach could be to find out the median of the gray values of pixels around a particular pixel and then replace its intensity value with the median. This filtering technique is called median filtering [1, 6]. Median filters very efficiently remove salt and pepper along with impulse. Nevertheless, it retains image details because they are independent of values which are dissimilar from others in the neighborhood. It works in contiguous windows. But the whole system and processes now does not belong to just a weighted sum [7], for example, taking a 3 × 3 window, finding out the median of the pixels in each and every window circled around [*a*, *b*] (Figs. 7 and 8).

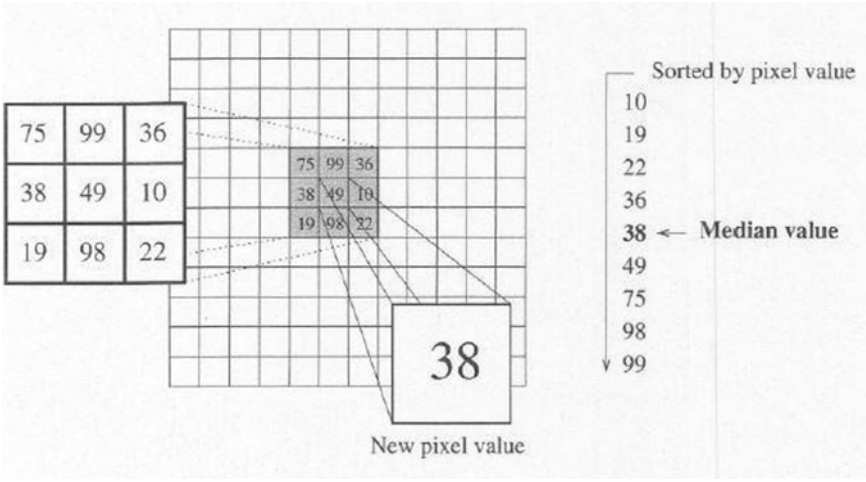


Fig. 7 Is an example showcasing median filtering with 3 × 3 neighborhood

Fig. 8 Shows the results of a 3 × 3 median filter on the corrupted images of Fig. 2

3.5 Outlier Filtering

As the name suggests, outlier filtering is the type of filtering which removes the outside noise. This process is carried out by comparing each and every pixel to 8 other pixels around one particular pixel. Before comparing these pixels, a certain threshold and parameters are set which a pixel need to cross to become a noisy pixel and thus be eligible for removal. If such kind of pixel is discovered, then that pixel is restored by setting the neighboring average of pixels in that place [7].

4 Removing Gaussian and Salt-and-Pepper Noise

Any corrupted images with different types of noises particularly Gaussian and salt-and-pepper noise can be jointly removed by a single process. Firstly, we take the corrupted image and do a portioning. Therefore, the image is separated into smaller parts depending upon the intensity values and the brightness of the image. Thereafter, the noise for Gaussian distribution function is computed by the help of Eq. 1. Then, the median for the pixels of the image will be computed by the following Formula [8].

$$X[a, b] = \text{median}\{Y[c, d], \text{ where } c, d \in w\} \tag{6}$$

With the help of both these equations, the pixels in the neighborhood of each pixel are deeply analyzed. Finally, the pixels which contain some noise or are corrupted are removed. Thus, at the end, we get an enhanced and clear image at the end.

5 Conclusion

For a nice visual interpretation of any image, it is important that the quality of an image is enhanced. Best way to do it is through noise removal filters. Effective de-noising can be executed by filtering out the unnecessary noise present in the image. This paper analyzes all the prominent filters used for effective de-noising. It also reviews their performances with different windows along with their drawbacks. It is also seen that it can remove impulse noise extremely well and Gaussian and speckle noise to a satisfactory level. The paper also reviews how Gaussian filter is very effective in de-noising images extracted from normal distribution. At the same time, it also reviews how to jointly remove Gaussian and salt-and-pepper noise effectively.

References

1. Malini S, Moni RS (2015) Image de-noising using multiresolution analysis and nonlinear filtering. In: 2015 international conference on advances in computing and communications, Kochi, pp 388–390
2. Dhruv B, Mittal N, Modi M (2017) Analysis of different filters for noise reduction in images. In: 2017 recent developments in control, automation & power engineering, Noida, pp 410–415
3. https://www.cs.bgu.ac.il
4. Tasnim T, Shuvo MMH, Hasan S (2017) Study of speckle noise reduction from ultrasound b-mode images using different filtering techniques. In: 2017 4th international conference on advances in electrical engineering, Dhaka, pp 229–234
5. http://www.cse.usf.edu/~r1k/MachineVisionBook/MachineVision.files/MachineVision_Chapter4.pdf
6. Podder P, Hasan MM (2016) A meta study of reduction of speckle noise adopting different filtering techniques. In: 2016 3rd international conference on electrical engineering and information communication technology (ICEEICT), Dhaka, pp 1–6
7. Panda CS, Patnaik S (2009) Filtering and performance evaluation for restoration of grayscale image corrupted by salt & pepper noise using low pass filtering schemes. In: 2009 second international conference on emerging trends in engineering and technology, ICETET, Nagpur, pp 940–945
8. Madhura J, Babu DRR (2017) An effective hybrid filter for the removal of gaussian-impulsive noise in computed tomography images. In: 2017 international conference on advances in computing, communications and informatics (ICACCI), Karnataka, pp 1815–1820
9. Arora G, Dubey AK, Jaffery ZA (2018) Design of Dmey Wavelet Gaussian Filter (DWGF) for de-noising of skin lesion images. In: 2018 international conference on smart innovations in communications and computational sciences, Indore, pp 475–484

Bharatanatyam Hand Mudra Classification Using SVM Classifier with HOG Feature Extraction

K. S. Varsha and Maya L. Pai

Abstract Communication is the ultimate of man's search for conveying his ideas, emotions, and concepts. Dance is one of the media of communication through which dancers share notion of feelings, with the spectators through gestures, i.e., mudra. Gesture recognition propagates a concept without verbal speech or listening, and in dance recognition, the notion is transferred through various dance poses and actions. This activity in a way really paves way to enhance Indian Sign Language. This study focuses to solve the mudra resemblance in Bharatanatyam through a new system developed with image processing and classification technique using histogram of oriented gradient (HOG) feature extraction techniques and support vector machine (SVM) classifier. SVM classifies the features of HOG into mudras as text labels. Popular feature vectors such as scale-invariant feature transform (SIFT), speed up robust feature (SURF), and local binary pattern (LBP) are hardened against HOG for accuracy and speediness, and this innovative proposed concept is useful for online dance learners.

Keywords Dance mudra · Histogram of oriented gradients (HOG) · Support vector machine classifier (SVM)

1 Introduction

Gestures reproduce ideas powerfully through non-vocal communication among human beings. It is one of the most effectual and implemented modes of message transmission even while we normally speak in our daily life.

"Mudra" is types of gesture, which are commonly used as a supplementary way of communication for the productive expression of the ideas. Bharatanatyam, renowned Indian dance form, is performed by classical male and female dancers all around the world. This ancient dance form is originated from Thanjavur district of Tamil Nadu in India. Bharatanatyam is performed to classical Carnatic music along with the bodily kinetic dance movements and subtle facial expressions. Moreover, the entire

K. S. Varsha (✉) · M. L. Pai
Department of Computer Science & IT, Amrita Vishwa Vidyapeetham University, Kochi, India

H. S. Saini et al. (eds.), *Innovations in Computer Science and Engineering*,
Lecture Notes in Networks and Systems 103,
https://doi.org/10.1007/978-981-15-2043-3_22

Fig. 1 Hand mudras of Bharatanatyam

body reacts and reproduces the emotions evoking the gentle feelings of the spectators resulting the ultimate relish, the "rasa."

The Natyashastra mentions 28 single-hand mudras, like "Mayooram" denote peacock or birds in general. Perhaps, the aesthetic and graceful hand gesture of Bharatanatyam is more intense expressions of higher meanings rather than the conventional dance forms. Hence, we focus on one set of hand gestures, "AsamyaktaHastas" (single hand). This study is an endeavor to solve the issue related to the overlaid mudras or similarities of hand gestures during performances. It is a cost-effective and more flexible method to comprehend in today's dynamic and tentative economic condition of the country. A few hand mudras are publicized in Fig. 1 [1].

Bailey, H. et al. focus on the essential connection of e-science technology with observe-led research within the dance. Especially it uses some significant interpretations from the e-Dance application, and it was a two-year implementation purely depends upon the various research aspects of choreography, human–computer intercommunication, video conferencing, and nonlinear explanations for recording [2, 3]. The salient concept of the e-Dance application in the research is the innovative and basic allegiance with e-science and especially AG [4].

The conventional segmentation methods like thresholding [5], color clustering [6], and edge [7], due to occlusions of hand gestures during the capturing time while dancing, fail to put forth the whole characteristic features of the hand mudras as shown in Fig. 2. The Bharatanatyam mudras are signified with the assistance of specific feature extraction models in writing. These are the three features used here: "Scale-Invariant Feature Transform" (SIFT), "Speed up Robust Feature" (SURF), and "Local Binary Pattern" (LBP). These highlights on pictures of move mudras are analyzed from self-caught information. SVM is the classifier of the highlights to recognize a mudra. Generally, in India, all these 31 mudras are the base point for every other classical dance form. Thus, Bharatanatyam classification is accepted even in other dance forms.

Bharatanatyam dance forms use the most strenuous human gestures in order to represent it in digital format. The core point is to develop a new concept to represent

Fig. 2 Segmentation methods

Bharatanatyam dance form on a digital platform. The most complex task is the feature extraction as the images are colorful and closeness in fingers. This is shown in Fig. 2. The important drawback of regular segmentation models like edge detection and thresholding is that it neglects to portray the correct shapes as in the essential pictures. This can be clearly recognized from Fig. 2 for a Bharatanatya hand gesture. Active contours are the highly vibrant segmentation models in recent times. Various methods have been proposed and brought out in literature [8, 9]. But the fundamental model discovered several drawbacks like central position, illumination of the mask, and iteration numbers. A reflective effect on extracting the proper segments has been produced by the listening active contour methods with more spatial information [10]. There are researchers who work on skin filtering method for division of various hand gestures. Hand gestures are extracted from the background with the help of separating the skin-hued pixels from the non-skin-hued pixels by the discussed method [11–16]. D Vector proposed a model of real-time hand tracking system using SSD, and it is mainly based on hand segmentation methods [17]. An adaptive boost algorithm introduced by Fang could not only recognize and reveal single hand but also the overlapped ones [18]. There are different external methods like data glove and color glove used by researchers [19–21]. Chung-wei put forth a moving object distinction like pedestrians, bicycle, cars, and bicycle with the help of a neighborhood shape and wavelet change HOG highlights with progressive SVM characterization [22]. In recent years, HOG with SVM classification helped in vehicle detection [23].

In this research work, we categorize Bharatanatyam mudras, significantly concentrating the resemblance of mudras with various feature extraction methods, and this study mainly follows four features that are obtained from hand gesture images produced. These features help in the classification with SVM.

2 Data and Methods

2.1 Data

The hand mudras are collected from Kerala Kalamandalam Cheruthuruthi under the permission of Dr. T. K. Narayanan (Vice chancellor, Kerala Kalamandalam). Data are collected under a non-uniform background with different enlightenment and from different age groups. Images collected from the five dancers (Bharatanatyam students Kalamandalam) who performed 31 Asamyukta Hasta mudras in dance at different timings are used for training dataset. The dataset was collected from two dancers who performed three samples for each mudra at different times for testing. In this study, we used static hand gesture recognition.

2.2 Methods

Feature Extraction

Feature extraction starts with a real arrangement of estimated information and makes the subsequent qualities which are real and non-excess, empowering the upcoming learning and theory steps, and at times aids a powerful human clarification [24]. Feature extraction is really a dimensionality reduction, and here in this analysis, the main focus is on the four feature extraction methods such as SURF, LBP, LDP, and HOG.

Multiclass SVM

In supervised learning, SVM is an important classification technique; it produces the binary illustration of data for classification. The basic SVM classifies the data by foretelling a hyper-plane between information during preparing stage and it can deal with just two class issues. In multiclass, SVM can handle more than two classes, and this study mainly focuses on 31 classes of mudra. For a training set $(p_1, q_1) \ldots (p_n, q_n)$ with labels q_j in $[1 \ldots z]$, it finds the solution of the following optimization problem during training.

$$\min \frac{1}{2} \sum_{i=1\ldots z} wj * wj + \frac{C}{n} \sum_{i=1\ldots n} \xi i \tag{1}$$

Histogram-oriented gradient Descriptor

HOG is another heavy feature extraction process for images so produced. Dense means it extracts a region of interest in the image. In this study, HOG method used to extract features of mudra dataset and classify the mudra according to the features extracted from the image.

3 Methodology

The dataset contains 31 × 5 images of Bharatanatyam mudra captured from live dancers with phone camera. These 155 images are going through the segmentation stage; segmentation helps to retrieve accurate features from the given image set. There exist various image segmentation techniques, and Otsu method is one of the most successful methods for image thresholding because of its elementary calculation. Figure 3 demonstrates the work process diagram of the proposed methodology.

Feature extraction section is started to haul out features for the 155 mudras. Each mudra is identified using class labels, and in this study, we are using names of Bharatanatyam hand mudra as class label for recognizing data with particular class. These features are used as the input for SVM classification, and it mainly use 31 classes of data. SVM classification result depends on the kernel function used for text classification. Kernel is to acquire data as input and convert it into the necessary form. Different SVM methods use different types of kernel functions; among all in this study, we are testing four different kernel functions, and polynomial kernel shows the best result shown in Table 1.

The whole data pack is separated into three subsets: 70% of data is used for training; 15% is used for validation; and 15% data used for testing. Testing SVM by utilizing a similar arrangement of mudra brought about a 100 rate equivalent to the class, and class labelsare"Pataka, Tripataka, Ardhapataka, Kartarimukha, Mayura, Ardhachandra, Arala, Shukatunda, Mushthi, Shikhara, Kapitham, Kadagamugam, Soochi, Chandrakala, Pathmakosham, Sarpashirsha, mrikasheersham, Simhamukha, Lanngum, Alapthmam, Baanam, Chathuram, Bramaram, Hamsasyam, Hamsapaksham, Smmthmsham, Mukulam, Thamrachoodam, Thrishoolam, ArdhaSoochi, Chandrakala" [25]. Confusion matrix is calculated for each feature descriptor. Confusion matrix of HOG is shown in Fig. 4.

The confusion matrix provides the coordinating measurements inside both the prepared and the testing data. Training was only given once along with the live captured dance images, whereas testing is on both the live images and Web images dataset. The confusion matrix produces 74% closeness between the dance gestures of inconspicuous information by SVM. The meaning of "Mudra Recognition Frequency (MRF)" is the amount of viably perceived mudras to mean amount of mudras used for partition. "MRF" is improvised with an expansion in the preparation vector from a solitary mudra set to two mudra sets. This set training for a two-mudra set includes live images, though the order of inconspicuous mudras is improved by 14%. For this situation, the MRF is at long last around 88%. The "hand shapes," "hand colors,"

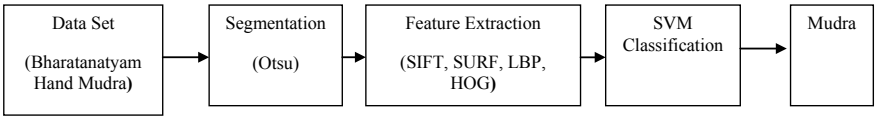


Fig. 3 Proposed model

Table 1 SVM result with kernel function

Kernel function	Features	SVM result
Polynomial kernel	LBP	80.10
	SIFT	70.31
	SURF	79.60
	HOG	92.33
Gaussian kernel	LBP	50.00
	SIFT	45.82
	SURF	46.52
	HOG	70.21
RBF	LBP	61.02
	SIFT	55.82
	SURF	57.62
	HOG	76.33
Sigmoid	LBP	78.11
	SIFT	68.01
	SURF	68.91
	HOG	80.21

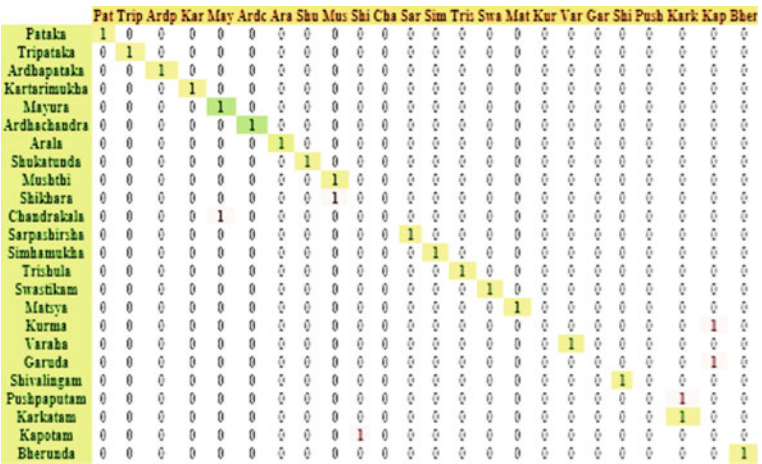


Fig. 4 Confusion matrix (HOG)

"hand orientations," and "hand texturensmis" are classified between similar mudras. SIFT is the next better feature vector with a maximum MRF. In this consideration, for a similar preparing and testing vectors, SIFT has a "MRF" of 95%. Nevertheless, the MRF is lower to 71% for various getting ready and testing tests. If there should arise an occurrence of different preparing vectors, an expansion in MRF by 8% is appeared with the assistance of SIFT and the SVM classifier enlists a normal "MRF" of 91%

with "HOG" highlight vector and the overall component vectors so-made lower than 81% coordinating. All the dataset is also classified with KNN classification with different K values, and optimized result getting for $K = 5$. The proposed work was simulated and implemented in MATLAB version R2015b.

4 Result

By accepting the method of segmentation, depending on Otsu method, the mudra data set has been effectively segmented, and later on used for feature extraction. In this study, using four different feature extraction methods, SVM classification results mainly depend on the kernel function used. The proposed model results are comparatively systematic; it produces best result practically well during the period of testing. The performance measures are shown in Table 2. The present SVM with HOG model performs relatively better than KNN classification with four feature vectors which are shown in bold in Table 2 and graphical representation of accuracy measures shown in Fig. 5.

Table 2 Classification result

Feature descriptor	KNN	SVM
LBP	71.31	80.10
SIFT	65.78	70.31
SURF	72.12	79.60
HOG	85.61	92.33

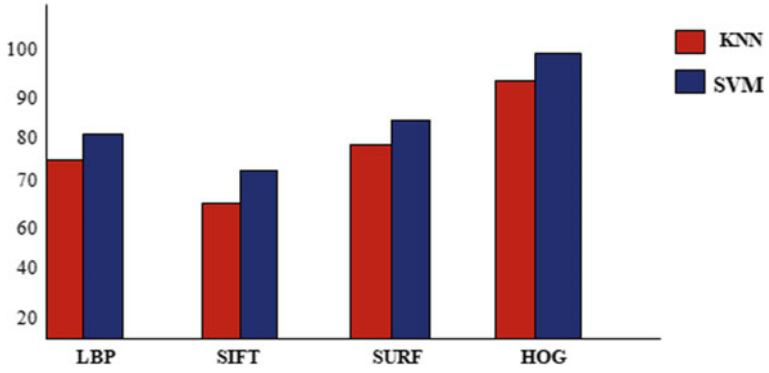


Fig. 5 Graphical representation of accuracy measure

5 Conclusion and Future Work

Non-verbal communication system uses gestures with hands and face expression for which the art of dance is perfect example. This study attempts to find resemblance between Bharatanatyam mudra based on image processing model. For this study, four feature extraction methods are compared. These highlights grouped by multi-class support vector machine concerning a specific element are estimated. The results indicate that HOG + SVM gives better accuracy. This model of mudra acknowledgment will help update the learning furthest reaches of a first time understudy. This study is an attempt to provide future direction to researchers which could lead to the improvement of ISL recognition. In future, precision and accuracy of gesture recognition can be improved through a combination of different approaches applied on a broad data base of gesture. This set of study would greatly help in the upliftment of people with hearing and speaking difficulties.

Acknowledgements The authors wish to thank all the members of Kerala Kalamandalam Cheruthuruthi. We would like to thank Dr. T. K. Narayanan (Vice chancellor, Kerala Kalamandalam) for the permission for the data collection that made all this work possible. A special thanks also to Bharatanatyam Students from Kalmandalam for the contribution of the data.

This study was approved by the Amrita Vishwa Vidyapeetham ethics committee and all the procedures performed in studies involving human participants were in accordance with the ethical standards of research committee.

References

1. http://natyanjali.blogspot.in/
2. Okada A, Shum SB, Sherborne T (eds) (2008) Knowledge cartography: software tools and mapping techniques. London, Springer
3. Bailey H, Buckingham Shum S, LeBlanc A, Popat S (2009) Rowley, a and turner, m dancing on the grid: using e-science tools to extend choreographic research. Philos Trans Royal Soc A 1898(367):2793–2806
4. Weick KE (1995) Sensemaking in organizations, vol 3. Sage Publications
5. Chatterjee S (2015) Matrix estimation by universal singular value thresholding. Ann Stat 43(1):177–214
6. Celenk M (1990) A color clustering technique for image segmentation. Comput Vis, Graph, Image Process 52(2):145–170
7. Putra IKGD, Erdiawan E (2010) High performance palmprint identification system based on two dimensional gabor. TELKOMNIKA Telecommun Comput Electr Control 8(3):309–318
8. Kishore PVV, Anil Kumar D, Goutham END, Manikanta M (2016) Continuous sign language recognition from tracking and shape features using fuzzy inference engine. In: International conference on wireless communications, signal processing and networking (WISPNET), IEEE, pp 2165–2170
9. Kishore PVV, Kishore SRC, Prasad MVD (2013) Conglomeration of hand shapes and texture information for recognizing gestures of Indian sign language using feed forward neural networks. Int J Eng Technol (IJET), ISSN 0975-4024
10. Anandh A, Mala K, Suganya S (2016) Content based image retrieval system based on semantic information using color, texture and shape features. In: International conference on computing technologies and intelligent data engineering (ICCTIDE), IEEE, pp 1–8

11. Gopalan R, Dariush B (2009) Towards a vision based hand gesture interface for robotic grasping. In: The IEEE/RSJ international conference on intelligent robots and systems, St. Louis, USA, pp 1452–1459
12. Kapuscinski T, Wysocki M (2001) Hand gesture recognition for man-machine interaction. In: Second workshop on robot motion and control, pp 91–96
13. Huang DY, Hu WC, Chang SH (2009) Vision-based hand gesture recognition using PCA + gabor filters and SVM. In: IEEE fifth international conference on intelligent information hiding and multimedia signal processing, pp 1–4
14. Yu C, Wang X, Huang H, Shen J, Wu K (2010) Vision-based hand gesture recognition using combinational features. In: IEEE sixth international conference on intelligent information hiding and multimedia signal processing, pp 543–546
15. Raheja JL, Das K, Chaudhury A (2011) An efficient real time method of fingertip detection. In: International conference on trends in industrial measurements and automation (TIMA), pp 447–450
16. Manigandan M, Jackin IM (2010) Wireless vision based mobile robot control using hand gesture recognition through perceptual color space. In: IEEE international conference on advances in computer engineering, pp 95–99
17. Victor D (2017) Real-time hand tracking using ssd on tensorflow
18. Fang Y, Wang K, Cheng J, Lu H (2007) A real-time hand gesture recognition method. In: ICME, IEEE, pp 995–998
19. Saengsri S, Niennattrakul V, Ratanamahatana CA (2012) TFRS: thai finger-spelling sign language recognition system. IEEE, pp 457–462
20. Kim JH, Thang ND, Kim TS (2009) 3-D hand motion tracking and gesture recognition using a data glove. In: IEEE international symposium on industrial electronics (ISIE), Seoul Olympic Parktel, Seoul, Korea, pp 1013–1018
21. Weissmann J, Salomon R (1999) Gesture recognition for virtual reality applications using data gloves and neural networks. IEEE, pp 2043–2046
22. Liang C-W, Juang C-F (2015) Moving object classification using local shape and HOG features in wavelet-transformed space with hierarchical SVM classifiers. Appl Soft Comput 28:483–497
23. Lee S-H et al (2015) An efficient selection of HOG feature for SVM classification of vehicle. In: 2015 international symposium on consumer electronics (ISCE), IEEE
24. "What is Feature Extraction?".deepai.org
25. Kumar KVV, Kishore PVV (2017) Indian classical dance mudra classification using HOG features and SVM classifier. Int J Electr Comput Eng (IJECE)

Demonstrating Broadcast Aggregate Keys for Data Sharing in Cloud

Kosaraju Rakshitha, A. Sreenivasa Rao, Y. Sagar and Somula Ramasubbareddy

Abstract In recent years, the major issue in cloud computing is providing privacy for getting to re-appropriating information put away on cloud. To store also to share information safely, cryptosystem is utilized. In cryptosystem, the client needs to scramble the data before securing data on cloud and after that decode the data to get to it. This errand can need numerous keys for information encode just like information decoding. But the problem arises with data integrity where data can be modified or the files can be replaced without the knowledge of the data owner. So, to ensure the trustworthiness of the record, the information proprietor figures the hash-based message authentication code (HMAC) signature on each encoded document.

Keywords Cloud Storage · Data sharing · Key-aggregate encryption · Data integrity · Hash-based message authentication code (HMAC)

1 Introduction

Re-appropriating of information is progressively requested in big business settings. In re-appropriating of information, there are odds of stealing information in virtual machine. The isolated virtual machine issued to obtain information of cloud put away on single physical machine. Already, plot was utilized for matching activities that is required for decoding of information. This scheme is extravagant because it requires "*n*"—number of blending unscrambling information. The proposed framework settles the difficulties happened in the past frameworks. The proposed framework gives packed type of mystery key where the key proprietor has ace key which contains diverse keys required for encryption too unscrambling various figure text classes. It

K. Rakshitha · Y. Sagar
CSE, VNRVJIET, Hyderabad, Telangana, India
e-mail: sagar_y@vnrvjiet.in

A. S. Rao · S. Ramasubbareddy (✉)
Information Technology, VNRVJIET, Hyderabad, Telangana, India

A. S. Rao
e-mail: sreenivasarao_a@vnrvjiet.in

H. S. Saini et al. (eds.), *Innovations in Computer Science and Engineering*,
Lecture Notes in Networks and Systems 103,
https://doi.org/10.1007/978-981-15-2043-3_23

underpins KAC plot which contains different security levels. Information encryption should be possible utilizing encryption keys. In any case, there is an issue of key administration where n number of such keys is expected to share the information. The change in mystery keys should have channel, and furthermore, its stockpiling is all the more. Hence, there is an opportunity of development in expenses just as assessment complexities as the quantity of keys are expanded. To put it plainly, it is extremely overwhelming and expensive. In this way, the best method to illuminate this is proprietor scrambles records with specific open keys yet just sends gatherer a lone interpreting key. There is a need of a verified channel for sending decoding key and stayed quiet, and little key size is constantly attractive for this situation which is accomplished in given approach. Thus, this approach takes a shot at to make unscrambling key more verified and inertial in the manner in which that it bolsters various decoding of figure writings, without expanding own size. Thus, proposed model advances open key encryption. In information trustworthiness checking with open undeniable nature, an outer reviewer (or anybody) can confirm the respectability of the cloud information. In this situation, information protection against the third party verifier is exceedingly basic since the cloud clients may store secret or delicate documents say business contracts or medical records to the cloud. In any case, this issue has not been fully examined. The "protection" definition in the previous privacy-safeguarding open evaluating plan requires that the verifier can't recuperate the entire squares from the responses generated by the cloud server. Be that as it may, this definition is not sufficient; for instance, it is helpless against word reference assault. The idea of "zero-information open examining" is to oppose disconnected speculating attack. However, a formal security demonstrate is not given in this as of late upgraded protection of remote information respectability conventions as fixed distributed storage; however, particular model works just came out in the open key framework (PKI)-based scenario rather than the personality-based framework.

2 Literature Survey

Reference [1] in this paper, how to ensure clients data assurance is a central request of distributed capacity. With dynamically logical mechanical assemblies, cryptographic plans are getting progressively adaptable, and much of the time incorporates distinctive keys for a single application. Here, we consider how to pack and enter in open key cryptosystems which reinforce task of secret keys for different figure content classes. In dispersed capacity paying little regard to which one among the power set of classes, the agent can by and large get an all out key of relentless size. Our approach is more versatile than different leveled key undertaking which can extra spaces if each and every key holder share a tantamount plan of advantages. In dispersed capacity, the amount of figure messages when in doubt grows rapidly, so we have to hold enough figure substance classes for the future development. Else, we need to grow the open key [2]. Here, a protection safeguarding open examining framework for data amassing security is used in cloud computing. We

utilize the homomorphic straight authenticator and sporadic covering to guarantee that the TPA would not pick up capability with any data about the data substance set away on the cloud server in the midst of the capable investigating process which not simply gets rid of the heaviness of cloud customer from the tedious and possibly expensive assessing task yet what is more. Facilitates the customers' fear of their redistributed data spillage. Considering TPA may all the while manage different survey sessions from different customers for their redistributed data archives we further expand our security defending open exploring show into a multi-client setting where the TPA can play out different investigating assignments in a cluster route for better capability. Wide assessment exhibits that our arrangements are provably secure and exceedingly profitable [3]. This paper displayed a multi-bundle key organization scheme that achieves dynamic access control in secure gathering correspondences, where different information streams are dispersed to assemble individuals who have different access benefits. We structured a planned key chart, just as the rekey convention. The development plan accomplishes the forward and in turn around security while enabling clients to sub-recorder/drop the gathering correspondences and change access levels. Contrasted and utilizing the present tree-based key organization plots that are intended for a solitary multicast session, the proposed arrangement can incredibly diminish the overhead connected with key administration. In the multi-layer administrations containing four layers, we watched over half decrease in the utilization of capacity, calculation and correspondence assets in the concentrated conditions, and about half decrease in the quantity of rounds expected to build up and update enters in the contributory situations. All the more critically, the proposed plan scales superior to anything the current tree-based plans when the gathering applications contain more information streams and require the system to oversee progressively tangled access control arrangement [1]. In this system is found to be very efficient for sharing the data on cloud. This sharing is done in a secure and confidential manner. For this, we have calculated KAE algorithm which means key-aggregate encryption algorithm. Here, we have to maintain two public keys. First one is discharge key which is used for encryption and decoding data over cloud. And the second key is total key which is used to decrypt limited block of cipher. Other data remain confidential. This system provides blocking mechanism for the user whose behavior seems to be malicious [4]. In this paper, figure content course of action trademark-based encryption is made. Our structure considers another kind of encoded get the chance to control where customer's private keys are data can show a technique over these properties figuring out which customers can unscramble. Our framework enables techniques to be conveyed as any monotonic tree gets the chance to structure and is impenetrable to interest ambushes in which an attacker may secure various private keys. At long last, we gave an utilization of our system which fused a couple of progress procedures. Later on, it is charming to consider property-based encryption structures with different sorts of expressibility. While key system abe and figure content course of action abe discover two intriguing and complimentary sorts of structures, there obviously exist various types of systems. The essential test in this profession is to locate another framework with rich types of articulation that produce in excess of a self-assertive blend of systems [5]. Providing security is most

important issue in online cloud data sharing. Users upload their data, and the data privacy is maintained by initially storing it in encrypted form. Here, the study and comparison of different techniques for data sharing are made, and we found that the multiple-key aggregate system is more efficient and secure than others. This system is developed for generating a unique key for accessing file by multiple users in the aggregate server. The delegation of decryption is made to be efficiently implemented. This secure ensures consistent size figure writings and aggregate key. The elliptic curve cryptography (ECC) is used as it well suits in cloud environment, providing shorter key length with faster computations. ECC provides a dimension of security with 164-bit key which equals to 1024-bit key in other systems. ECC is widely used in mobile applications since its high security with low computing power and low resource usage. The multiple-key protocol is used to generate and broadcast multiple keys for sharing of same file among multiple users [1]. Thinking about of the reasonable issue of security protecting information sharing framework dependent on open distributed storage which is need an information proprietor to designate an expansive number of keys to clients to allow them to get to the archives in this proposed idea of key total accessible encryption and build a solid KASE scheme. It can provide an efficient answer for structure functional information sharing framework dependent on open distributed storage. In a KASE plot, the proprietor needs to appropriate only one key to a client while contributing alot of records with the client and the client necessities to exhibit a solitary trapdoor when they inquire over all reports shared by a similar proprietor. On the other side, if a customer needs to address over chronicles shared by various owners that customer must convey various trapdoors to the cloud [6]. This paper at long last reasons that our proposed framework is extremely secure in light of the fact that it gives two-stage security initial one: Encryption with solid total key second: Splitting scrambled document and putting away on various cloud. As of now, we have utilized two mists, for example, Google drive and drop limit anyway future we will use more and differing fogs to give more noteworthy security.

3 Implementation

We build up a component for open key-based total key circulation that lessens the protected channel necessity. We use impart encryption which is a prominent framework out in the open key cryptography to beneficially pass on the absolute keys among various customers in a safe mold. Our all-inclusive KAC development joins the essential KAC occurrence gave people in general key-based communicate encryption framework to manufacture a completely open key-based online information sharing plan.

From Fig. 1, information proprietor can enlist in this framework, and later, they can login and transferred the scrambled documents (data classes) in cloud storage. And additionally, information proprietor shares the information classes to information clients, and they can play out the information honesty checking convention for information consistency; here, HMAC calculation is utilized for information

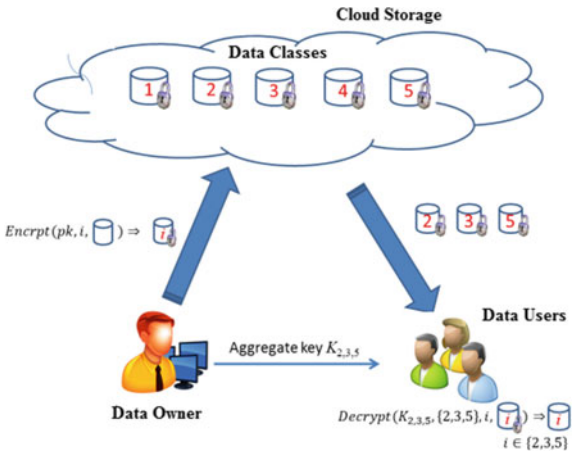


Fig. 1 System model

respectability checking in distributed storage. Information clients likewise can enlist and login and later at that point can unscramble the different scrambled records with single aggregate key which is shared by information proprietor.

3.1 Broadcast Encryption

The key-aggregate cryptosystem (KAC) may essentially be considered as a twofold idea of communicate encryption. In convey encryption, a singular figure content is communicated among various customers, all of whom may decode the equivalent using their very own individual private keys. In KAC, a solitary all out key is coursed among various clients and may be used to unravel figure writings mixed concerning different classes. For impart encryption, the attention is on having shorter figure messages and low overhead individual deciphering keys, while in KAC, the middle is in having short figure messages and low overhead complete keys.

3.2 Hash-Based Message Authentication Code (HMAC)

To ensure respectability of the record, the information proprietor likewise processes the hash-based message verification code (HMAC) signature on each encoded document. A comparable procedure for the HMAC key is embraced. In any case, the HMAC key is kept by the information proprietor only. The explanation behind a MAC is to approve both the wellspring of a message and its respectability without the usage of any additional instruments. HMACs have two in every way that really matters unmistakable parameters, a message input and a puzzle key known just to the message originator. Extra uses of keyed-hash capacities incorporate their utilization

I challenge-reaction recognizable proof conventions for registering reactions, which are an element of both a secret key and a test message. A HMAC work is utilized by the message sender to make a respect (the MAC) that is encircled by get-together the enigma key and the message input. The MAC is usually sent to the message beneficiary near to the message. The gatherer shapes the MAC on the got message utilizing a similar key and HMAC fill in as was utilized by the sender, and differentiations the outcome figured and the got MAC. If the two attributes compose, the message has been reasonably gotten, and the specialist is guaranteed that the sender is a person from the arrangement of clients that offer the key. The accompanying pseudo code exhibits how HMAC might be executed. Block size is 64 (bytes) when utilizing one of the accompanying hash capacities:

Capacity hmac

Data sources:
Key: Bytes exhibit of bytes.
Message: Bytes exhibit of bytes to be hashed.

3.3 The Framework for Extended KAC with HMAC

System broadened KAC with total key communicate is introduced underneath:

(1) Set Up: Takes the quantity of information classes n, the quantity of clients m, and security parameter yields general population parameter.
(2) Owner Key Gen: Outputs people in general key PK, the ace mystery key msk and communicate mystery key bsk for an information proprietor enlisting in the framework.
(3) Owner Encrypt: Takes as data a data class and the plaintext data M. Yields a not completely encoded figure content C0. Note that C0 is not the last figure message and is not displayed to the outside world. It is sent to the system head by methods for an ensured channel for further modification as depicted straightaway. Note here that any instantiation of this arrangement must ensure that the midway figure content C0 is ensured using suitable randomizations so as to spill nothing about the shrouded plaintext data M amidst transmission to the system manager.
(4) System Encrypt: Takes as information the mostly encoded ciphertext C0, the ace mystery key msk and the communicate mystery key bsk. Yields the last ciphertext C which is made accessible on the cloud. This progression is done by the framework chairman, who is a confided in outsider.
(5) User Key Gen: Takes as information the information client id and yields the relating mystery key.
(6) Extract: Takes as info the ace mystery key msk and a subset of information classes. Registers the total key KS for all encoded messages having a place with these subsets about classes and passes as contribution to broadcast calculation creating the communicate total way.

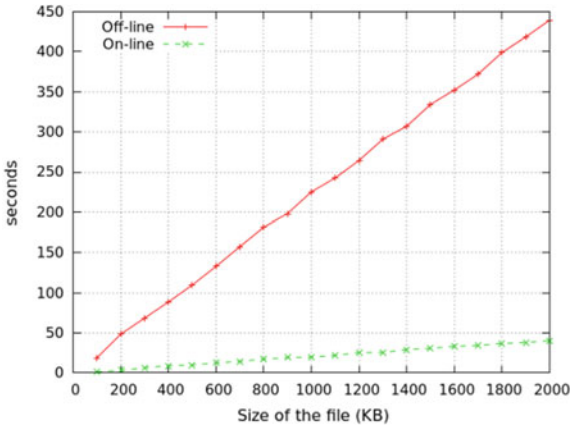


Fig. 2 Tag generation time for increased size of files

(7) Broadcast: Takes as information the total key KS and the objective subset of clients yields a solitary communicate total key that permits any client to decode all scrambled information/messages ordered into any class.
(8) Decrypt: The unscrambling calculation currently takes, other than the ciphertext C and the comparing information class, a substantial client id. It additionally takes as information the communicate total key and the mystery key. The calculation yields the decoded message.
(9) Tag Gen: It accepts contribution as scrambled document, irregular number, and it gives as yield the hash an incentive with help of HMAC calculation (Fig. 2).
(10) Verify: It accepts contribution as encoded document, irregular number from cloud and confirm and creates the hash esteem and contrast and existing hash esteem then both are same it returns genuine or it returns false.

4 Result

Here, we inquired about another unrefined called information reliability checking for secure cloud capacity. We formalized the security model of two essential properties of this rough, explicitly, soundness and flawless information protection. We gave another improvement of this crude and exhibited that it achieves soundness and immaculate data privacy. Both the numerical examination and the execution demonstrated that the proposed tradition is capable and helpful shown in Figs. 3 and 4.

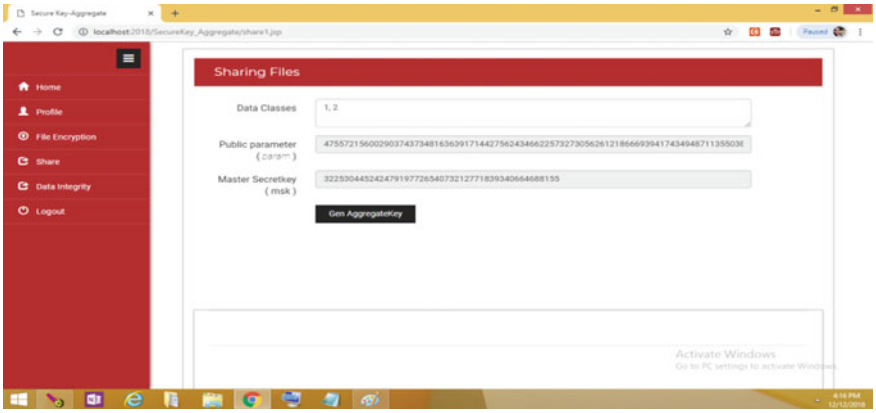


Fig. 3 File encryption and sharing

Fig. 4 File decryption and downloading

5 Conclusion

Here, we proposed a single key using two-step authentication process. One is the partial encryption, and other is the full encryption. This two-step authentication is used for uploading the file into the cloud as well as for generating the key. In the same way, two-step decryption will be one done. First step for decrypting the data and the second step for downloading the data. Here, we also used HMAC for data integrity. Data integrity tells us whether the file sent to the user is safe or not. In future work, this can use any type of format such as pdf, power point, videos, audios and images.

References

1. Chu CK, Chow SS, Tzeng WG, Zhou J, Deng RH (2014) Key-aggregate cryptosystem for scalable data sharing in cloud storage. IEEE Trans Parallel Distrib Syst 25(2):468–477
2. Wang C, Chow SS, Wang Q, Ren K, Lou W (2013) Privacy-preserving public auditing for secure cloud storage. IEEE Trans Comput 62(2):362–375
3. Sun Y, Liu KJR (2004) Scalable hierarchical access control in secure group communications. 0-7803-8356-7/04/$20.00 (C), IEEE
4. Bethencourt J, Sahai A, Waters B (2007) Ciphertext-policy attribute-based encryption. In: 2007 IEEE symposium on security and privacy (SP'07), IEEE, pp 321–334
5. Pathan ASK (ed) (2016) Security of self-organizing networks: MANET, WSN, WMN. CRC Press, VANET
6. Bachhav S, Chaudhari C, Shinde N, Kaloge P (2015) Secure multi-cloud data sharing using key aggregate cryptosystem for scalable data sharing. Int J Comput Sci Inf Technol 6(5):4479–4482

An Evaluation of Local Binary Descriptors for Facial Emotion Classification

R. Arya and E. R. Vimina

Abstract Feature descriptors are vitally important in the broad domain of computer vision. In software systems for face recognition, local binary descriptors find wide use as feature descriptors. Because they give more robust results in varying conditions such as pose, lighting and illumination changes. Precision depends on the correctness of representing the relationship in the local neighbourhood of a digital image into small structures. This paper presents the performance analysis of various binary descriptors such as local binary pattern (LBP), local directional pattern (LDP), local directional number pattern (LDNP), angular local directional pattern (ALDP), local optimal-oriented pattern (LOOP), support vector machine (SVM), K-nearest neighbour (KNN) and back propagation neural network (BPNN) are used for emotion classification. The results indicate that ALDP + Polynomial SVM on MUFE, JAFFE and Yale Face databases gives better accuracy with 96.00%, 94.44% and 89.00%, respectively.

Keywords Binary descriptors · Facial Emotion Recognition · SVM · KNN · BPNN

1 Introduction

Face recognition, retrieval, emotion analysis—these are important issues that computer vision applications need to address. Facial emotion is a type of non-verbal communication which plays a vital role in expressing the emotional state of an individual [1]. Our life is full of experiences. Experiences and bound to have emotions and feeling associated with them. The strong feelings about a human's present/past situation are called emotions. Ekman et al. have identified and listed a limited number of universal facial expressions which are found among all humans irrespective of their racial or national identity—these are fear, disgust, anger, happiness, surprise and sadness [2, 3]. Usually, each experience is bound to have a complex set of emotions associated with it. Most often, emotions are expressed through facial expressions.

R. Arya (✉) · E. R. Vimina
Department of Computer Science & IT, Amrita Vishwa Vidyapeetham University, Kochi, India

H. S. Saini et al. (eds.), *Innovations in Computer Science and Engineering*,
Lecture Notes in Networks and Systems 103,
https://doi.org/10.1007/978-981-15-2043-3_24

Every expression could either be negative or positive. In business establishments, emotion recognition system is used to identify the consumer's temperament towards their brands and products for better marketing effects. FER systems can be used to identify the patient's needs and requirements in a hospital. Better understanding of human emotions could lead to better products in automation sector. Detecting human emotions with technology is a challenging task. Automatic emotion recognition uses image processing techniques to read and analyse emotions on a human face.

Any system that analyses face images has to address a major concern—high sensitivity to various artefacts that are inherent in the very act of image capture—optical noise, difference in illumination, variations in posture, changes of viewpoint and other effects such as image blurring [4, 5]. Any facial emotion recognition (FER) consists of two components; face description and emotion matching [6]. In any computer vision problems, feature description and matching are the most relevant factor. The principal stages of FER processes are feature extraction followed by feature classification. In order to keep the quantity of the data being processed in check, facial feature extraction techniques focus on the identification of the most striking and relevant features on a face. The performance of algorithms for extracting features hinges upon the quality of feature recognition as well as the computational effort that goes into the recognition process. There are several methods that are used to extract these facial points from images/videos; these are broadly of two types: techniques which base themselves on geometry and those which stress appearance. Feature representation techniques are mainly classified as global face descriptor [7, 8] or local face descriptor [9, 10], or [10, 11]. Global face descriptor takes the whole image to get its representation, but in the case of local face descriptor, a face image is partitioned into a multiplicity of sub-images or sub-patches to extract the relevant information. Recently, binary local descriptors have gained much attention due to its efficiency in describing the facial feature effectively [11, 12]. Local binary descriptors are an effective encoders for identifying repeated local patterns in several visual recognition tasks [13]. LBP is the first implementation by Ojala et and is used for measuring the local contrast measure of image [14]. Since, there are several variations of binary descriptors are developed. Accuracy of any FER systems is measured on the basis of how accurately features are obtained from the input image.

We try to identify that feature descriptor which gives the best fit to classify facial expressions. For this, local descriptors which are suitable in FER systems are identified. A few of local binary descriptors are analysed in this paper and evaluate their individual performances and classify the emotions.

2 Methodology

This section examines five local binary descriptors LBP, LDP, ALDP, LDN and LOOP which are widely used for representing facial features. The classifiers such as SVM, KNN and BPNN are used for emotion classification.

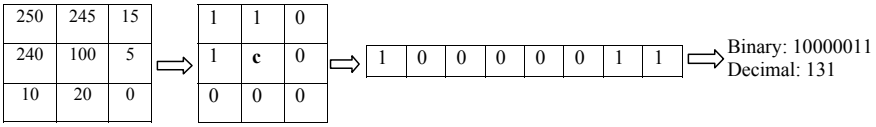


Fig. 1 LBP representation of an image

2.1 Feature Extraction

Facial feature extraction techniques are used for extracting relevant features from face images with special focus on the reduction of the quantum of information under process. By considering the recognition quality and computational efforts, feature extraction methods are primarily of two broad categories: methods which focus on geometry and those which emphasize appearance. Geometry-based method takes relevant facial characteristics are extracted using the poses and in appearance-based technique takes the whole image by using statistical techniques to find out the basic feature vectors.

2.1.1 Local Binary Pattern (LBP)

LBP captures [14] the intensity variation pattern of a digital image. It is a popular texture descriptor used for emotion classification. It thresholds the neighbourhood of each pixel in an image, and results get indicated by the binary number. Let i_c be the intensity value at pixels position (x_c, y_c) and i_n ($n = 0$ to 7) be the pixel intensities in the 3 * 3 neighbourhood of (x_c, y_c). Then, the LBP equivalent of the pixel at (x_c, y_c) is given by

$$\text{LBP}\,(x_C, y_c) = \sum_{n=0}^{7} S(i_{n-} i_c) 2^n \tag{1}$$

$$\text{where, } s(v) = \begin{cases} 1, \text{if } v \geq 0 \\ 0, \text{otherwise} \end{cases}$$

The computation is pictorially represented in Fig. 1.

2.1.2 Local Directional Pattern (LDP)

A major drawback of LBP is that it is impacted by noise because of the influence of the intensity of the neighbouring pixels. So, a more sophisticated method of feature extraction, the LDP, was conceived and developed by Jabid and co-authors [15]. This method, in preference to a direct reading of raw pixel intensities, uses the edge response of the application of Kirsch gradient operator. Several application areas of

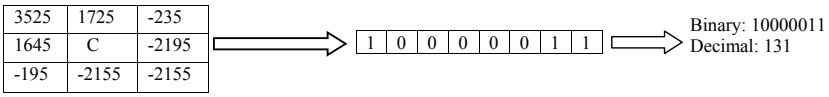


Fig. 2 LDP representation of an image

LDP are facial expression recognition [16], signature verification [17] and textural classification [18]. LDP is an enhanced variant of the LBP descriptor incorporating a directional component by employing the Kirsch compass kernels. Here, Kirsch mask is applied on the 3 * 3 neighbourhood, and centred pixel is avoided. Eight edge responses of Kirsch mask are represented as M_n where $n = 0$–7, corresponding to pixels with intensity in, $n = 0$–7 and let M_k be the kth highest Kirsch activation. We examine the magnitude of every response and then those among the adjoining pixels exhibiting Kirsch response higher than M_k are assigned the value 1; the others are assigned 0. Hence, the possible number of binary words is reduced from $2^{(n+1)}$ to C_{k-1}^{n+1}. Then, LDP value for the pixel $(x_c; y_c)$ is given in Eq. 2,

$$\mathrm{LDP}_k(x_c; y_c) = \sum_{n=0}^{7} S(M - M^k) \,.\, 2^n \tag{2}$$

$$\text{where, } s(v) = \begin{cases} 1, \text{if } v \geq 0 \\ 0, \text{otherwise} \end{cases}$$

The LDP response of a pixel is shown in Fig. 2.

2.1.3 Angular Local Directional Pattern

Abuobayda M. M. Shabat.et al. (2018) introduced angled local directional pattern (ALDP) for analysing texture. This is an enhanced version of LDP. Experiments are done on two texture datasets and different classifiers, show that ALDP significantly gives better results than both LDP and LBP methods [19]. Major disadvantage of LDP is that—this method uses Kirsch mask at eight different directions about each pixel, and the problem is that it does not consider the centre pixel. Centre pixel is vitally important in many applications. In order to overcome this, ALDP takes centre pixel value as a threshold, instead of choosing k values. ALDP features consist of an eight-bit binary code that is generated for each pixel. Like LDP, Kirsch mask edge responses are taken, and only difference is that it turns every negative response into its absolute value. Further, angular vector components are calculated, where each angle (0°, 45°, 90°, 135°) composed of several number of vectors, each vector consists of three components, and the representation of equations is shown in Table 1. The value of the central pixel is initially taken as a threshold for the other two adjoining pixels. Magnitude of the pixel is not taken into account. If the threshold value exceeds the

Table 1 Angular representation of eight responses

0°	45°	90°	135°
P_0 = b (M_0–c, M_4–c) P_1 = b (M_3–M_2, M_1–M_2) P_2 = b (M_7–M_6, M_5–M_6)	P_6 = b (M_5–c, M_1–c)	P_3 = b (M_7–M_0, M_1–M_0) P_4 = b (M_6–c, M_2–c) P_5 = b (M_3–M_4, M_5–M_4)	P_7 = b (M_3–c, M_7–c)

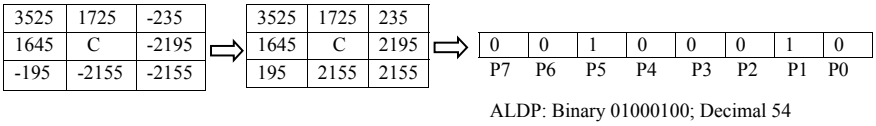


Fig. 3 ALDP computation of a pixel

value of either neighbours, binary code is given the value 1, otherwise 0. ALDP representation of an image is shown in Fig. 3.

2.1.4 Local Optimal-Oriented Pattern (LOOP)

Chakraborti et al. (2018) introduces a new descriptor for binary local patterns, LOOP. Experiments are performed on Lepidoptera species recognition [20] LOOP overcomes the several drawbacks of the LBP and LDP descriptors. The main drawback is arbitrary sequence of binarization of weights and threshold value. This descriptor incorporates invariance under rotation within the main formulation of the local binary descriptor. LOOP takes the advantages of these descriptors and prevents the nonlinear combination of both. As discussed earlier, like LDP Kirsch mask is applied on the image. Exponential weight w_n is assigned on each pixel ranging between 0 and 7. Then, the LOOP value for the pixel (x_c,y_c) is given in Eq. 3, and the response of LOOP is shown in Fig. 4.

$$\mathrm{LOOP}(x_c;\, y_c) = \sum_{n=0}^{7} S(i_n - i_k) \,.\, 2^{w_n} \tag{3}$$

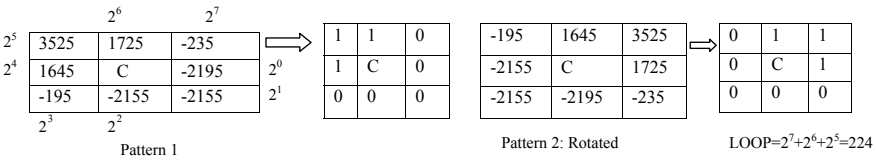


Fig. 4 LOOP computation of a pixel

$$\text{where, } s(v) = \begin{cases} 1, \text{if } v \geq 0 \\ 0, \text{otherwise} \end{cases}$$

2.1.5 Local Directional Number Pattern

Akhilesh et al. (2016) developed a descriptor for face recognition. The technique employs a 'compass mask' which generates information pertaining to direction and sign [21]. LDN makes use of six-bit binary code which is better than eight-bit binary code mentioned in the previously discussed methods. The arrangement of the texture and the intensity differences are represented by the LDN descriptor. LDN also avails the use of Kirsch mask to spot edge responses as in LDP, ALDP and LOOP. Here, the LDN code is formed by taking the most positive and the least negative three significant bits. The LDN is given in Eq. 4. The central pixel is represented as (i, j), and the most positive and the least negative responses are represented as m_{ij} and n_{ij}, respectively, in Eqs. 5 and 6

$$\text{LDN}(i, j) = 8m_{ij} + n_{ij} \tag{4}$$

$$m_{ij} = \arg\max_m \{S_m(i, j) | 0 \leq m \leq 7\} \tag{5}$$

$$n_{ij} = \arg\min_n \{S_n(i, j) | 0 \leq n \leq 7\} \tag{6}$$

The response of LDN while applying on an image is shown in Fig. 5.

2.2 *Classifiers*

In FER models, classification method is the final process for emotion classification—the classifiers decide the emotion exhibited from among the set: happiness, surprise, fear, sadness, disgust, anger and neutral. For emotion classification, methods used are support vector machines (SVMs), K-nearest neighbour (KNN) and back propagation

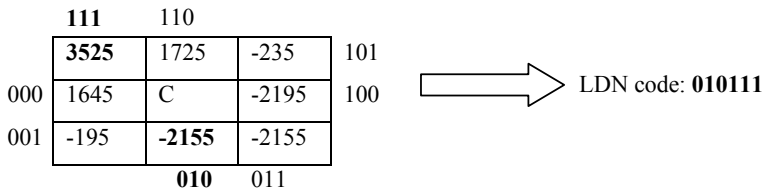


Fig. 5 LDN representation of an image

neural network (BPNN). For training and testing on the basis of extracted features, these classifiers are used.

2.2.1 Support Vector Machines

SVM was introduced and built up by Vapnik et al. SVMs work out a generic mechanism that fits the surface of a hyperplane to the input data by using a kernel function. Kernel function helps to transform data into another higher dimension that has clear hyperplane. The kernel functions most commonly used are linear, polynomial and radial basis function (RBF) kernel functions.

2.2.2 K-Nearest Neighbourhood

The K-nearest neighbour algorithm works out a classification of objects using the class labels to training examples that inhabit the feature space. The classification assigns unlabelled query point to the label of its k-nearest neighbours. Usually, the classification limits itself to the labels of its k-nearest neighbours—the choice among them is made by majority vote. After each image is transformed into a fixed-length vector with real number components, we use for KNN, the most common distance function—the Euclidean distance.

2.2.3 Back Propagation Neural Network

Another classification method used is BPNN, and data move in both directions. The algorithm proceeds with two passes through the layers—one pass is forward, and the other goes backwards. Different activation functions such as sigmoid, tanh functions are used in BPNN to improve the learning rate. During the entire backward pass, the weights are adjusted as indicated by an errors rectification approach.

3 Evaluation Metrics

Accuracy of any FER systems mainly depends on how precisely features are extracted from input image. A confusion matrix is used in classification algorithms for summarizing the performance.

Accuracy $= \boldsymbol{X = t/n * 100}$ (where t is the number of correct classification and n is the total number of samples).

4 Experimental Analysis and Results

4.1 Facial Expression Datasets

Three facial expression datasets such as Japanese Female Facial Expression (JAFFE), MUFE dataset and Yale Face datasets are used. The JAFFE database comprises 213 images of ten persons displaying the seven facial expressions considered universal—happiness, sadness, anger, surprise, fear, disgust and neutral, MUFE dataset is also a facial expression database consists of 630 facial images—these show 80 males and 20 females exhibiting the seven aforementioned facial expressions that are deemed universal. Yale Face database contains 165 images of 15 people—11 images per subject such as centre light/glass, happy, left-light/no glass, normal, right-light, sad, sleepy, surprise and wink. We use samples from this database representing various expressions such as happy, sad, sleepy, surprise and wink.

4.2 Implementation

We designed and implemented our algorithms in MATLAB using JAFFE, Yale Faces and MUFE databases. The entire set of input data is classified into a training set and a testing set. 70% of the total data is utilized for training. The remaining 30% forms the set for testing—to demonstrate and to make comparisons of the performance of the algorithms being considered, and the LBP, LDP, LDN, ALDP and LOOP features are extracted in the beginning. Then, the SVM, KNN and BPNN are used to perform the classification of the tested face images. Figure 1 shows the work flow diagram. Then, the SVM, KNN and BPNN are used to perform the classification of the tested face images. Figure 6 shows the work flow diagram.

These descriptors' performance is analysed on classifiers and accuracy are calculated on each descriptor. On the basis of performance analysis, ALDP with polynomial SVMs on MUFE datasets gives better accuracy among three datasets. Performance of these descriptors on difference classifiers and recognition rate is shown in which are shown in Tables 2, 3 and 4.

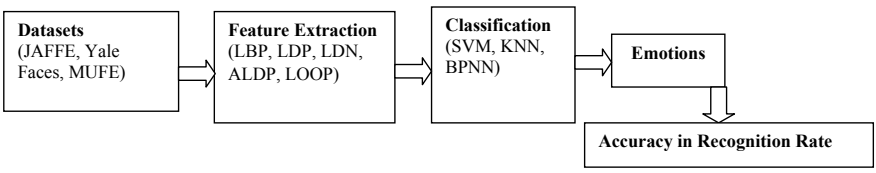


Fig. 6 Work flow diagram

Table 2 Accuracy table: MUFE dataset

Classifier/descriptor		LBP	LDP	LDN	ALDP	LOOP
SVM	Linear	75.40	77.00	80.20	88.67	85.00
	Polynomial	78.24	88.10	88.00	**96.00**	94.56
	RBF	74.14	76.80	77.44	82.20	80.11
KNN	$K = 3$	72.01	74.67	79.10	81.44	70.77
	$K = 5$	74.76	77.00	80.04	82.66	72.12
	$K = 7$	75.00	84.78	82.38	84.80	81.00
BPNN	Sigmoid	74.83	75.47	74.00	78.00	82.90
	Tanh	78.00	79.90	78.44	80.56	83.00

Table 3 Accuracy table: JAFEE dataset

Classifier/descriptor		LBP	LDP	LDN	ALDP	LOOP
SVM	Linear	74.34	75.23	79.21	86.32	83.45
	Polynomial	76.23	85.09	85.34	**94.44**	93.76
	RBF	70.88	72.32	77.00	80.83	77.34
KNN	$K = 3$	70.90	71.28	77.00	78.98	66.78
	$K = 5$	73.97	77.67	79.98	80.99	71.88
	$K = 7$	74.01	79.88	81.76	83.78	79.76
BPNN	Sigmoid	72.65	73.30	72.00	78.00	81.66
	Tanh	76.41	75.00	77.14	80.56	82.88

Table 4 Accuracy table: yale face dataset

Classifier/descriptor		LBP	LDP	LDN	ALDP	LOOP
SVM	Linear	72.00	73.60	77.67	81.44	83.28
	Polynomial	74.20	88.10	88.00	**89.00**	90.44
	RBF	70.55	76.80	77.44	78.11	80.11
KNN	$K = 3$	66.66	74.67	79.10	79.38	76.00
	$K = 5$	70.56	77.00	80.04	81.20	77.24
	$K = 7$	73.90	84.78	82.38	82.78	80.01
BPNN	Sigmoid	76.28	79.90	78.44	78.50	81.22
	Tanh	72.00	73.60	77.67	81.44	83.28

5 Conclusion

In this paper, we present a systematic analysis of local binary feature descriptors. The strength and weakness of these descriptors are also discussed. The performance of five local descriptors such as LBP, LDP, LDN, ALDP and LOOP is evaluated using

three classifiers such as SVM with [linear, polynomial and RBF Kernels], KNN with different 'K' values [$K = 3$, $K = 5$, $K = 7$] and BPNN with activation functions [sigmoid, tanh Functions]. These five local descriptors are applied on three facial expression databases: MUFE, JAFEE, Yale Face, ensuring identical experimental settings. The results indicate that ALDP + SVM using polynomial kernel give 96% of recognition rate with better accuracy on MUFE datasets than other datasets, and finally, system performance is evaluated.

References

1. Rashid TA (2016) Convolutional neural networks based method for improving facial expression recognition. Intell Syst Technol Appl 530
2. Ekman P, Friesen WV (1971) Constants across cultures in the face and emotion. J Pers Soc Psychol 17(2):124–129
3. Kumari J, Rajesh R, Pooja KM (2015) Facial expression recognition: a survey. Procedia Comput Sci 58:486–491
4. Ding C, Xu C, Tao D (2015) Multi-task pose-invariant face recognition. IEEE Trans Image Process 24(3):980–993
5. Kan M, Shan S, Zhang H, Lao S, Chen X (2016) Multiview discriminant analysis. IEEE Trans Pattern Anal Mach Intell 38(1):188–194
6. Wright J, Yang AY, Ganesh A, Sastry SS, Ma Y (2009) Robust face recognition via sparse representation. IEEE Trans Pattern Anal Mach Intell 31(2):210–227
7. Turk M, Pentland A (1991) Eigenfaces for recognition. J Cogn Neurosci 3(1):71–86
8. Belhumeur PN, Hespanha JP, Kriegman DJ (1997) Eigenfaces versus fisherfaces: recognition using class specific linear projection. IEEE Trans Pattern Anal Mach Intell 19(7):711–720
9. Ahonen T, Hadid A, Pietikainen M (2006) Face recognition with local binary patterns: application to face recognition. IEEE Trans Pattern Anal Mach Intell 28(12):2037–2041
10. Rivera AR, Castillo JR, Chae O (2013) Local directional number pattern for face analysis: face and recognition. IEEE Trans Image Process 22(5):1740–1752
11. Su Y, Shan S, Chen X, Gao W (2009) Hierarchical ensemble of global and local classifiers for face recognition. IEEE Trans Image Process 18(8):1885–1896
12. Wolf L, Hassner T, Taigman Y (2011) Effective unconstrained face recognition by combining multiple descriptors and learned background statistics. IEEE Trans Pattern Anal Mach Intell 33(10):1978–1990
13. Huang D, Shen C, Ardabilian M, Wang Y, Chen L (2011) Local binary patterns and its application to facial image analysis: a survey. IEEE Trans Syst Man and Cyber-Part C 41(6):765–781
14. Ojala T, Pietikinen M, Harwood D (1994) Performance evaluation of texture measures with classification based on Kullback discrimination of distributions. In Proc, ICPR
15. Jabid T, Kabir MH, Chae O (2010) Local directional pattern (LDP) for face recognition. Proc Int Conf IEEE on Consum Electr 329–330
16. Zhong F, Zhang J (2013) Face recognition with enhanced local directional patterns. Neurocomputing 119:375–384
17. Jabid T, Kabir MH, Chae O (2010) Robust facial expression recognition based on local directional pattern. ETRI J 32(5):784–794
18. Shabat AM, Tapamo JR (2014) A comparative study of local directional pattern for texture classification. In: Proc Int Conf IEEE World Symp Computer Applications & Research (WSCAR), pp 1–7
19. Shabat AMM, Tapamo J (2018) Angled local directional pattern for texture analysis with an application to facial expression recognition. IET Comput Vision 12(5):603–608

20. Chakraborti T, McCane B, Mills S, Pal U (2018) LOOP descriptor: local optimal-oriented pattern. IEEE Signal Process Lett 25(5):635–639
21. Ramirez Rivera A, Rojas Castillo J, Oksam Chae O (2013) Local directional number pattern for face analysis: face and expression recognition. IEEE Trans Image Process 22(5):1740–1752

A Review on Blockchain and Its Necessitate in Industrial IoT

Geetanjali Rathee, Sharmi Dev Gupta and Naveen Jaglan

Abstract In this paper, we have reviewed blockchain technology along with its usage in industrial IoT. Further, the literature survey has been described that elaborates how blockchain is rising nowadays. Further, the number of applications where blockchain technology can be applied along with smart devices has been discussed. In the last section, we have considered the industrial IoT use case with their recent issues and how these issues can be resolved using the blockchain technology. A proposed security framework in IIoT using blockchain technology is presented. Finally, the paper is concluded with some security solutions in industrial IoT using blockchain technology.

Keywords Blockchain technology · Industrial internet of things · Security threats · IoT

1 Introduction

The perception of Internet of things (IoT) has been identified via industrial media and ledgers as the next beckon of innovation into our everyday life [1]. The smart objects/devices and intelligent sensors working mutually are steadily becoming more endeavor and pervasive to accomplish the users' needs. Further, devices organized in smart city, industrial automation and households are now unified with the Internet. This interconnection of objects offers an entire series of information, for example, appliance status, energy practice and environmental activities that tin to be aggregate,

G. Rathee (✉)
Department of Computer Science and Engineering, Jaypee University of Information Technology, Waknaghat, Solan, HP 173234, India

S. D. Gupta
AIG PPS AVM, Cognizant Technology Solutions Private Limited, Unitech, New Town, Kolkata 700156, India

N. Jaglan
Department of Electronic and Communication Engineering, Jaypee University of Information Technology, Waknaghat, Solan, HP 173234, India

H. S. Saini et al. (eds.), *Innovations in Computer Science and Engineering*,
Lecture Notes in Networks and Systems 103,
https://doi.org/10.1007/978-981-15-2043-3_25

composed and then allocate in a protected, proficient and secure mode. Beside a lot of recompense of using IoT objects, several business associations are anxious to use it. Moreover, the exploitation of IoT resolution is still exclusive due to the allied costs of centralized clouds and server farms. Further, after the divulge of Edward Snowden [2], it turn out to be difficult in the errand of IoT users to belief their technical associates who, in common, offers object consent and organize to assured establishment by authorizing them to congregate and scrutinize the user data. Therefore, secrecy and security have to be at the core of panorama IoT elucidations. Further, in order to amplify the trust and security among the authorities, transparency is vital. Hence, there is a need to propose some open-source mechanisms for raising the next legion of IoT users [3]. In recent two years, blockchain technology has been growing at an astounding pace in turn to offer the transparency among the customers. It is capable to organize, track and confirm the transportation by recording the information from a big amount of devices and assisting the creation of parties devoid of centralized cloud. Blockchain has recently immersed the attention of associates crossways a broad cross of businesses such as real assets, healthcare, finance departments and government sectors [4]. This unique feature of blockchain is that it strengthens the developers and researchers working in the Internet of things (IoT) domain. The purpose of this manuscript is to offer a thorough explanation of blockchain, work that has been done by different authors and their use cases. This will permit the readers to recognize potentially several use cases of blockchain, and also make erudite decisions when incorporating a blockchain in their project. Further, the issue in IIoT (Industry 4.0 in IoT) use case has been discussed with its effective solution using blockchain technology. The residual organization of the paper is structured as follows. The related works of blockchain with IoT is presented in Sect. 2. The different use cases of blockchain technology are illustrated in Sect. 3. Furthermore, Sect. 4 elaborated Industry 4.0 issues and their security solutions using blockchain technology. Lastly, Sect. 5 concludes the work and pointed out the future extent of the paper.

2 Related Work

This section describes the usage of blockchain technology in various fields. Initially, the blockchain was commenced with Bitcoin in order to resolve the problem of double-spacing [5]. Further, it is defined as a disseminated data structure that is shared and replicated among the elements of a network. Blockchain may arise on its own number cryptocurrency essential as a believer of the blockchain and as a record whose files are grouped into time-stamped blocks. Each block is recognized by its cryptographic botch/hash. Further, each block allusions the block hash that approached before it and founds a link among the blocks by generating a chain of blocks, or blockchain [6]. This section describes a brief introduction of blockchain and IoT. The authors in [7] have proposed a decentralized architecture in order to further expand the sustainability of IoT devices. Initially, from the firm's side,

the maintenance cost of current centralized model is very high. Further, from the consumer's point of view, there exists the lack of trust in the devices that needs to provide a security through transparency among the users. These problems are solved through a trustless and a scalable peer-to-peer model that can maneuver transparently and able to distribute data securely.

The Benet [8] has proposed a technique that provides IPFS system that allows the devices either craft with the elegant contracts tackle parched into their blockchain user, or they out concerning it via a finding service. Further, the clients can doubt the contract and out about the novel firmware and appeal it by its hash via a disseminated file system. The initial needs for this file/sleeve will be provided by the firm's own knob. After the binary has proliferated to enough nodes [9], the company's node can impede serving it. This process occurs automatically without any user interaction. Moreover, a blockchain system where cryptocurrency is bartered offers a suitable billing level and overlay the means for a souk of services among the objects. The device that hoards a replica of the dual may indict for allocating it, in sort to attain the profit or sustain the infrastructure costs. File coin is another example that permits the devices to lease their disk spaces and Ether APIs that formulate it probable to legalize API calls. The caller desires to offer the essential micro payment either in Ethereum or in Bitcoin before requesting them [10]. Furthermore, Slock [11] works on the curls of the smart electronic that carries the appropriate token and can be unlocked with a device. These symbols are acquired on the Ethereum standard of blockchain, a public system recognized for elegant contracts to utilize its personal cryptocurrency known as Ether [12]. The depicted Table 1 presents number of blockchain applications discussed by various authors.

3 Use Cases of Blockchain

In this section, we have discussed the fields or uses cases where blockchain technology has been applied or can be implemented. *Supply chain*: Supply chain use cases are the main blockchain application for deciphering the genuine business harms due to the requirement of traceability of products or workers information. Shipment impediments are regularly due to mediators inside the supply chain whose job is an endorsement of reports allied with the consignments [13]. Further, in *Bitcoin*, blockchain expertise can be useful in several pastures and applications. Swan recommended that blockchain applicability progression ongoing with Bitcoin that is blockchain 1.0, then progressed in the direction of smart contracts such as blockchain 2.0 and soon enthused to efficiency, impartiality and synchronization submissions (blockchain 3.0). *Smart contracts*: It can be functionalized in various convenient cases counting mortgages, international conveys and throng funding. For running smart contracts, Ethereum is debatably defined as the most popular blockchain-based platform. Even though, it can really run other dispersed relevance's and cooperates with additional blockchain. Beyond smart contracts and crypto currencies, blockchain expertise can be practical in dissimilar areas where IoT applications are concerned

Table 1 Related work of blockchain technology

Blockchain application	Description	Architecture type	Ensures real-time security
Firmware network	Used blockchain technology in order to ensure the trust among IoT devices	Decentralized	No
Smart contracts	Provides IPFS system that allows the objects either craft with the smart contract's deal with arid into their blockchain user	Distributed	Yes
Cryptocurrency	Formulate it probable to legalize API calls. The caller desires to offer the essential micro payment either in Ethereum or in Bitcoin before requesting them	Peer-to-peer network	No
Smart locks	Works on smart electronic curls that carries the appropriate token and can be unlocked with a device	Network	No
IIoT	Ensures the trust in IIoT in decentralized networks using deep learning	Centralized and decentralized	Yes

such as data storage sensing, time-stamping services, identity management, intelligent transportation systems, smart living applications, supply chain management, wearable's, cyber law, mobile crowd sourcing and defense in military scenarios [14]. *Agriculture*: Blockchain can also be worn in IoT farming use cases. For instance, the authors in [15] have offered a traceability scheme for trailing the food supplies of Chinese agri. The structure depends upon blockchain and the use of radio frequency identification (RFID) in order to improve the food quality and safety and to diminish the victims in logistics. *Energy saving*: Blockchain application can be used in saving the energy in networks. The energy region is capable of profited from the relevance of blockchain or to Internet of energy (IoE) or to IoT [16]. *Healthcare* with IoT enabled blockchain relevance is established in the prose as well. For example, it offered a traceability relevance that creates the exploit of blockchain technology and IoT sensors to confirm the public accessibility and data integrity to record the temperatures in the pharmaceutical deliver series [17]. It also appeal that the work

explained and deployed a general smart healthcare scheme that constructs the use of IoT objects, blockchain, fog computing and message advisers. IoT below-level refuge can furthermore be improved via blockchain expertise [18]. Last but not least, *Industry*: In order to trace the every activity of the workers location and products supply in the industrials can be successfully handled by the blockchain technology with lost maintenance cost. The authors in [19] have described different industrial applications based on blockchain including their connection to industrial IoT (IIoT) systems. In this manuscript, we have considered the usage of blockchain in industrial IoT that helps to improve the industrial growth by tracing each and every activity of the industry.

4 Blockchain in IIoT

Nowadays, Industry 4.0 defined to the next phase in the organizations progress to trace and control each activity of their entities. Its principle is to accumulate, evaluate, record and control the whole activities of creature automated in real-time environment with improved quality and reduced production cost. Industry 4.0 is honestly associated with the exploitation of smart devices that persuaded to handle their assets in a more flexible, efficient and fast way. Further, smart devices may look over the whole management system (i.e., products manufacturing rate, products selling/consuming costs, malicious activity, workers location, etc.) without any involvement of man power. For employing this scenario, we require Internet of things (IoT) as an indispensable since they permit for managing or looking over the entire behavior on real-world stuffs. In IoT world, the controlling instructions and alert messages can be concerned instantly to the manager from anywhere in a specified facility. The implementation of more associated devices, however, may lead to personnel safety and information security concerns. The IoT permits real-time imprison of information from sensors as the price of actuators and sensors remains falling and businesses in the industrial sector are capable to conquer cost impediment in adopting IoT podiums. Further, the sensors deployments may ease the privacy and security concerns about the product pilfering or any mischief in the organization. Whenever the information are composed of different sensors, actuators and machines within an industrial milieu, the information access/control and generation of devices are permitted through the Internet then such a situation is called the industrial Internet of things (IIoT) [20]. Presently, IoT explanations trust on the federal client/server architecture concerning to cloud servers in the course of Internet. However, the user's data storage over cloud may integrate number of security concerns. The user may defend its data by trading its private cloud which further augments the budget and costs of the organization or user. Now a days, most of the industries have hybrid architecture that is the amalgamation of both centralized and decentralized where organization's entities are situated at different countries and the owners necessitate for maintaining and communicating the transparency of record of all the information between the companies. Industry 4.0 is intrinsically a decentralized or hybrid system, with

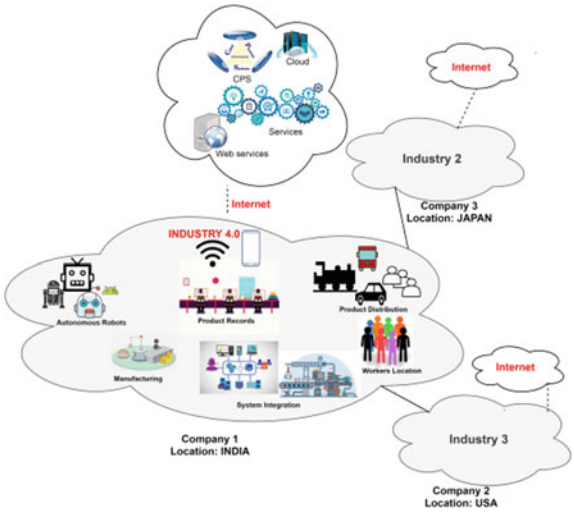


Fig. 1 Hybrid Industrial IoT (IIoT)

intelligence in independent creatures as depicted in Fig. 1. It consists of hybrid IIoT architecture situated at three different positions where each company is attached with own Internet expertise. If the companies headquarter is location in Delhi (INDIA) as presented in Fig. 1, then it has all the rights to oversee, examine or keep records of the entire tricks of all the companies positioned in different locations. IIoT give the benefit by monitoring or controlling all the illegal or legal behavior occurring at any of its company from a single place.

Despite a lot of IIoT benefits, control systems or smart devices may lead to numerous security and privacy concerns. Security and privacy breach in IIoT can be done in various ways such as enter into constrained places where one of the employees may pilfer some significant products, breaching the private data by compromising or hacking some of the smart devices. There must be an alarm that is engendered or buzzed in all the companies situated at different places. Therefore, it is necessary to propose a secure framework/technique to ensure security in the network. Blockchain expertise has been rising at an astonishing lick above the precedent two years. It is proficient to coordinate, track and carry out communication and accumulate in sequence from huge quantity of objects, allowing the formation of claim which entails no federal cloud. The blockchain would detain the products information and workers activity from IoT devices append to components or products as the consignment progress from source to destination. The recording of products or documents is done automatically through smart devices. Each activity of the company including product manufacturing, documentation and workers activity, a blockchain is maintained where each chunk comprise three mechanism such as information, hash and hash of preceding block. The information contains the actual information that defined the type of the blockchain such as the product manufacturing blockchain, documentation blockchain and workers identity blockchain, etc. The second component that is hash distinguishes a block and all of its actual information with a unique value.

Once a block is produced corresponding to the data its hash is being deliberate. The alteration of any data within the block will lead the change of hash, which will be easily identified by all the parties involved. The third element within each chunk is the hash of the preceding blocks which effectively generates a blockchain with transparency and security. Now, let us assume, where a worker assisted for recording the product entry within company may try to annoyance with the second chunk such as hash of the block, once the alteration in product count may lead to alter the hash and previous hash of the product that further leads all ensuing blocks irrational because they no longer accrue a suitable hash of preceding blocks. Therefore, varying a sole chunk will create all succeeding blocks deplorable.

5 Conclusion

In this manuscript, we have reviewed the state-of-art of IoT and blockchain technologies. Further, we have described various blockchain uses cases and explored the Industry 4.0 application in the Blockchain with a significant proposed scenario for IIoT application. The aim of this review paper is pointed out the significance of blockchain technology in various fields. Further, we have defined how a blockchain technology could be helpful in Industry 4.0 having a decentralized network. In our future work, we will propose a solution corresponding to the above IIoT blockchain discussion with some analyzed and evaluated parameters.

References

1. Keoh SL, Kumar SS, Tschofenig H (2014) Securing the internet of things: a standardization perspective. IEEE Internet Things J 1(3):265–275
2. Chadwick A, Collister S, (2014) Boundary-drawing power and the renewal of professional news organizations: the case of the guardian and the Edward Snowden national security agency leak
3. Lee I, Lee K (2015) The internet of things (IoT): applications, investments, and challenges for enterprises. Bus Horiz 58(4):431–440
4. Guo R, Shi H, Zhao Q, Zheng D (2018) Secure attribute-based signature scheme with multiple authorities for blockchain in electronic health records systems. IEEE Access 6:11676–11686
5. Crosby M, Pattanayak P, Verma S, Kalyanaraman V (2016) Blockchain technology: beyond bitcoin. Appl Innov 2(6–10):71
6. Fernandez-Carames TM, Fraga-Lamas P (2018) A review on the use of blockchain for the internet of things. IEEE Access 6:32979–33001
7. Lee CH, Kim KH (2018) January. Implementation of IoT system using block chain with authentication and data protection. In: IEEE international conference on information networking (ICOIN), pp 936–940
8. Benet J (2016) IPFS_Content Addressed, Versioned, P2P File System (DRAFT3). accessed on Mar. 15, 2016. [Online]. Available: https://github.com/ipfs/papers/raw/master/ipfs-cap2pfs/ipfs-p2p-_le-system.pdf
9. Huckle S, Bhattacharya R, White M, Beloff N (2016) Internet of things, blockchain and shared economy applications. Procedia Comput Sci 98:461–466

10. Yassami S, Drego N, Sergeev I, Julian T, Harding D, Srinivasan BS (2016) True micropayments with bitcoin. Available: https://medium.com/@21/true-micropayments-with-bitcoine64fec23ffd8
11. Slock.it_Blockchain + IoT, accessed on Mar. 15, 2016. [Online]. Available: https://slock.it/faq.md
12. Qi R, Feng C, Liu Z, Mrad N (2017) Blockchain-powered internet of things, e-governance and e-democracy. In: E-democracy for smart cities. Springer, Singapore, pp 509–520
13. Fawcett SE, Magnan GM (2002) The rhetoric and reality of supply chain integration. Int J Phys Distrib Logist Manag 32(5):339–361
14. Christidis K, Devetsikiotis M (2016) Blockchains and smart contracts for the internet of things. IEEE Access 4:2292–2303
15. Tian F (2016, June) An agri-food supply chain traceability system for China based on RFID & blockchain technology. In: 13th IEEE international conference on service systems and service management (ICSSSM), pp 1–6
16. Yao X, Wang Z, Yang Z, Wang Y (2013) Energy-saving, responsive membranes with sharp selectivity assembled from micellar nanofibers of amphiphilic block copolymers. J Mater Chem 1(24):7100–7110
17. Angraal S, Krumholz HM, Schulz WL (2017) Blockchain technology: applications in health care. Circ Cardiovasc Qual Outcomes 10(9):1–12
18. Sun J, Yan J, Zhang KZ (2016) Blockchain-based sharing services: what blockchain technology can contribute to smart cities. Financ Innov 2(1):26
19. Sikorski JJ, Haughton J, Kraft M (2017) Blockchain technology in the chemical industry: machine-to-machine electricity market. Appl Energy 195:234–246
20. Miller D (2018) Blockchain and the internet of things in the industrial sector. IT Prof 20(3):15–18

Deep Learning Framework to Predict and Diagnose the Cardiac Diseases by Image Segmentation

R. Kannan and V. Vasanthi

Abstract Technologies have been vastly developed in all sectors of the society. Especially in medical field, its growth has been at rapid phase. The newly invented medical equipment has currently been playing massive role in saving the lives of many patients if given the proper and timely treatment to them. Among many modern medical equipment, MRI scanning deserves special mention. Using this technology, we can have the detailed images of organs inside the body as well as categorize and identify the stage of disease. Moreover, with the help of MRI, myocardial disease can be categorized and assessed with several conditions. In particular, we can save patient from a critical situation. However, it is difficult to have an accurate prediction of the cardiac disease. Furthermore, the current medical procedures require more time and medical care to accurately diagnose cardiovascular diseases. Under these circumstances, deep learning method can be useful to have a segment clear and accurate cine image in very less time. A deep learning (DL) technique has been proposed to assist the atomization of the cardiac segmentation in cardiac MRI. We have adopted three types of strategies, according to which we firstly optimize the Jaccard distance to accept the adjective function and then implement the residual learning techniques to integrate it into the code. Finally, a fully convolutional neural network (FCNN) was trained to introduce a batch normalization (BN) layer. However, our standard results show for myocardial segmentation that time taken for volume of 128 × 128 × 13 pixels is less than 23 s which is found when the process is done by using 3.1 GHz Intel Core i9 to be volume.

Keywords Deep learning framework · UNET · MXNET · Heart disease

R. Kannan (✉)
Department of Computer Science, Rathinam College of Arts and Science, Coimbatore, India

V. Vasanthi
Department of ICT, Sri Krishna Adithya College of Arts and Science, Coimbatore, India

H. S. Saini et al. (eds.), *Innovations in Computer Science and Engineering*,
Lecture Notes in Networks and Systems 103,
https://doi.org/10.1007/978-981-15-2043-3_26

1 Introduction

The recent global survey reveals that the mortality rate of people dying due to cardiac-related disease is higher than any other disease. Heart disease is usually caused by a variety of factors. Some of the main factors are smoking, unhealthy food habits, being physically inactive, lack of sleep, uncontrolled diabetes mellitus, excessive alcohol intake, high blood cholesterol, excessive body weight, stress, etc. The block in one is more of coronary arteries and is also considered to be one of the most important causes of cardiac diseases. However, but in many cases, the delayed medical treatment proves to be fatal to the patients. In such cases, the modern medical technologies would come as a boon for the doctors and the lifesaver for the patients.

Over the past few years, technological advancement has been very useful in all sectors, especially in the medical field, in particular, diagnostic imaging technologies such as X-ray, CT-scan, MRI-imaging, etc. [1]. In specific, MRI-scan leads the role to help anatomy and physiology of the health and disease-forming processes in detail. The radiologist typically calculates the percentage of blood-flow process of the heartbeat to get a sense of heart health. The approximate value of healthy man should be at an ejection fraction (EF) measure of 55–70%. Radiotherapy can take up to 30 min for a case to get this metric for a general heart cycle. Besides, the diagnosis of the disease and the accuracy of the disease may vary depending on the doctors.

However, this method is not only a time-consuming process but also it proves to be difficult for the doctors or radiologists to take the accurate decision. Many techniques have been used for the problem of the left ventricle automatic segmentation. Most of these approaches are appropriate to the start of a process. A number of model-based left ventricular units, including active contours, the level-set method, active shape models and active appearance models are analyzed. Unfortunately, they have to be strongly dependent on their initial modeling opportunity. Generally, inappropriate initialization undesirable local minima of the objective function. Many recent studies on computer vision and pattern recognition will help to achieve a high level of techniques to solve challenging tasks such as classification, division and object detection. Subsequently, fully convolutional networks (FCNs) are trained for the medical imaging segmentation [2].

Though they are plenty of advantages in deep neural networks, the features of lower layer will be changed when upper layer and lower layer are adjusted during training of the deep neural network. This is considered to be a major demerit. The aspect of changing the inputs during the optimization is called internal covariate shift. In such a scenario, batch normalization is used for avoiding this error.

The proposed system has been developed with the aim to suggest an appropriate and exact automatic myocardial segmentation method for cardiac MRI on the basis of the deep convolutional neural network (DCNN). In this work, many types of architectural network have been used and trained to precise the interest of structures in the image. The sunny brook cardiac data has been applied for the training model. To further improve our system, we used the normalization for the purpose of CNN

method. The results illustrate that the proposed model we used for this study provides a rapid approach to the myocardial segmentation.

The structures that we have proposed are as follows: Firstly, we introduced the UNET architecture with the residual learning process and batch normalization. Secondly, we have also explained the objective and the training strategy used to training the CNN, then the proposed method for evaluating the MRI CINI image and finally, we have concluded the results of our proposed method.

2 Literature Review

In recent years, image segmenting plays a pivotal role, especially in medical image segmentation. Researchers are using various methods and techniques to segment the images using different datasets [3]. However, the results of the research are not identical. The various results obtained by researchers have been shown in Table 1.

After comparing both results of the researchers, it has been found that the results are quite different in accuracy. They are comparable with the results obtained from different accurate results.

Table 1 Image segmentation evaluation measures from several researches

Author	Method	Data	Evaluation measures
Mina Nasr-Esfahani, Majid Mohrekesh	Fully convolutional layer	York datasets of heart images collections from 33 patients	Dice score (0.872)
Chunliang Wang, Orjan Smedby	5-fold cross validation and average Dice coefficient	Multi-modality-whole heart segmentation (MMWHS) datasets which consist of 20 MRI and CT images	Average Dice coefficients for left ventricle (MRI 0.895, CT 0.935), right ventricle (MRI 0.795, CT 0.825), left atrium (MRI 0.847, CT 0.908), right atrium (MRI 0.S21, CT 0.SB1), myocardium left ventricle (MRI 0.807, CT 0.879)

3 Materials and Methods

3.1 Sunnybrook Cardiac Data (SCD)

The sunny brook cardiac data has been used to train and evaluate the present network for myocardial segmentation. The 45 MRI CINI images in the dataset with expert definitions are incorporated as part of the clinical practice. The 45 CINE MRI images have been obtained from various patients and pathologists, healthy, hypertrophy, heart failure with an infraction and without infraction. For the automatic segmentation of the left ventricle (LV) form MRI image, the SCD dataset was used by training MXNET model. We receive all MRI images with a temporal resolution (TR) of 20 cardiac phases, with each patient holding breath for 10′15 s. The images thus collected are then scanned to the end-diastolic phase.

SX MRI acquisition of endocardial and epicardial definitions is performed by experienced cardiologists in the slices at ED and end-systolic (ES) stages. Manual segmentation can serve as a basic tool for the purpose of evolution. Accordingly, we manually manipulated 128 × 128 pixels with a spatial resolution (SR) of 1.36 × 1.36 mm to select the ROI on the short axis surrounding the heart image. The extent of the ROI was defined as an inclusion of the entire left vertical with a medical specialist.

3.2 Image Preprocessing

MRI images taken by various scanners and radiologists not uniform in general. The deep learning algorithm cannot identify the various scanned images that are different in sizes. Subsequently, we can not be able to obtain the exact results by using the deep learning process. To have the identical images, following steps to be taken: Firstly, we have to rotate the images for getting them properly aligned. Some images could be smaller in size, in such case, we have to maximize them, whereas some images could be bigger in size, in such case, we have to minimize them to the proper sizes. Despite having completed some process, still some variances are there in images. So as to get them rectified, we have to rescale the images to 1.36 × 1.36 mm pixel level by using the pixel spacing square factor. After rescaling the images, the part of the image that is important for processing lies in 128 × 128.

In order to fasten the process, I have to crop the particular area of the image. For having better image quality, I have to adjust the contrast ration of the image for the purpose of identification of the left ventricle region of interest, certain approaches have been used. In order to obtain the improved results of the segmentation task in terms of processing and accuracy, left ventricle region of interest has been used to crop down the MRI image for focusing the left ventricles. The usage of a ROI image as the input into the MXNET would get you the image with less noise. The left ventricle in the MRI image has four different aspects, such as the heart cavity

containing the left ventricle that is near the center of the MRI image, the unique frequency of the left ventricle moment that is different from the frequencies of other heart muscles, the degree of pixel variance around the left ventricle muscle and the circle shape of the left ventricle. Those aspects have been employed for identifying the ROI.

3.3 Image Labeling and Cleaning

We can predict the results more accurately with image labeling and it is very difficult to label Sunny Brook Cardiac Data (SCD) heart images by manually. Because each heart images have more than 10 slices and those slices have 10–12 frames. We have used a label box automate tool for labeling entire images. After labeling, we have found that many patients' heart images have unevenness in the data and we have cleared or ignored or removed this kind of patient images before starting the training [4].

3.4 UNET Architecture

As shown in Fig. 1, the encode–decode in modified UNET system is used to classify the cardiac MRI images according to the configuration mode so that the features provided in the training set help the network learn the better process. Moreover, in the decode path, the network learns the image reconstruction process from the previously learned encoded features.

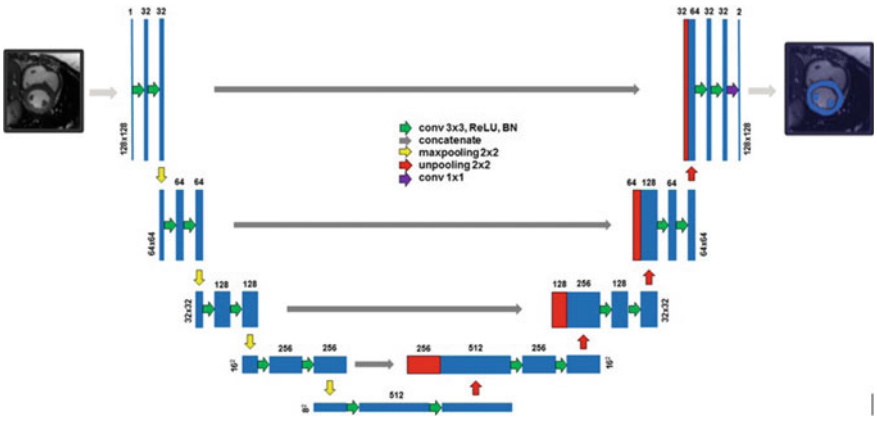


Fig. 1 UNET architecture

Also in Fig. 1, it is clearly shown that the most important characteristic of the UNET architecture is the interaction between the input of the decoding path and the output of the encoding path at each level. The ability to localize high spatial resolution (SR) features to the fully conventional network provided by these concatenations generates a more accurate output based on this information. Overlap tile strategy gives a way of clear segmentation of large images [5]. For the purpose of predicting the pixel in the border of the image, we assume and estimate missing context by using concatenation from the encoding path. The contraction path is composed of 3×3 and 3×3 convolutional layer. After performing the convolutional, we can increase the learning rate and speed the training time by using batch normalization. Course contextual images should be transferred to upsampling method for having clear images by the means of skipping certain connections. Prior to performing 2×2 max pooling operation to downsampling, residual learning system is performed. Avoiding the problem of vanishing gradients is the main reason behind skipping over layer [6].

Each of the encoding paths mentioned is very similar to the decoding path process. For e.g., each step is also known as up-convolution which halves the number of feature channels and concatenation with the related feature map from the encoding path and two 3×3 convolutions that are followed by RELU and a batch normalization (BN). Finally, in order to get the input of the next level, the residual learning is followed [7]. At the final layer, a 1×1 convolution is performed to map the 64 feature maps for the two classes that are used for myocardial segmentation (MS). After softmax nonlinear, the output of the last layer exemplifies the possibility of a pixel belonging to the myocardial on the left ventricle. In fact, the voxels with the likelihood of more than 0.5 are considered as a part of the left ventricles' tissue [8].

4 Results and Discussion

4.1 Training

Half of the images and their respective segmentation have been manually cropped into 128×28 pixels with a spatial resolution of 1.36×1.36 mm. An expert designed this ROI size to make sure that the entire left ventricle had been taken into consideration. In proposed UNET, we employ Jaccard distance as an objective function in the place of Dice's coefficient generally applied in image processing [9, 10]. It is not easy to categorize myocardial using only the medical information, and therefore, one or two medical authorities are needed to determine their true condition. Therefore, to improve the results of our research, more original datasets have been used to train the network architect. Moreover, for teaching the network desired in variance and robustness properties, the data argumentation is very important. Accordingly, during each training cycle, the input of the network is randomly deformed by a spatial shift in the short axis 10 range, which is rotated up to 10 degrees on the short axis, using

the b-spline interpolation and Gaussian deformations field ($\mu = 10$ and $= 20$) zoomed up to 2X. For the purpose of reduction to data storage and obtaining a 5500 new images overall, the data argumentation is employed on the fly.

4.2 Results

Three sets of experiments had been carried out for the purpose of evaluating the methodology on the Sunny Brooks Data. The papillary muscles were not taken into consideration for the first two experiments on both automatic and manual segmentations as the result of the prospective method would not spot papillary muscles (PM) as section of myocardial tissue.

In the first experiment, we evaluated the batch normalization, residual learning and the proposed objective function loss, with regards to generally used to Dice coefficient for the classic UNET architecture. We have come to know with the help of empirical results that Jaccard (0.6 ± 0.1 mean accuracy Dice's value) outplays the Dice's coefficient (0.5 ± 0.1 mean accuracy Dice's value) when it has been employed as the objective loss function. In addition to that (Fig. 2a) shows that this progress (Jaccard distance vs Dice coefficient) is not related to batch normalization (BN) and residual learning. As per results shown in Table 2, the usage of batch normalization

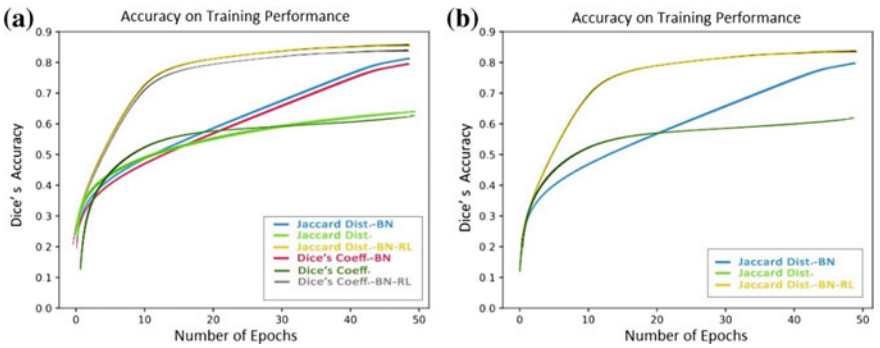


Fig. 2 Batch normalization and residual learning strategies

Table 2 UNET image segmentation accuracy

SF	Architecture	Dice's Acc
2	U-net-Dice's	0.7491
2	U-net-JD	0.7494
2	U-net-BN-JD	0.8697
2	U-net-BN-RL-JD	0.8899
1	U-net-BN-RL-JD	0.9108

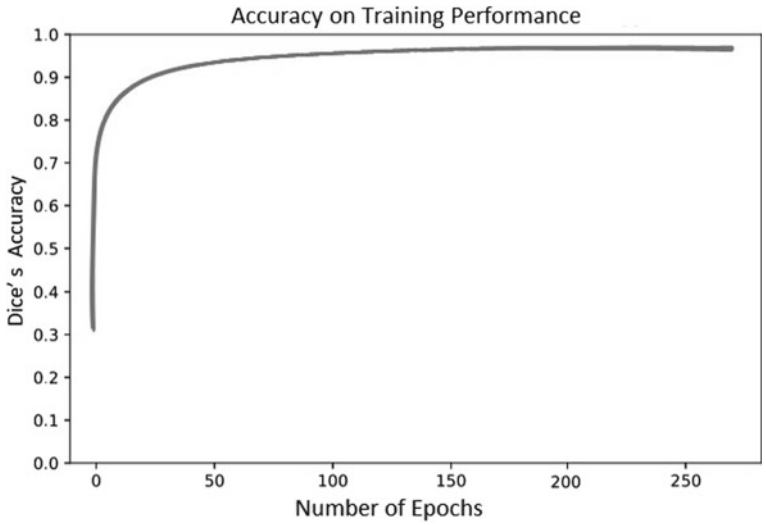


Fig. 3 UNET architecture accuracy of training performance

and residual learning (RL) strategies is the most important to obtain an accurate and exact myocardial segmentation.

In addition, the higher myocardial segmentation accuracy is shown by the combination of two strategies. But we can come to the conclusion that batch normalization's contribution is superior to the residual learning contribution if the strategies of training accuracy of batch normalization (BN) and residual learning (RL) are analyzed. Also, we can conclude basic UNET for our architecture, if compared with the training accuracy of residual learning. However, it is strongly recommended to employ both strategies together, because the accuracy by employing them together is remarkably greater than the individual contribution of the strategies as shown in Fig. 3.

The accuracy of our second experiment in Fig. 3 shows that the accuracy achieved during the training iteration of the classification of cardiovascular disease in the CNN method, i.e., in 30 epochs. In this case, the current CCN reaches the value of the 0.9 and for the Dice's coefficient, respectively, that can be compared to manual segmentation.

In the third experiment when the papillary muscles are taken into consideration as the part myocardial tissue, there is a possibility of diminution in accuracy as it formed myocardial classification in exact order. Hence, we got 0.89 for the Dice's coefficient and mean squared error 0.01.

The first example image as shown in Fig. 4 is automated 3D myocardial segmentation. In particular, the myocardial segmentation in the three orthogonal views is shown in Fig. 4a and then 3D views section in Fig. 4b. Qualitative details of the automatic 3D myocardial segmentation as shown in Fig. 5 can be seen in several slices in Fig. 5a. These examples illustrate the appropriate approach for myocardial infarction that we proposed to the myocardial infarction. Those voxels where

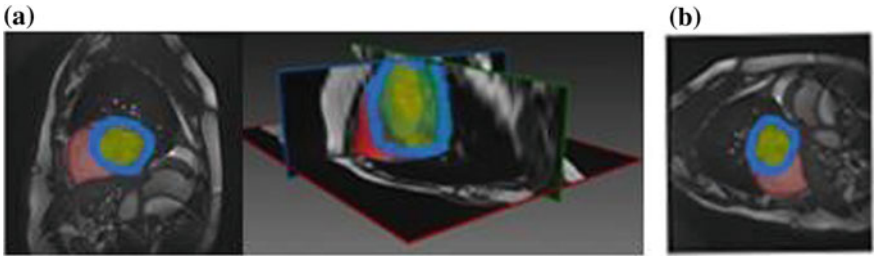


Fig. 4 Example of image segmentation

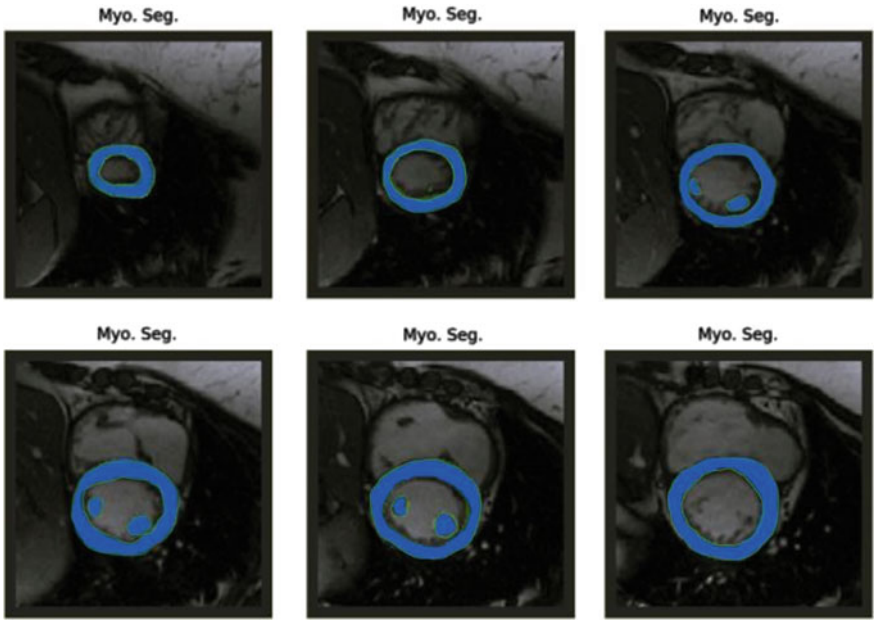


Fig. 5 Qualitative results of image segmentation

the recommended automatic segmentation and the manual myocardial segmentation overlap, are depicted in yellow color, otherwise the voxels will be depicted in blue. Those pixels in blue can be considered only a reduced number of voxels corresponding to a non-overlapping classification.

5 Conclusion

Myocardial segmentation using deep learning method has been explained and illustrated in this paper. The following methods such as a batch normalization and residual

learning strategies and Jaccard distance as an objective loss function are pertinent for segmenting the myocardial.

Thus, quantitative and qualitative outputs have shown that the prospective technique can be used to evaluate different functional and structural feature diagnosis and treatment of various pathologies. Prior to this research, the preform deformation and real-time data augmentation play a vital role, and for this process, we only needed 23 cardiac MRI images. Its processing time is 7.1 h and the NVIDIA TELSA c2075 (12gb) is used to get the correct accuracy of 0.9018 Dice's coefficient.

Segmentation and monitoring of different cardiac structures, such as the left ventricle, are considered beneficial for all clinicians. Nevertheless, accuracy and reliable measurement value metric analysis and operational evaluation are highly dependent on application interactions. The strategies and conclusions of our research can also be used as a base for evaluation of different structural separation aspects of heart. In addition, this work extends the automatic detection and monitoring of right and left ventricles.

References

1. Li X, Chen H, Qi X, Dou Q, Fu C, Heng P (2018) H-Dense UNET: hybrid densely connected UNET for liver and tumor segmentation from CT volumes. IEEE Trans Med Imaging 37(12):2663–2674
2. Voulodimos A, Doulamis N, Doulamis A, Protopapadakis E (2017) Deep learning for computer vision: a brief review. Comput Intell Neurosci 2018(13):1687–5265
3. Nasr-Esfahani M, Mohrekesh M, Akbari M, Soroushmehr S.R, Karimi N, Samavi S, Najarian K (2018) Left ventricle segmentation in cardiac mr images using fully convolutional network. In: Computer vision and pattern recognition, pp 1802–07778
4. Payer C, Štern D, Urschler M (2017) Multi-label whole heart segmentation using CNNs and anatomical label configurations. STACOM@MICCAI
5. Yuheng S, Hao Y (2017) Image segmentation algorithms overview. In; Computer vision and pattern recognition, pp 1707–02051
6. Wang C, Smedby Ö (2018) Automatic whole heart segmentation using deep learning and shape context. In: Statistical atlases and computational models of the heart, STACOM@MICCAI, vol 10663, pp 242–249
7. Papandreou G, Chen LC, Murphy K, Alan L (2015) Weakly- and semi-supervised learning of a DCNN for semantic image segmentation. In: IEEE international conference on computer vision, pp 1742–1750
8. Chen LC, Papandreou G, Kokkinos I, Murphy K (2018) Deep lab: semantic image segmentation with deep convolutional nets, atrous convolution, and fully connected CRFs. IEEE Trans Pattern Anal Mach Intell 40:834–848
9. Boopathi Kumar E, Thiagarasu V (2016) Color image segmentation techniques: a survey. Glob J Eng Sci Res 2348–8034
10. Mohamed RG, Seada NA, Hamdy S, Mostafa MGM (2017) Automatic liver segmentation from abdominal MRI images using active contours 176(1):0975–8887

An Exhaustive Review on Detecting Online Click-Ad Frauds

Anurag Srivastav and Laxmi Ahuja

Abstract Social media has become a targeted place for hackers and intruders. The problem is that the detection mechanism which we use is not capable of detecting all the click frauds and has not raised the bar to commit click fraud but is very much effective in the long run. Today's web browsers support a rich variety of web standards in which a click-bot must be implemented to evade the detection mechanism. A click-bot of heavy size will risk itself of being easily detected by the host. This paper will show a brief review of how this system of detecting fraud-ad works and how we can prevent it from happening with us. This paper reviews what different existing techniques can be used in a more effective way and how they function in a given situation and the ways by which we can keep our data safe from these fraudsters.

Keywords Fraud-ads · Click-bots · Detection mechanism · JavaScript · Machine learning

1 Introduction

According to the situation of present cutting edge in click fraud, we initially portray click-bots and human clickers, the two fundamental on-screen characters utilized to submit click fraud. We at that point talk about the promoter's job in restraining click fraud. At last, we portray the web benchmarks broadly bolstered by current programs, just as highlight detection strategies.

In the click fraud, there are two types of fraudsters involved, whether it can be a click-bot which is programmed to automatically place ads and another is human clickers which manually clicks the ad and increases the impression which helps in

A. Srivastav (✉) · L. Ahuja
Amity Institute of Information Technology, Amity University, Noida, Uttar Pradesh, India

L. Ahuja
e-mail: lahuja@amity.edu

H. S. Saini et al. (eds.), *Innovations in Computer Science and Engineering*,
Lecture Notes in Networks and Systems 103,
https://doi.org/10.1007/978-981-15-2043-3_27

earning money to the publisher. Human clickers can also place fake ads on the screens of user's systems. The systems which are not secured properly get attacked by these types of frauds.

1.1 Click-Bots

A click-bot carries on like a program yet typically has moderately restricted usefulness contrasted with the last mentioned. For example, a click-bot is not strong enough to describe or execute sites made with HTML, CSS and JavaScript. Along these lines, right now, a click-bot is described as malware embedded in an unfortunate casualty's PC. Notwithstanding accepting a modern click-bot furnished with abilities like a genuine program, its real difficulty conduct when associated with the publicized site would in any case be different from that of a genuine client. This is in light of the fact that click-bots are motorized activities and are not adequately progressed to see and think as human customers, and beginning at yet, do not go about as human customers [3].

A common click-bot plays out some ordinary limits including starting the sale of Hyper Text Transfer Protocol to the Web sites then regaining its substance from the web server. In any case, it does not be able to submit click fraud itself, and however, it requires a remotely accessed bot to complete the fraudulent [2] (Fig. 1).

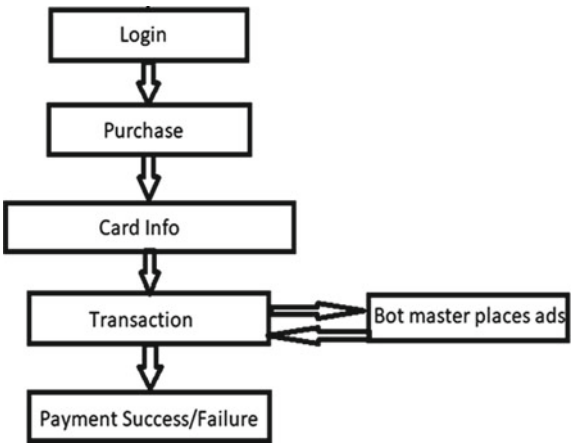


Fig. 1 Represents how an unfortunate casualty have conducts click fraud under the command of a bot-master [1]. Firstly, the website asks for login details which user have to fill followed by purchase of items. The most sensitive part comes when payment process starts. After selecting item of purchase, it asks for card details, then the user makes the transaction. Here, at the transaction stage, fraudulent happens. Bot masters or remote bots places their ads to steal card information from the user once the user clicks the ad [10]

1.2 Detection Mechanism

Highlight detection is a system that recognizes whether a component or capability is upheld by a program's specific condition. One of the regular strategies utilized is reflection [5]. In the event that the program does not bolster a specific feature, JavaScript functions return invalid while referencing the element; generally, JavaScript restores a non-invalid string. The program gets invalid when used JavaScript with "document.createElement."

Highlight detection methods have three essential focal points. To begin with, highlight detection can be an effective instrument to distinguish click-bots. A click-bot cannot "pass" the element detection except if it has actualized the fundamental usefulness of a genuine program. Second, incorporate detection centers around the client's helpfulness by and large, and even many categories and variety of features can be used to detect these ads in more reliable manner [6].

2 Literature Review

Fraud detection turned out badly—Human survey and transaction rules
As indicated by Fraud Benchmark Report by cyber-source 83% of North American organizations lead manual surveys, and on a normal, they audit 29% of requests physically. Association of people gives bits of knowledge about fraud designs and authentic client conduct. These experiences can tweak robotized screening rules. Be that as it may, the manual audit is expensive, tedious and prompts high false negatives. Because of low trust in robotized arrangements, manual audit staff represents the significant measure of their fraud the board spending plan. Organizations must put resources into comprehensive preparing for representatives dealing with the manual survey. Preparing the workforce to physically audit exchange is tedious and costly. Manual surveys likewise increment the time required to satisfy the request. Client dissatisfaction can sneak in for administrations, for example, digit and programming where the client needs a speedy arrangement.

Over 90% of online fraud detection stages use exchange guidelines to coordinate suspicious exchanges through human audit. Shockingly, this customary methodology of utilizing tenets or rationale articulation to question exchanges is as yet utilized by certain banks and installment entryways. The "rules" in this stage utilize a blend of information and skyline filtering. The aftereffects of this procedure are commonly twofold marking the exchanges as valid or fraud [7].

Groups of hoodlums additionally use malware and phishing messages as a way to bargain clients' security and individual subtleties. Once acquired, fraudsters will utilize these subtleties to get to client accounts or to submit fraud. These strategies all intend to bargain clients close to home and monetary subtleties, including card

information, so as to empower the offenders to submit fraud. Here, the card information utilized is real, however, not under the assent of the proprietor. In these cases, such guidelines and human audit would neglect to square exchanges.

AI is the exploration of planning and applying calculations that can take in things from past cases. It utilizes complex calculations that repeat over extensive informational indexes and break down the examples in information. The calculation encourages the machines to react to various circumstances for which they have not been expressly modified. It is utilized in spam detection, picture acknowledgment, item proposal, prescient investigation and so on.

AI is a 3-section cycle, for example, Train-Test-Predict. Upgrading the cycle can make expectations progressively precise and significant to the particular use-case [9].

2.1 Opportunities for Click-bots to Attack

There are two approaches in which a click-bot waits to attack a user's unsecured PC [8].

Active Approach: If a user is clicking any site or link over the Internet without thinking and the user's PC is not secured, the click-bot uses that user as a bait to attack as it places random ads in which the user clicks and gets attacked.

Passive Approach: In this approach, the bot reads the clicking patterns of user and learns the sites which the user is searching for or intended to search for and then bot places itself to work.

2.2 Existing Techniques

Signature Based: To detect a click-bot, this technique is useful as it detects the patterns of the click-bot as a click-bot is not a human, it repeats the same pattern.

Anomaly Based: A click-bot can be detected easily with the help of this technique as when a bot places a random ad while surfing a total different topic, this technique detects it as a bot.

Credential Based: This technique uses the credential of the ad to check whether it is genuine or not. It basically checks how many times and where this ad has been pop-up.

Honeypot Based: This technique uses a script to trick the ad because being a human we can understand what is a trap but click-bot does not.

3 Proposed Work

There can be three stages/approaches to stop these types of frauds:

The primary methodology, exploring the issue of fundamentality by spreading awareness of frauds which is done through placing ads. These can get you lose your credit card and many valuable things. People should start learning cryptographic use in today's use of the Internet. Use of SSL in the web sites helps in creating a secure link between the web server and client.
The second methodology concentrated on the best way to make the installment framework versatile to make the fraud-ad publisher to remove that ad from the specific web site.
The third methodology gives favorable position to representatives in the weapons' contest. The methodology proposes traffic investigation systems that distinguish "problem areas" of traffic between the assaulted elements.

4 Methodology

There is a revolution coming up in online fraud detection among the new start-ups. This revolution has evolved from 2017 which expands the idea of protecting their businesses and personal data on the Internet. They are using the capability model according to the online fraud detection market direction [4]. The model consists of seven stages:

a. **Static Data-Based Identification**

It helps in gathering information like security passwords and other patterns used. Mostly payment page uses this in their security protocols.

b. **Rule-Based Risk Assessment**

This step helps the organization go through their security check-ups according to the rule. This does not always suitable because of the lack of security.

c. **Endpoint Profiling**

It is used the user's PC is connected to the Internet. Mostly, it is used check the behavior of the system when connected to the Internet.

d. **Entity Relationship Graph**

Basically, it has been used to check the functionality of more than one module connected to each other and their response to the database.

e. **Behavior Analytics**

It helps in analyzing the behavior and action of the user and performs action accordingly. It is widely used future trend prediction.

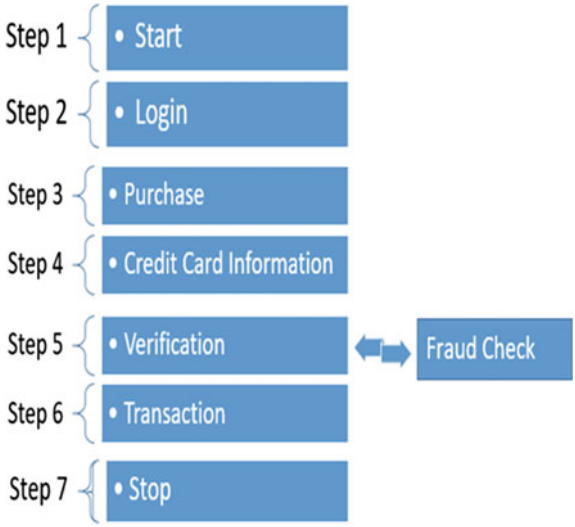


Fig. 2 Model for fraudulent detection

f. **User Interface Protection**

Additional feature added in the user's PC to protect from cyber-criminals as the UI is not protected completely.

g. **Continuous Risk Assessment**

After passing through each stage, there is a check-up for risk assessment at each stage to find any casualty which can affect the user's PC.
Every entity in the capability model identifies frauds including synthetic ones [8]. Continuous risk assessment is done on the basis of transactional frauds which is shown in Fig. 2 [11].

5 Conclusion

Since AI is an extremely prominent field among academicians just as industry specialists, there is an enormous extent of advancement. Experimentation with various calculations and models can help your business in detecting fraud. AI strategies are clearly dependable than human survey and exchange rules. The AI arrangements are proficient, adaptable and process countless continuously.

Since the growth of fraudsters increasing, be it a click-bot or a human clicker, the security ways and techniques are also coming up to provide protection from these. As discussed in the paper, existing techniques and current detection mechanism can be used at an improvised level to provide security to different business or a personal PC.

Acknowledgements Authors express their deep sense of gratitude to the Founder President of Amity University, Dr. Ashok K. Chauhan, for his keen interest in promoting research in the Amity University and have always been an inspiration for achieving great heights.

References

1. Australian Bureau of Statistics (2016) Credit card fraud statistics. Abs
2. Daswani N, Stoppelman M (2007) The anatomy of Clickbot.A. In: HotBots'07 proceedings of the first conference on first workshop on hot topics in understanding botnets
3. Geometry R, Analysis G No 主観的健康感を中心とした在宅高齢者における健康関連指標に関する共分散構造分析
4. Green J Aruba Perspectives with Gartner Report "Seven Imperatives to Adopt a CARTA Approach", pp 1–24
5. Kintana C, Turner D, Pan J, Metwally A, Daswani N, Chin E, Bortz A (2009) The google ad traffic quality team the goals and challenges of click fraud penetration testing systems. Issre
6. Kshetri N, Voas J (2019) Online advertising fraud. Comput (Long Beach Calif) 52:58–61. https://doi.org/10.1109/MC.2018.2887322
7. Mungamuru B, Weis S (2008) Competition and fraud in online advertising markets. In: Lect Notes Comput Sci (including Subser Lect Notes Artif Intell Lect Notes Bioinformatics), vol 5143, LNCS, pp 187–191. https://doi.org/10.1007/978-3-540-85230-8_16
8. Nagaraja S, Shah R (2019) Clicktok: click fraud detection using traffic analysis
9. Oentaryo R, Lim E-P, Finegold M, Lo D, Zhu F, Phua C, Sim K, Nguyen MN, Faisal M, Aung Z, Woon WL, Chen W, Berrar D, Cheu E-Y, Yap G-E, Perera K, Neupane B, Patel D, Oentaryo DB (2014) Detecting click fraud in online advertising: a data mining approach Ghim-Eng Yap
10. The Fraud Practice; Fraud Library—History of Credit Card Fraud
11. Council Post—How to Reduce Chargebacks Without Killing Online Sales

Image Enhancement of Historical Image Using Image Enhancement Technique

Roshan Raj Jajware and Ram Bhushan Agnihotri

Abstract Image enhancement technique is one of the very challenging issues in the image processing technique. The main motive of the image enhancement process is to work on an image or picture so that the result should be more applicable than original. Historical docs are very important origin of information, but it commonly suffers from the problem of getting degrade. The main aim is to keep all of these documents secure and alive. The purpose is to enhance the quality and visualization of the historical image. In this paper, we have used improved adaptive histogram equalization of the contrast of the image, and we have analyzed the result.

Keywords Historical · Image · Color · Histogram · Document · L*A*B* color space · RGB color space · Entropy

1 Introduction

Historical images and texts getting blurred or degrade day by day to preserve them we have to do something, and I am going to do this image enhancement of historical image using image enhancement technique to save the history so that people are able to see all those clearly by naked eyes. Historical images are very important for us by this in future people will able to recognize the old India or the old world, the original images of great peoples and many things like that. In this, I will remove noise from image and preserve the image for long time. There are many other processes to enhance the image, but my aim is to make it easy for the people. In the process of clearing or sharping the image, one of the monotonous works is to recognize the historical document. Historical images must face many problems such as bad paper quality, degradation and lack of standards alphabet, stain and noise dense [1]. Historical and ancient documents are preserved in libraries and in museum in all over the world; to expose these documents to the public firstly, we must make it clearer and sharper [2]. There are many techniques to make blur image clear like contrast enhancement and noise filtering [2].

R. R. Jajware (✉) · R. B. Agnihotri
Amity University Noida, sector 125, Noida, India

H. S. Saini et al. (eds.), *Innovations in Computer Science and Engineering*,
Lecture Notes in Networks and Systems 103,
https://doi.org/10.1007/978-981-15-2043-3_28

2 Literature Review

To make historical image better, they present a background light intensity algorithm. In this algorithm, they used an adaptive linear purpose estimated the rough background because of the rough surface of the background paper, aged color and the light source of that camera which has been used for the image lifting. They have downloaded 100 hand-written documents images from somewhere; they took those images because those images have some problems because of uneven background problems [2]. Then, they make them sharper and clearer so that people can read that. The main motive of image enhancement is to work on an image and make that image more suitable for a specific application. Digital image enhancement tricks provide a multitude of choices for improving the visual quality of those images [3]. Computational techniques involve contrast enhancement and noise filtering on two-dimensional image arrays [4]. This paper proposed an original technique for improvement, which combines two powerful noise reduction techniques. The steps involved are like total variation framework [2]. cleaner picture or image and contains of a filter grounded on Non-local Means some techniques use only grey level histogram, some use spatial while others are using fuzzy set theoretic approaches [5]. Image enhancement algorithms offer a variety of approaches for modifying images to get visually acceptable images [6]. The two most popular image segmentation techniques are the first technique is active contours later applied by applying the level set formulation and additional refined [6]. This chapter has presented a three-stage approach. The first stage is for removing noise while conserving significant features this stage is an anisotropic filter. The second stage is for the enhance edges and partially reverse the smoothing that is repeatedly a importance of tomographic reform this stage applies unsharp mask sharpening [7]. The new version of persona and malek theory has been proposed for edge detection and image restoration, and in that updated version, they kept all the improvements and avoid the drawbacks [8]. In order to secure the compatibility with the lower resolution or parameter of applications and databases, to take the advantages of higher resolution or parameter printers and to maintain the higher throughput, this is desirable to perform the required pixel image data processing at the destination printer rather than that the computer [9]. Some of the image processing techniques, which are being used to give better representation of image, are the noise filtering, and one of the famous techniques is histogram equalization and the power-law transformation [10].

3 Methodology

To improve the contrast of any color image with respect to make the image clearer and sharper so that it can be visible from a naked eye is typically done by transforming the image to a color space that should have the image luminosity as one of the components, such as the L*A*B color space. Here, we perform the contrast

adjustment on the luminosity layer "L*" only, and then, the image is transformed back to the RGB color space. Manipulating luminosity affects the intensity of the pixels, while securing the original colors.

*3.1 L*A*B* Color Space*

The CIELAB color space or L*A*B* color derived by the CIB. It expressed the color as the three number values, that is L*A*B*, where L* is for the lightness of the image, A* is for the green-red and B* is for the blue-yellow color components. CIELAB designed to emotively dependable according to the human color vision. Assuming that the same value of number changes in these values is similar to visually impaired changes, regarding the given white point, The CIELAB model is device-free, and it defines the color separately how they designed or showed. The use of CIELAB color space is usually done when the graphics for the print has to be from RGB to CMYK. Since the CIELAB gamut contains both RGB and CMYK color model.

3.2 Histogram Equalization

Adaptive histogram equalization is a type of technique, which allows adjusting the intensities of an image so that anyone can enhance the contrast of that image. This method usually used to increase the global contrast of any image. By using this adjustment, we can distribute the intensities in a better manner on the histogram. This allows for areas of lower local contrast to gain a higher contrast. Histogram equalization completes this by effectively spreading out in the most common intensity values.

3.3 RGB Color Space

An RGB color space is the preservative color space, which is specialized in the RGB color model. A distinct RGB color space defined as in the three chromaticity of the R as in red, G as in green and B as in blue additive primaries and can create any of the chromaticity that is the triangle characterized by those elementary colors. The entire spec of the RGB color space also needs the white point chromaticity and the gamma correction curve. We can also understand RGB color by thinking it as all the possible colors, which can be made from the combination of the three colored lights for red, green and blue.

Table 1 Table of entropy

Original image entropy	Enhanced image entropy
6.6036	7.4262
7.1314	7.6754
7.4184	7.7638
7.4024	7.8159
7.2483	7.6916
7.3501	7.8305
6.9311	7.5960
7.2975	7.8300
6.0756	6.8426
6.5341	7.4126

4 Result

The experiments conducted using GNU Octave 4.2.1 and MATLAB 2018a Windows 10, 64 bits OS with Intel Core TM. 1.90 GHz CPU and 4.00 GB RAM. Ten test images of different types are taken from open access Web sites. We have taken different images. Historical texted or related to historical documents to show the verities of blurred images. In this paper, the following images are taken under consideration: blurred stamp paper, notes, latter, newspaper, death certificate, stamp paper, certificates. Entropy selected for quantitative analysis of the result test images. Entropy used to evaluate the quality of an image. Higher value of entropy means better image quality. Entropy can be calculated from histogram of the image. It is the measure of unpredictability of an image. It can be used to characterize the image content.

Entropy is given by:

$$E = -\log_2 \ p$$

where p contains the normalized histogram count.

Chart:

Table 1 shows the value of entropy of raw image and the entropy of the furnished image.

In this paper, the entropy of the original image and the enhanced image are calculated by experimenting using MATLAB.

5 Conclusion

In this paper, I downloaded ten historical blurred images in which some are texted documents, while some are certificates; I downloaded them from an open Web site and by applying all those methods, which I have proposed below, we got the image

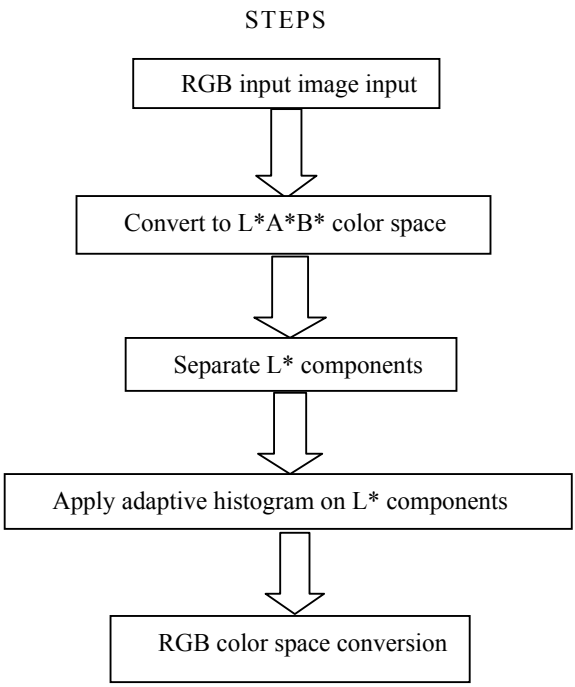


Fig. 1 Steps which i have followed to make the image sharper and clearer

clearer and sharper. The steps, which I have followed, are shown in Fig. 1. In Fig. 2, there are two tables, table "a" and table "b" where the table "a" contains the raw image and the table b contains the enhanced image, there are in total 20 images, and 10 of them are raw and the remaining 10 are furnished. In Fig. 3, the red pole on the chart shows the entropy level of the raw image, which I have downloaded and the blue one shows the entropy level of the enhanced image you can see the difference clearly and to make it more clear I have drawn a table also as you can see it in Fig. 3.

Fig. 2 Twenty images in two columns: column 2.1 contains the raw image and column 2.2 contains the furnished image which i have made sharper and clearer

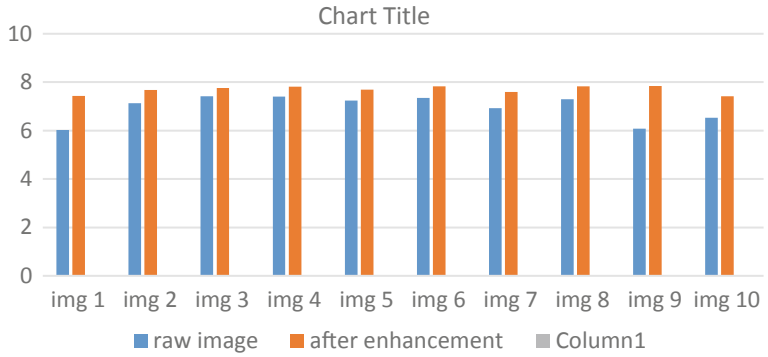


Fig. 3 Entropy level of the image the blue color shows the entropy level of the raw image, while the red color shows the entropy level of furnished image

References

1. Hong L, Wan Y, Jain A (1998) Fingerprint image enhancement: algorithm and performance evaluation. IEEE Trans Pattern Anal Mach Intell 20(8):777–789
2. Lee J-S (1980) Digital image enhancement and noise filtering by use of local statistics. IEEE Trans Pattern Anal Mach Intell 2:165–168
3. Shi Z, Govindaraju V (2004) Historical document image enhancement using background light intensity normalization. In: Proceedings of the 17th international conference on pattern recognition, ICPR 2004, vol 1. IEEE, pp 473–476
4. Maini R, Aggarwal H (2010) A comprehensive review of image enhancement techniques. Preprint at arXiv: 1003.4053
5. Likforman-Sulem L, Darbon J, Smith EHB (2011) Enhancement of historical printed document images by combining total variation regularization and non-local means filtering. Image Vis Comput 29(5):351–363
6. Pal NR, Pal SK (1993) A review on image segmentation techniques. Pattern Recognit 26(9):1277–1294
7. Sheppard AP, Sok RM, Averdunk H (2004) Techniques for image enhancement and segmentation of tomographic images of porous materials. Phys A Stat Mech Appl 339(1–2):145–151
8. Catté F et al (1992) Image selective smoothing and edge detection by nonlinear diffusion. SIAM J Numer Anal 29(1):182–193
9. Lund Mark D (1997) Pixel image edge-smoothing method and system. US Patent No. 5,650,858. 22 Jul 1997, pp 195–199
10. Image processing techniques such as noise filtering, histogram equalization and power law transformation have been used to result in better representation of images

Load Balancing Techniques Applied in Cloud Data Centers: A Review

Koyela Chakrabarti, Koushik Majumder, Subhanjan Sarkar, Mihir Sing and Santanu Chatterjee

Abstract Load balancing in cloud computing has become an important factor in cloud data centers to ensure proper utilization of resources while preserving the quality of service and meeting service-level agreement of the client applications. The paper presents a literature review on various load balancing techniques that have been applied to the cloud data centers. The techniques involve efficient task to resource mapping during provisioning, or dynamically managing resource allotment for tasks in execution, or optimal utilization of link bandwidth of software-defined networks for data flow. A brief summary of the techniques along with a comparative analysis and advantages and limitations of each have been tabulated. Finally, the paper has been concluded with future scope mentioning the essential points to be taken care of while designing a robust load balancing algorithm for better performance, quality of service and availability.

Keywords Performance optimization · Cloud computing · Deadline · Load balancing

1 Introduction

Load balancing in cloud computing is done at different levels of task execution for optimization of resource utilization. It can initially start with optimal mapping of resources available for task requirement. Some architectures employ load balancers at the task scheduling level to minimize the number of pending jobs and job starvation. Other load balancers work at the time of execution for real-time monitoring of system performance using sensors for adjusting resource usage. The main focus of load balancing is to strike a balance between improving throughput, reducing latency of the tasks executing and utilization of resources in cloud data centers.

K. Chakrabarti (✉) · K. Majumder · S. Sarkar · M. Sing · S. Chatterjee
Department of Computer Science and Engineering, West Bengal University of Technology, Kolkata, India

K. Majumder
e-mail: koushik@ieee.org

H. S. Saini et al. (eds.), *Innovations in Computer Science and Engineering*,
Lecture Notes in Networks and Systems 103,
https://doi.org/10.1007/978-981-15-2043-3_29

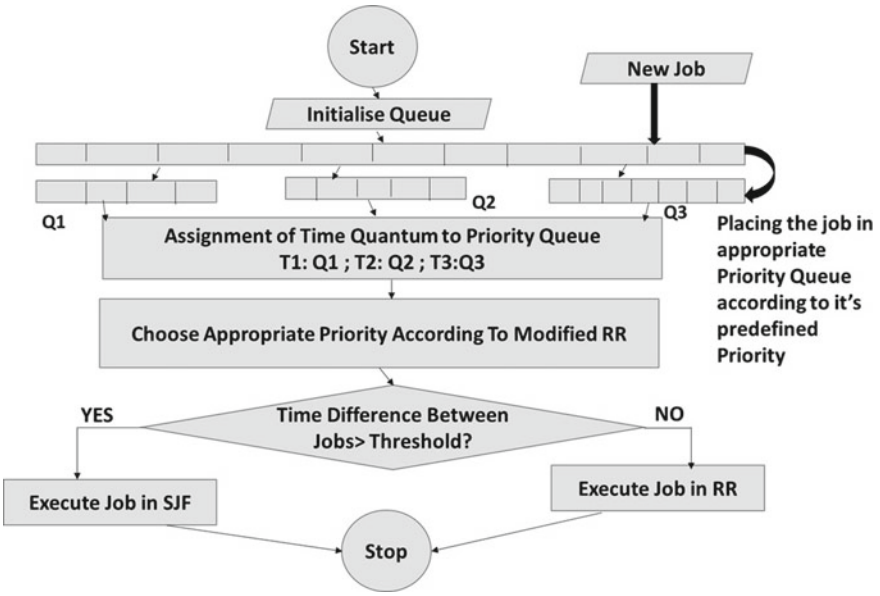


Fig. 1 Workflow of queueing architecture of MOA

2 Related Work

2.1 Modified Optimal Load Balancing in Cloud Computing (MOA)

This paper [1] proposes a scheduling-based algorithm that uses shortest job first (SJF) and round robin (RR) scheduling for optimal use of resources. Jobs are submitted with a priority and placed in an appropriate priority queue. Every queue is allotted a time frame according to the average burst time of the jobs waiting in that queue to be executed. The execution of the job in the respective queues in either RR or SJF mode is decided by the burst time difference between successive jobs. If it is within a threshold, RR is chosen, otherwise jobs are scheduled according to SJF. This threshold is the burst time of shortest job submitted in the data center, irrespective of priority (Fig. 1).

2.2 Load Balancing in Cloud Computing Using Dynamic Load Management Algorithm (DLMA)

The architecture proposed in [2] is a simple throttled load balancing algorithm for balancing homogenous workload. The load balancer keeps a list of free and busy

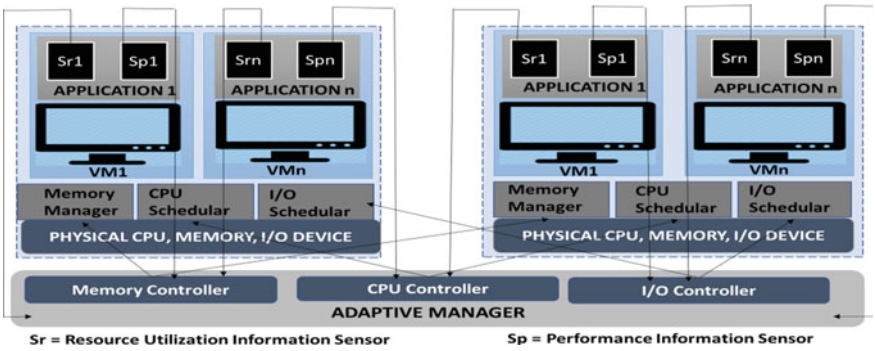


Fig. 2 AMVR architecture

VMs. The provisioner forwards the task request to the balancer which assigns the first free VM or an active VM having enough resources to execute the task. In case none of the options are available, the task is made to wait. Whenever a task completes, the provisioner is informed and it again tries to provision the task in the same way as explained.

2.3 Adaptive Management of Virtualized Resources in Cloud Computing Using Feedback Control (AMVR)

The model [3] uses a multi-input and multi-output (MIMO) resource manager which uses a feedback-based mechanism for dynamically allocating resources to jobs to satisfy the service-level objective (SLO) for that particular application. The main actor here is a MIMO-based adaptive manager which delegates the task of CPU, I/O and memory management to sub-modules for respective resource management of the hosts. Every application running is monitored by two sensors for performance and resource utilization, respectively, and information is sent to the central controller. The controller matches the information against the SLO for the application. Extra resources are granted or revoked in case of an under-performing or over-performing application, respectively (Fig. 2).

2.4 An SLA-Aware Load Balancing Scheme for Cloud Data Centers (SALBS)

The paper [4] proposes a distributed two-tiered architecture for load balancing. The VMs are separated into virtual clusters. Each cluster is managed by a global load balancer (GLB). The GLBs are interconnected by point-to-point connections. Each

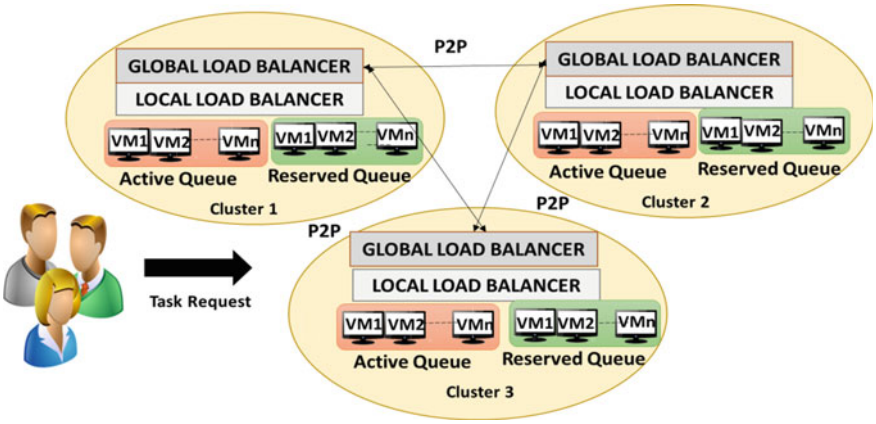


Fig. 3 SALBS architecture

GLB has a local load balancer (LLB). LLB uses a single-layer artificial neural network (ANN) to provision a VM to a task. The remaining load capacity of the most utilized resource in the VM, previous weight information and the service-level agreement (SLA) of the application to be executed are fed as input to adjust the weight of the ANN. In case, a cluster is unable to provision a task, the LLB hands it over to the GLB which forwards the task to a lightly loaded cluster (Fig. 3).

2.5 A Dynamic and Load Balanced Flow Scheduling Approach for Big Data Centers in Cloud (DLBS)

The paper [5] does a link between bandwidth utilization and deadline-dependent data flow scheduling of a data center having OpenFlow (OF) as background network. The algorithm maintains a dynamic table containing current bandwidth utilization of every link and a static table that maintains the paths among switches. To select the optimal path for initial data flow scheduling, the bandwidth utilization ratio of all the intermediate links are considered and the maximum value among them becomes the utilization ratio for the path. Now the path where this utilization ratio is least, if more than one path exists between two switches, is chosen for the data flow. In case of rescheduling dataflow, for three-layered non-blocking fully populated network (FPN), the busiest link is identified and the dataflow that uses the maximum bandwidth in the link is rescheduled. For three-layered fat tree-network (FTN), the algorithm identifies the top 10% busiest links and then finds out the common dataflow transmitting through those links and reschedules the flow (Fig. 4).

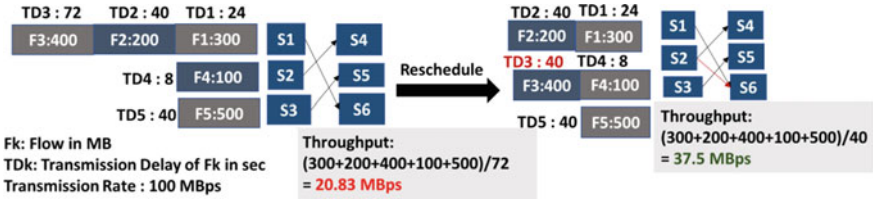


Fig. 4 Rescheduling of dataflow queue in of architecture

3 Comparative Analysis

A comparative analysis based on various load balancing features like service-level agreement (SLA) of the discussed algorithms is presented in Table 1. The advantages and limitations of each algorithm are presented in Table 2.

4 Conclusion and Future Scope

Based upon our comparative analysis of various load balancing algorithms, we have found that, in order to offer better performance, a superior load balancing architecture needs to be designed while considering the following points. Firstly, care should be taken to negate SPOF situation. So, highly modularized distributed balancer architecture needs to be adopted. Next, resource allocation algorithms should take SLA constraints like deadline sensitivity or response time of the task submitted into consideration so that the algorithm is implementable in real-life data centers. Finally, the algorithm must be lightweight so that the computational resources are utilized mostly for task processing rather than executing load balancing program itself.

Table 1 Comparative analysis of load balancing schemes

Paper	Parameters/resources considered for load balancing	Workload	SLA compliance	Algorithm used	Computation overhead of load balancer	Architecture type
MOA [1]	Priority and burst time of job submitted	Heterogenous	Yes, for initial priority as defined in task request	Priority-based non-preemptible Scheduling algorithm using RR and SJF	Low to moderate	Centralized
DLMA [2]	–	Homogenous	No	Throttled load balancing-based algorithm	Low to moderate	Centralized
AMVR [3]	CPU, memory, bandwidth and I/O	Heterogenous	Yes	Feedback control based on inputs from the sensor modules of VMs	High	Centralized
SALBS [4]	CPU, memory, bandwidth and I/O	Heterogeneous	Yes	ANN-based load prediction	High	Two-tiered distributed
DLBS [5]	Bandwidth	Heterogeneous data load	Deadline, slack time	Weighted priority-based queuing of data traffic and maximum bandwidth availability-based path selection for flow	Moderate to high	Centralized

Table 2 Advantages and disadvantages of load balancing schemes

Paper	Advantages	Disadvantages
MOA [1]	1. Faster execution of shorter jobs reduces number of pending tasks 2. RR scheduling ensures prevention of starvation of longer jobs 3. Employing different time quanta to each queue based on the burst time of the jobs minimizes waiting time of jobs	Fails to implement dynamicity to reassess the time slicing when a new workload arrives in the system
DLMA [2]	Simple non-preemptive algorithm that is easy to implement for a cloud dealing with homogeneous workload	1. Only one kind of VM available with fixed resource allocation 2. Does not work for heterogeneous workload with different SLA constraints
AMVR [3]	1. Works for a heterogenous cloud with different SLA constraints 2. Dynamically adjusts the resource for effectively managing load on data center	Huge amounts of data exchange between sensors and balancers might lead to network congestion
SALBS [4]	1. Load management is done in a distributed fashion 2. Highly modularized load management system also averts single point of failure (SPOF)	1. Local balancer to VM ratio is not defined 2. No provision for upscaling or downscaling the architecture is done 3. The ANN employed will take some time to correctly predict the load in the system
DLBS [5]	1. Scheduling of the data flow is done in a manner to avoid starvation 2. Real-time monitoring of load imbalance in the network and dynamically changing the path for the flow effectively brings down the transmission delay time	Load balancing at a fixed time interval might not be effective for a varying data load in a private cloud

References

1. Tripathi S, Prajapati S, Ansari NA (2017) Modified optimal algorithm: for load balancing in cloud computing. In: 2017 International conference on computing, communication and automation (ICCCA), Greater Noida, pp 116–121
2. Panwar R, Mallick B (2015) A comparative study of load balancing algorithms in cloud computing. Int J Comput Appl 117(24):33–37
3. Li Q, Hao Q, Xiao L, Li Z (2009) Adaptive management of virtualized resources in cloud computing using feedback control. In: 2009 First international conference on information science and engineering, Nanjing, pp 99–102
4. Li C-C, Wang K (2014) An SLA aware load balancing scheme for cloud data centers. In: The international conference on information networking (ICOIN), pp 58–63
5. Tang F, Yang LT, Tang C, Li J, Guo M (2016) A dynamical and load-balanced flow scheduling approach for big data centers in clouds. IEEE Trans Cloud Comput

A Comparative Analysis of Live Migration Techniques for Load Management in Cloud

Koyela Chakrabarti, Koushik Majumder, Subhanjan Sarkar, Mihir Sing and Santanu Chatterjee

Abstract Live migration is a popular technique used in cloud computing to optimally utilize hardware resources dynamically in the system and reduce unnecessary power consumption in cloud data centers. This paper discusses several prominent live migration techniques applied in cloud computing that aim to evenly distribute load in the system or to consolidate inactive servers. Each algorithm attempts to reduce the overhead of migration by either minimizing the number of migrations or decreasing the application downtime or scheduling the migration while taking available link bandwidth into consideration. A brief summary of each, followed by a comparative account in terms of the major features of the algorithms and advantages and shortcomings of each algorithm is tabulated. The paper is finally concluded by mentioning important points to be taken care of while migrating an application from one physical host to the other in order o achieve better performance.

Keywords Load balancing · Cloud computing · Server consolidation · Live migration · Pre-copy · Post-copy

1 Introduction

Live migration is a technique that migrates a task executing in one host server to another over network. The resource utilization acts as the main trigger for migrating a task. The overhead of migration mainly depends upon the amount of memory consumed by the application to be migrated. There are two major techniques involved while migrating the memory. The first one or pre-copy method involves transferring the pageable memory to the target host first, then suspending the virtual machine (VM) to transfer kernel memory to the target and finally resuming the VM in the destination host. The post-copy method involves transferring the VM to the target

K. Chakrabarti (✉) · K. Majumder · S. Sarkar · M. Sing · S. Chatterjee
Department of Computer Science and Engineering, West Bengal University of Technology, Kolkata, India

K. Majumder
e-mail: koushik@ieee.org

H. S. Saini et al. (eds.), *Innovations in Computer Science and Engineering*,
Lecture Notes in Networks and Systems 103,
https://doi.org/10.1007/978-981-15-2043-3_30

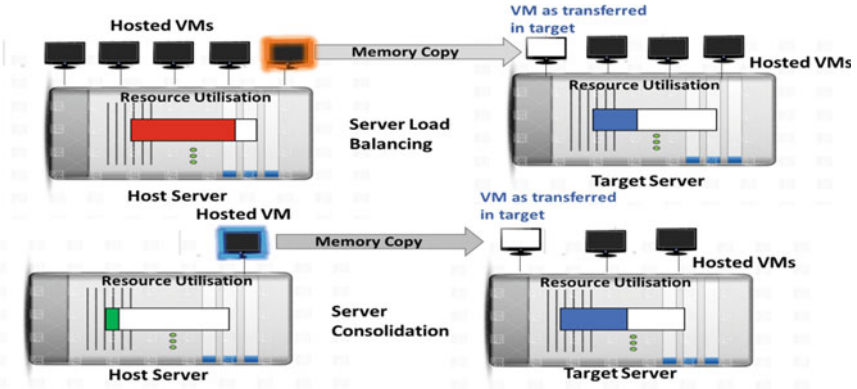


Fig. 1 An illustrative view of migration

first and then migrating the pageable memory to the target as per demand. Algorithms for live migration aim to minimize the overhead of migration. The techniques range from carefully choosing the minimal set of applications to migrate or use hybrid post- and pre-copy techniques and reduce the memory size to be transferred. Some of those prominent techniques will be briefly discussed in the subsequent section. The following Fig. 1 gives a logical illustration of live migration in cloud computing.

2 Related Works

2.1 A Case for Fully Decentralized Dynamic VM Consolidation in Cloud (FDDVC)

The paper [1] proposes a fully decentralized architecture to consolidate the PMs in cloud using live migration. The algorithm aims to maximize server consolidation with minimum number of migrations using ant colony optimization technique. To process the algorithm faster, the servers in neighborhood are considered as target hosts. The hosts are connected in an unstructured peer-to-peer network arrangement. and Cyclon protocol is employed to dynamically and asymmetrically change the topology of the system. To ensure that, same server is not targeted for consolidation by more than one host, and the target server needs to be locked by the consolidating server. This provides a better search space for the consolidating host to choose a target host. Therefore, the ratio of consolidated hosts to total hosts in the system is also improved than systems with a fixed topology and hence a fixed neighborhood (Fig. 2).

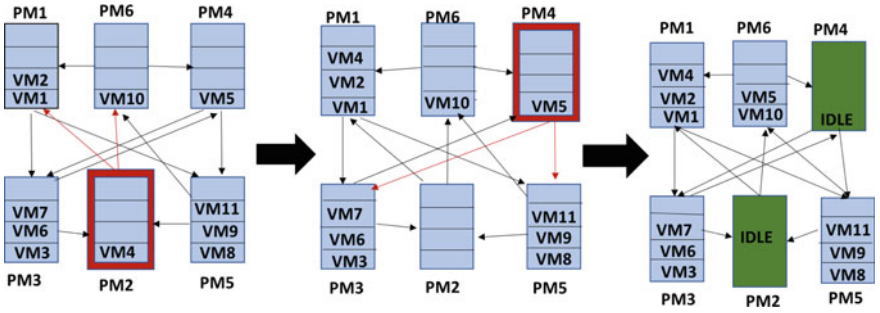


Fig. 2 Consolidation of VMs in FDDVC

2.2 *Dynamic Resource Allocation Using Virtual Machines for Cloud Computing Environment (DRAVM)*

The paper [2] proposes an algorithm that adapts itself to consolidate or balance the load in the system depending upon the resource utilization level of the hosts. The server load is divided into three categories, hot, cold and warm that denotes overutilized, underutilized and properly utilized resource levels, respectively. The thresholds are predetermined for the various resource types. If any of the resources is overutilized in a server, it is categorized as a hot spot. The algorithm tries to iteratively migrate VMs in descending order of their resource consumption from that host. At most, one VM can be migrated in each iteration. While consolidating, amount of memory to be transferred and resource utilization level of all other servers in the system are taken into consideration. For consolidation, more than one VM can be migrated at a time from a host trying to power cycle.

2.3 *RIAL: Resource Intensity Aware Load Balancing in Clouds*

The live migration-based architecture [3] adaptable to being centralized or distributed according to datacenter size proposes a migration methodology to balance the load among the servers in the data center. The algorithm attempts to reduce skewness in resource utilization, distance between communicating VMs, amount of memory to be transferred and number of migrations to reduce migration overhead. Migration is triggered only when a VM remains overutilized for a particular predetermined time slot to avoid unnecessary migration during a spike in the resource demand in the system (Fig. 3).

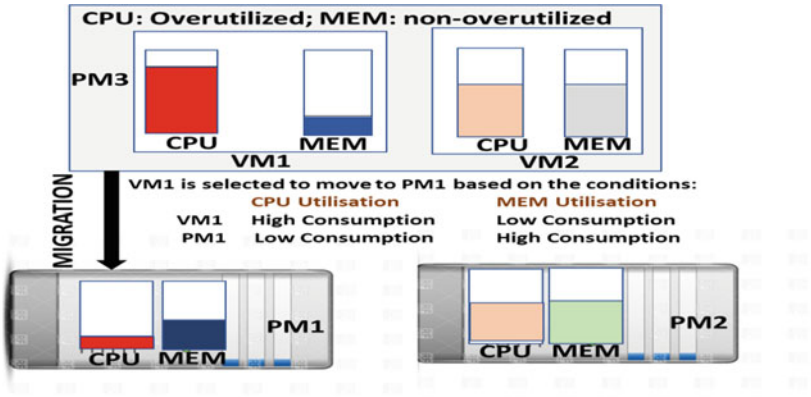


Fig. 3 Selection of target host for overloaded PM in RIAL

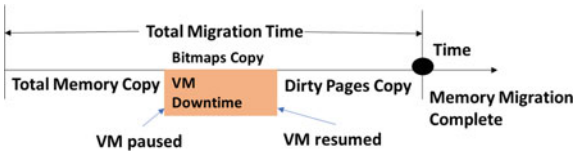


Fig. 4 Migration phases of HMDC

2.4 HMDC: Live Virtual Machine Migration Based on Hybrid Memory Copy and Delta Compression

The paper [4] proposes a three-phase live VM migration scheme that uses bitmap and delta compression to reduce the overhead of the memory pages transferred. The first phase replicates the total memory from source to destination while caching the pages getting updated during the process. The pages dirtied are marked using bitmap. Next, the VM is stopped at the host and the kernel memory, and the bitmap is sent to the destination. In the final stage, the destination demand pulls the pages from source. The cached pages marked by the bitmap are compressed using delta binary XOR run length encoding and sent to the destination (Fig. 4).

2.5 A Network-Aware Approach for the Scheduling of Virtual Machine Migration During Peak Load (NSVMM)

The research paper [5] uses Q learning of model-free reinforcement learning (RL) to migrate a VM based on network bandwidth condition of physical link. Using moving average model, taking previous two time-steps, the current and future link bandwidth

and direction of traffic as increasing or decreasing or same, is identified. The state-action space of the RL is defined by the tuple <bandwidth available, direction-of-flow, action>. The action can either be to wait or to migrate. This decision is taken by maximizing the reward function. A migration decision is given a negative reward based on current level of bandwidth. Similarly, the decision to wait will attract a negative reward calculated as per the future bandwidth condition.

3 Comparative Analysis

A comparative account of the migration techniques used in algorithms mentioned above is summarized in Table 1 followed by the advantages and disadvantages of each in Table 2.

Table 1 Comparative analysis of live migration techniques

Paper	Focus	Migration objective	Trigger	Technique used
FDDVC [1]	When and which VM to migrate during non-peak hours	Server consolidation	Heterogeneous resource underutilization leading to unnecessary power consumption	Ant colony optimization is used to minimize the number of migrations
DRAVM [2]	When and which VM to migrate during both system overload and non-peak hours	Server load balancing and consolidation	Heterogeneous resource over and underutilization based on predetermined thresholds per resource for utilization level	Resource utilization-based migration decision for load balancing. memory size-based migration for server consolidation
RIAL [3]	When and which VM to migrate during system overload	Server load balancing	Heterogeneous resource overutilization based on a resourcewise predetermined threshold	Matrix-based method of multi-criteria decision-making

(continued)

Table 1 (continued)

Paper	Focus	Migration objective	Trigger	Technique used
HDMC [4]	How to migrate the chosen VM from source host to target host	Reducing the total migration time Reducing dirty page sending overhead during demand pulling phase	CPU utilization level	Memory caching and delta compression
NSVVM [5]	When to schedule the migration of the chosen VM from the source to destination server	Avoiding network traffic congestion and reducing the total migration time	Bandwidth utilization level of link	Using Q learning of RL to schedule the migration by maximizing reward points

4 Conclusion and Future Scope

Some important points are to be noted while designing a live migration algorithm. A resource utilization prediction module using machine learning techniques like regression might give a fair idea about when a migration might be necessary in the system. A memory-intensive application frequently updates the pages. Hence,

Table 2 Advantages and disadvantages of live migration techniques

Architecture	Advantage	Disadvantage
FDDVC [1]	1. Decentralized architecture to tackle single point of failure 2. High ratio of consolidated to total server due to dynamically changing network topology 3. Attempts to reduce number of migrations so that the total migration overhead is reduced in the system	1. Locking mechanism used to consider the neighbors for the consolidation process might lead to starvation 2. Dependence on high-speed LAN connection for the algorithm to work efficiently
DRAVM [2]	1. Initiates migration for both load balancing and consolidation of servers 2. Tries to adjust uneven resource utilization of servers in the system by migrating appropriate VMs	1. The algorithm is computation extensive 2. Constant monitoring of the servers and exchanging information might lead to network congestion
RIAL [3]	1. Tries to minimize the number of VMs migrating 2. Algorithm takes care of the distance between intercommunicating VMs while selecting a target host	Sender initiated load balancing mechanism degrades the performance of an already overloaded host

(continued)

Table 2 (continued)

Architecture	Advantage	Disadvantage
HMDC [4]	1. Delta compression of the cached dirty pages reduces the page transfer overhead 2. Initial memory push improves the hit ratio after the target VM resumption 3. The bitmap for the cached dirty pages and cached dirty pages in target helps quicken the process of reconstruction of a compressed dirty page received from the sender	No assessment for the need to cache a particular dirty page is done
NSVMM [5]	The algorithm ensures that network does not get congested due to migration and also that low bandwidth availability in the link does not increase the total migration time	Only one link bandwidth is considered for the migration process

it might be costlier to migrate that application using a pre-copy method. Again, deadline sensitive applications might find a post-copy style method costlier, for the disruption in task execution while demand pulling pages from source. So, the type of application to be migrated is also to be considered. Apart from choosing style or compression methods for transferring pages, it is also important to consider available link bandwidth. Care must be taken to ensure that the client applications are not hampered while migrating a VM. Lastly, a resource heavy VM might take a long time and consume high link bandwidth to migrate. Therefore, an extensive cost versus profit analysis in terms of load balancing is to be done for scheduling live migration.

References

1. Feller E, Morin C, Esnault A (2012) A case for fully decentralized dynamic VM consolidation in clouds. In: 4th IEEE international conference on cloud computing technology and science (Cloudcom), Taipei, Taiwan, pp 26–33
2. Xiao Z, Song W, Chen Q (2013) Dynamic resource allocation using virtual machines for cloud computing environment. IEEE Trans Parallel Distrib Syst 24(6):1107–1117
3. Shen H (2017) RIAL: resource intensity aware load balancing in clouds. IEEE Trans Cloud Comput
4. Hu L, Zhao J, Xu G, Ding Y, Chu J (2013) HMDC: live virtual machine migration based on hybrid memory copy and delta compression. Appl Math Inf Sci 7:639–646
5. Duggan M, Duggan J, Howley E, Barrett E (2017) A network aware approach for scheduling of virtual machine migration during peak loads. Clust Comput 20(3):2083–2094

Optimization of Engine Endurance Test Reports Using R and R Shiny

Srinidhi Kulkarni, Amit Shinde, Padma Dandannavar and Yogesh Deo

Abstract Research and development is the driving force for the technological future of Mercedes-Benz and guaranties first-class products for its cars. The aim of this work includes innovation, future-oriented products and highly efficient development processes. This study involves visualization of Mercedes-Benz engine testing activities to validate various parameters like fuel consumption, vibration and noise, etc., and generate report templates as per requirements which include plotting charts using graphical packages in R. This process is automated using R shiny dashboard.

Keywords R · R shiny · Data analysis · Motorölstand · Dygraph · MikTeX · GenData and FINAS

1 Introduction

Car industry has been for over 130 years [1]. First vehicles had two-stroke motor, wooden haggles no suspension. Vehicles have increasingly confounded over the time. Vehicle execution can be characterized by a few criteria, for example, speed quickening limit, brake and control capacities and so on. There are different usage to build the general vehicle execution, for example, motor execution improvement, transmission and suspension, framework enhancement, oil innovation advancement, streamlined plan, or driver course preparing and so on.

S. Kulkarni (✉) · P. Dandannavar
Department of Computer Science, KLS Gogte Institute of Technology, Belagavi, India

P. Dandannavar
e-mail: padmad@git.edu

A. Shinde · Y. Deo
Mercedes Benz Research and Development India Pvt. Ltd., Pune, Maharashtra, India
e-mail: amit.a.shinde@daimler.com

Y. Deo
e-mail: yogesh.deo@daimler.com

H. S. Saini et al. (eds.), *Innovations in Computer Science and Engineering*,
Lecture Notes in Networks and Systems 103,
https://doi.org/10.1007/978-981-15-2043-3_31

The motor yields rely upon many working parameters, for example, air-fuel proportion, pressure proportion, admission air temperature and weight, burden and motor speed, start timing [2]. Innovative work in car building has been accomplished for long time are as yet continuous as long as we have to exploit from it [3]. With the rise of competency in automotive excellence, the urge of being the most efficient vehicle is also increasing. Motor execution improvements include expanding the motor yields, power and torque and diminishing the motor information; explicit fuel utilization [2]. This can be achieved by making the engines more efficient by considering parameters such as power and fuel consumption, vibration, cooling, type of engine and the environment conditions. The interest of MBRDI always lies in production of most efficient engines for upcoming cars, and to achieve this, a team is involved who works on prototype vehicles.

The main objective of this project is to visualize on-road Mercedes-Benz passenger car mechanical engine testing activities to find out performance and durability, and this helps to validate various parameters on road conditions. Tests are carried for effectiveness of cooling, power and fuel consumption, lubrication, vibration and noise, controllability and harmful emissions. To analyze load performance, pressure measurements, validating in actual driving conditions, thermal fatigue failures, premature wear failures. Using these parameters, report templates are generated for report preparation of data analysis as per requirement which includes plotting charts using graphical packages in R. Endurance testing reports are automated using R shiny dashboard and graphical packages. The graphs provide advanced summaries of various engine parameters while testing using graphics packages in R and data quality summaries generated using MikTeX in R LaTeX documents.

2 Literature Survey

Yao [4] introduced how to ascertain fuel infusion amount and fuel utilization per hundred kilometers given infusing sign and speed signal with the end goal of empowering driver to keep fuel utilization cognizant, steadily improving driving propensity and in the end decreasing fuel utilization.

Lo et al. [5] and others proposed the fuel utilization estimation technique which is structured dependent on a hereditary calculation which can produce quality successions and change for recovering a versatile quality grouping.

Yildirum et al. [6] and others proposed a paper which introduces the consequences of test information got with the utilization of a motor square vibration transducer and mouthpiece. The point of the examination is to investigate the vibration and burning commotion attributes of biodiesel delivered from waste browning oils and fossil diesel fuel (FDF) contingent on motor speed.

Kan et al. [7] and others proposed strategies that all the more precisely gauge and imagine vehicle vitality utilization/emanations dependent on investigation of vehicles' portable exercises (MA) and stationary exercises (SA). To begin with, assembling of space-time ways of singular vehicles is done, extricate moving parameters, and recognize MA and SA from each space-time way portion (STPS).

3 Problem Definition

There are ample studies carried on engine data for specific parameters like vibration and noise, pressure, fuel consumption, etc. Our aim here is to visualize the engine testing activities to find out the performance and durability on road conditions for various parameters and create report templates using R and optimize this technique using the R shiny dashboard.

4 Input Parameters

1. Data Download—The data is downloaded from the German server
2. Config File—It is one of the most important input parameters for the script. Each row in the file resembles one slide in the report. It consists of title, subtitle, type of plot, signals required for calculation, scale, reason for slide failure
3. Gen Data—This is another important parameter for the script. It contains vehicle type, vehicle number, motor number, total kilometers the vehicle ran, etc.

5 Methodology

Installation

- R installation
- R studio installation
- Miktex installation
- Image magic installation
- Package installation.

Preparing the folder structure

- A particular folder structure is required for execution of script
- The ppt templates, configuration file all need to be placed in the specific folders only.

Motorölstand execution

- The Motorölstand chart helps in visualizing the oil level over a period of time during the vehicle run.
- Change-point analysis is performed in the data which tries to detect whether or not a change has occurred or whether multiple changes might have occurred.
- This change-point analysis was done using the dygraph, the dygraph is plotted, and then, the change points would be noted down manually and provided as input to the script.
- Once the script would execute, the Motorölstand chart would generate with the change points.

Script execution

- Once execution of Motorölstand is complete, the report script is executed.
- After the script gets executed, the report can be downloaded along with the excel extract.

Validation

- Validation steps involve

  i. *GenData Verification* → Verify the GenData if the kilometer reading, engine number, power are mentioned correctly
  ii. *Motorölstand Verification* → Check if the Motorölstand graph matches with missogram combo for the kilometer reading. Also, check the date and coefficient values present in the line data
  iii. *Excel Extract Verification* → Match the readings in the report to the excel extract
  iv. *EnergyBalance and Camtronic slide Verification* → Verify the slides for the readings
  v. *Missing Slide Verification* → Check the reason for the missing slides and verify it with the fail slide
  vi. *Date, Slide No, Engine No, Page No Verification* → Confirm if the dates, slide number, page number and engine number are mentioned correctly
  vii. *Power Torque Scale Verification* → Validate the scaling of the slides containing power and torque signals
  viii. *Time series Verification* → Check the 2.30 slides for readings below −80 and above 60 scale, and if present, then a time series plot needs to be inserted showing the variation in the signal
  ix. *Other slides Verification* → Validate all the other slides for readings and proper scaling
  x. *FINAS, ODIS, DIAGMERA Verification* → FINAS data contains the different events, vehicle modification details, etc. ODIS data contains the oil data. DIAGMERA data contains details about software change. Place the FINAS, ODIS and DIAGMERA files in the report and check for the engine series and for the format of the files.

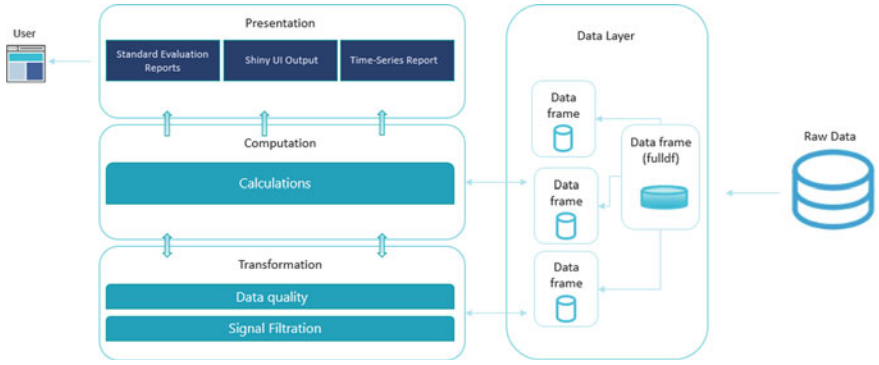


Fig. 1 EDA architecture

The diagram is broadly classified into the following modules (Fig. 1):

Module 1: Data Layer

The module 1 consists of the data frame (fulldf) which is a compressed version of the rawdata. This data frame is then clustered into further data frames which consist of all the signals required to perform the further calculations.

Module 2: Data Quality

The data quality check with turnaround time is required for validation. This feature has been developed especially to increase the accuracy of validation checks done on endurance test reports.

Module 3: Computations

After the data quality is done, the calculations required for each of the slides are performed which includes processing of the different tracks, signals, etc.

Module 4: Presentation

Once all the calculations are done, the report is ready to be downloaded. The shiny app consists of different buttons to download the report, the excel extract and the time series report.

The same methodology can be explained in the form of a flow diagram as shown Fig. 2.

6 Existing Methods

File-by-file approach

- Script executes the calculation in series (file-by-file approach).
- Due to Hard-coding in the script, manual changes are required to take into account different tests. (Increases the possibility of error).
- Limited data cleansing and data quality features available.
- *Challenges faced in Script*

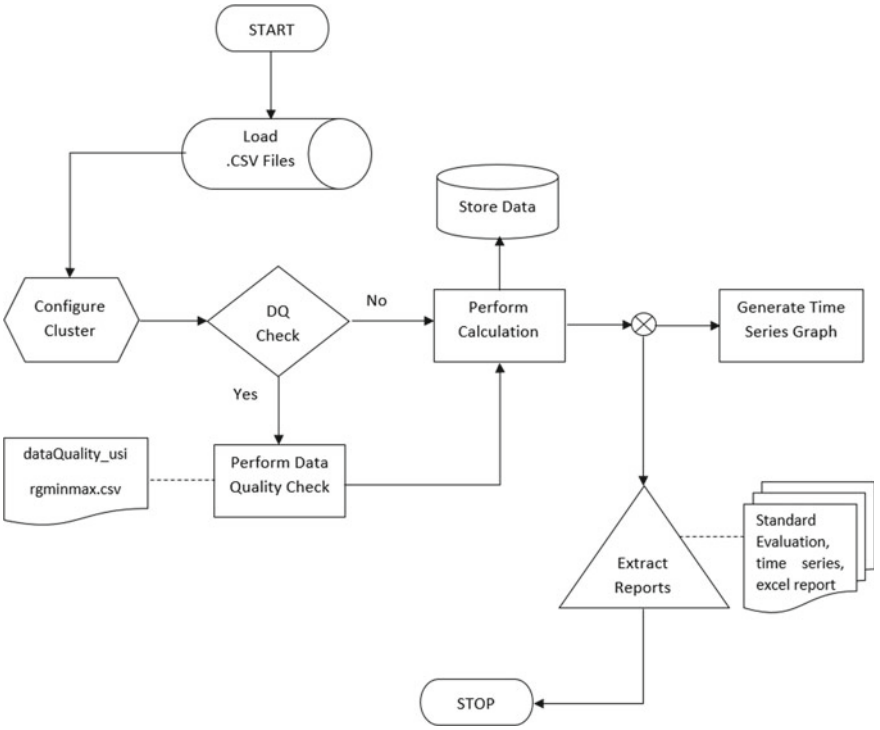


Fig. 2 Flow diagram of report creation process

- If error occurs at any point of time, then complete script needs to be executed again.
- Cannot execute the script only for particular plots (complete script needs to be executed).
- Manual efforts required for validating the report generated.
- Incorporating new change requests requires large amount of script modification.

Parallel processing approach

- Raw data (.csv files) for complete endurance test is combined into a single data frame and taken at once in the memory (parallel processing).
- Insignificant data (signals not used for computation) is filtered out thereby improving in-memory processing of the data frame.
- Script can be executed in parts (for specific slides, some prerequisites need to be processed).
- Automation possible through mapping in the configuration file.
- Improved report validation and data cleansing features
- *Bottlenecks in the Script*

– Different delimiters used in .csv files
– High RAM consumption

7 Structural Enhancements and Functional Programming Approach

Structural Enhancements

(1) *Configuration file*—The main sheet contains channel names that are mapped to signal alias in channel signal mapping. It also contains a sheet for storing the track names which before had to be updated in the script.
(2) *Parallel processing*—Version 8.0 script introduced parallel processing, using explicit parallelism approach. The raw data is combined into single data frame. This helped in achieving significant improvement in turnaround time.
(3) *Data Quality*—This feature has been developed to increase the accuracy of validation checks done on reports. This check removes NAs, filters frozen signals and discards the signals which are less than 2%.
(4) *Goodslide and failslide*—The goodslide file consists of those slides which are present in the report, and failslide file contains those slides which did not appear in the report.
(5) *Log file*—This file provides the user with signal information that is available in the data and the signal being considered for calculations.

Functional Programming Approach

(1) *Used Signal patch*—This patch provides that particular signal available from different signal alias. This patch code is updated in the script by providing a check on the number of alias present because the function was duplicating the signal which was taking lot of time
(2) *Optimization of redundant code*—Parallel processing approach contained redundant code for calculation part, generating the goodslide and the failslide. This redundant code was replaced by three functions

- LoadSigData()
- Getgoodslide()
- Getfailslide()

(3) *Motorölstand process optimization*—The Motorölstand was generated using the dygraph, and the change points were noted down manually and then provided as input to the script. This process is been optimized using the shiny app where the change points need to be just clicked and the points get stored in a vector which is used as input automatically.

This plot is made interactive by adding features like selecting points and regions. Reactive programming is used for interaction with user for selecting the points [8] (Fig. 3).

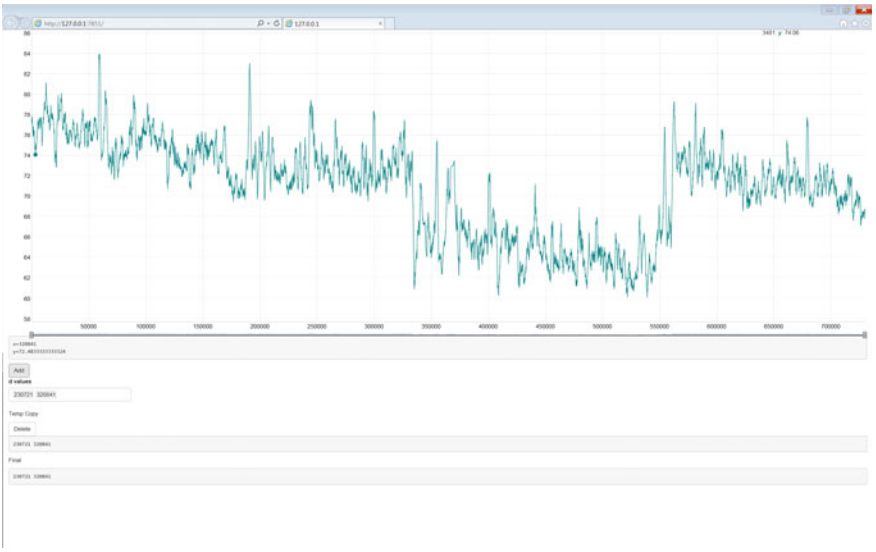


Fig. 3 Dygraphs generated through dummy data

8 Experimental Results

Result investigation demonstrates the time taken by each approach for generating the report template for different vehicles which include petrol-engine vehicles and diesel-engine vehicles. From Table 1, it is clear that the file-by-file approach consists of 82 slides, and the functional programming approach consists of 99 slides. Here, as the number of input files increase, the time taken by both the approaches also goes on varying. The same result which has been indicated in the table can be also represented in the graph format in Fig. 4.

Table 1 Demonstrating the experimental result

S. No.	Number of files	Time taken (min)	
		File-by-file approach (82 slides)	Functional programming approach (99 slides)
1	50	14	7
2	100	22	13
3	200	30	32
4	500	53	57

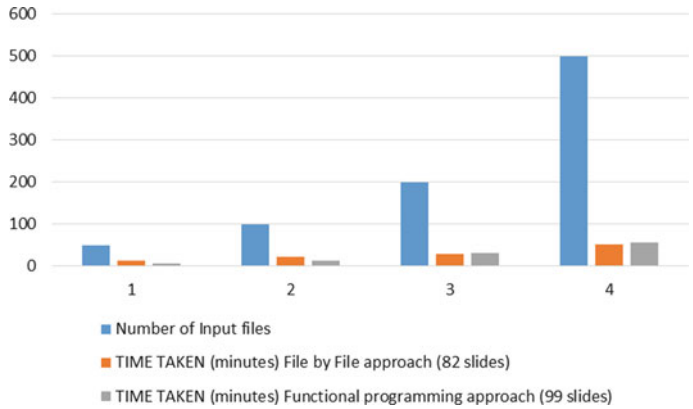


Fig. 4 Graph representing the experimented result

9 Conclusion and Future Scope

The manual generation of engine data analysis report is delivered to the customer after verification of the specifications defined and validating the criteria set. The future enhancements in this process are to be made full proof and error free without manual intervention such that the customer will be able to access the report with an automated email triggering without any validation required.

References

1. Ricardo-AEA/R/ED59296 (2014) Data gathering and analysis to assess the impact of mileage on the cost effectiveness of the LDV CO_2 regulations. Ricardo-AEA/R/ED59296/Issue Number 1
2. Naikan VNA, Kapur S (2006) Reliability modelling and analysis of automobile engine oil. Proc Inst Mech Eng Part D J Automob Eng
3. Lopez G, Seaber A (2009) The theory and practice of race-vehicle data acquisition and analysis in motor-sports engineering education. American Society for Engineering Education
4. Yao HX (2011) Instant fuel consumption test method and experimental analysis of EFI vehicle on the move. In: International conference on electric information and control engineering IEEE
5. Lo C-L, Chen C-H, Kuan T-S, Lo K-R, Cho H-J (2017) Fuel consumption estimation system and method with lower cost. Symmetry 9:105. https://doi.org/10.3390/sym9070105
6. Yildirim H, Özsezen AN, Çınar A (2018) Vibration and noise depending upon engine speed in a diesel engine fueled with biodiesel. In: The 6th European conference on renewable energy systems, Istanbul, Turkey 25–27 June
7. Kan Z, Tang L, Kwan M-P, Zhang X (2018) Estimating vehicle fuel consumption and emissions using GPS big data. Int J Environ Res Public Health
8. Shiny RenderText. Available: https://shiny.rstudio.com/reference/shiny/latest/renderText.html

Algorithmic Analysis on Medical Image Compression Using Improved Rider Optimization Algorithm

P. Sreenivasulu and S. Varadharajan

Abstract This paper offers a medical image compression scheme that includes three stages, namely segmentation (modified region growing (MRG) algorithm), image compression (ROI-discrete cosine transform (DCT) and SPHIT encoding methods, non-ROI-discrete wavelet transform (DWT) and merge-based Huffman encoding (MHE)). Subsequently, the filter coefficients of both the DCT and DWT are optimized using improvised steering angle and gear-based ROA (ISG-ROA). Finally, decompression stage takes place by adopting the reverse process of compression with similar optimized coefficients. Here, the filter coefficients are tuned in such a way that the CR has to be minimal. In addition, an algorithmic analysis is carried out for the proposed model and the outcomes are discussed.

Keywords Region of interest · Image compression · Modified rider optimization · Algorithmic analysis

1 Introduction

Compression [1] is the process of reducing the size of bytes in a file devoid of deteriorating the quality of image to an undesirable level [2]. The minimization in file size permits more images to be accumulated in a specified quantity of memory space or disk. It moreover minimizes the time necessary for images to be transmitted over the Internet. There exist numerous methods by which the image files could be compressed [3]. The two most general compressed graphic image formats for Internet use are the GIF format and the JPEG format [4]. The JPEG technique is mostly exploited for images, whereas the GIF technique is generally exploited for line art and erstwhile images, where the geometric shapes are comparatively uncomplicated. In the present days of medical development [5], the handling of medical images has

P. Sreenivasulu (✉)
ECE Department, ASCET, Gudur, Nellore, AP 524101, India

S. Varadharajan
Sree Venkateswara University College of Engineering, Tirupati, India
e-mail: varadharajan1@india.com

H. S. Saini et al. (eds.), *Innovations in Computer Science and Engineering*,
Lecture Notes in Networks and Systems 103,
https://doi.org/10.1007/978-981-15-2043-3_32

turned out to be crucial for treating the patients. As the huge production of medical images turned out to be essential, it is also essential to go through the compression process [6] before medical image storage or its transmission through Internet [7]. Minimizing transmission time is moreover significant throughout the transmission process [8] Therefore, compressing the medical images holds a significant role for proficient transmission and storage.

2 Adopted Segmentation Model and Image Compressing Approaches

At first, the image is segmented using MRG algorithm [9], this is to segment ROI and non-ROI regions. After segmentation, the ROI regions are provided to the image processing model, named discrete cosine transform (DCT) [10], and then the sourced DCT-outcome image is encoded using SPHIT method [11]. On the other hand, the non-ROI regions are provided to the DWT model and then the outcome is compressed via MHE model. The MHE involves three considerable phases: (i) Formation of Huffman code using original data, (ii) Code transformation-dependent conditioning and (iii) Encoding. In Huffman coding, at first, the symbol probabilities are organized in sliding order, it is divided into two, i.e., the upper nodes (root) are labelled as 0 and lower (leaf) as 1. After coding the data, phase (ii) process is carried out to traverse the original data with the code word. Subsequently, the code transformation is performed by combining the two symbols. Further, the merging procedure is carried out. Finally, encoding process takes place. In process of encoding, initially, the group of signs deployed for the code transformation procedure and the previous sign of group of symbols used for the code conversion procedure is verified to ensure if code transformation procedure is to be considered or not. The above three steps are performed, and all signs are confirmed for encoding the original data. Followed by this confirmation, a code is created for the original data. The last code is the encoded data depending on the MHE technique. Thus, the obtained compressed image is indicated I_{NROI} is indicated by IC_{NROI}.

In addition, the filter coefficients of both DCT and DWT are optimized by means of modified ROA model known as ISG-ROA scheme. Following the process of compression, decompression is done by carrying out the reverse concept of compression with similar optimized coefficients. The objective of this compression model is focussed on the reduction of CR that depends entirely on the tuning of filter coefficients of both DCT and DWT. The diagrammatic representation of the adopted medical image compression scheme is revealed in Fig. 1.

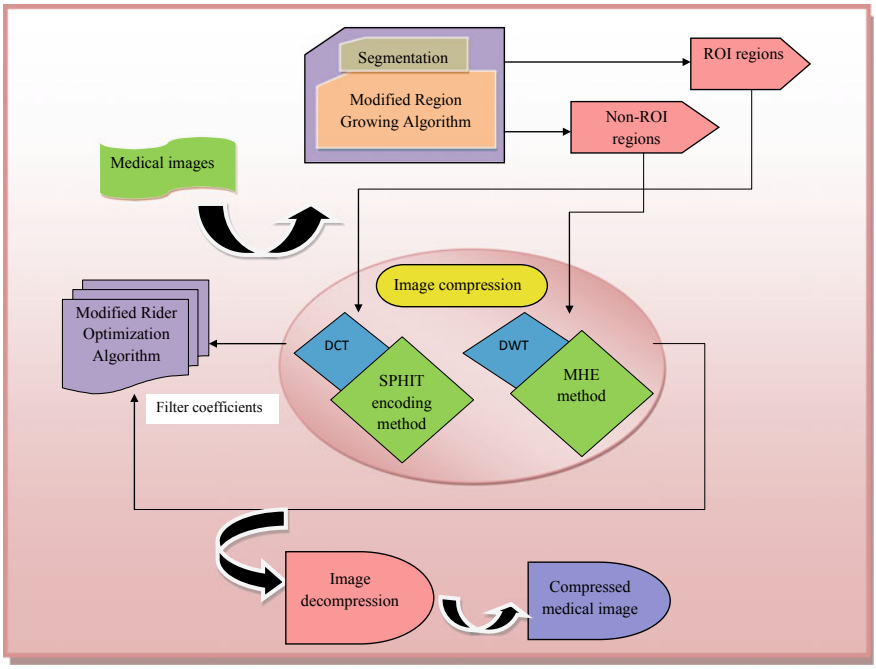


Fig. 1 Diagrammatic representation of the proposed medical image compression model

2.1 Proposed ISG-ROA Algorithm

The filter coefficients and of DCT and DWT are provided to ROA algorithm for optimization. ROA [12] depends on the cluster of riders that travels towards a similar destination for winning the race. In conventional ROA, activity counter $(A_c^{\tau+1}(i))$ contributes much in updating the gear and steering angle. In ROA, gear is updated if $A_c^{\tau+1}(i) = 0$ and the steering angle is updated if $A_c^{\tau+1}(i) = 1$. To develop the performance of traditional ROA further, this paper performs a modification on updating steering angle, and gear on considering both active counter, and best solutions. Here, the distance is evaluated among every solution with leading solution as given in Eq. (1). Accordingly, the sorting of solutions are based on minimum distance, and the five initial solutions are regarded as best solutions. The steering angle is updated if it fulfils the condition $A_c^{\tau+1}(i) = 1$, and it belongs to best solutions, and gear is updated if it fulfils the condition $A_c^{\tau+1}(i) = 0$, and it belongs to best solutions. This updating process offers better modification at high convergence rate. The pseudocode of proposed ISG-ROA model is highlighted in Algorithm 1. The major aim is to reduce the CR of the compressed image.

$$\text{Dis} = \text{Distance}(\text{leading solution}, \text{current solution}) \tag{1}$$

Algorithm 1 Proposed ISG-ROA Model

Input: Random positions of riders, $Z_{u,c}^{\tau}$
Output: Leading rider, Z^{L}
Assign the population
Assign the rider constraints
Determine the success rate
While $\tau < \tau_{off}$
for $u = 1$ to X
If $A_c^{\tau+1}(i) = 1$ and belongs to best solutions, update steering angle
If $A_c^{\tau+1}(i) = 0$ and belongs to best solutions, update gear
Update bypass position rider, follower position, over taker position and attacker positions as per equation

$$Z_{u,h}^{\tau+1}(B) = \beta\left[Z_{\gamma,h}^{\tau} * \alpha(h) + Z_{\eta,h}^{\tau} * (1-\alpha(h))\right],$$

$$Z_{u,h}^{\tau+1}(F) = Z^{L}(L,c) + \left[\cos\left(N_{u,c}^{\tau}\right) * Z^{L}(L,c) * \partial_{u}^{\tau}\right],$$

$$Z_{u,c}^{\tau+1}(O) = Z_{u,c}^{\tau} + \left[I_{u}^{\tau} * Z^{L}(L,c)\right],$$

$$Z_{u,h}^{\tau+1}(A) = Z^{L}(L,c) + \left[\cos\left(N_{u,c}^{\tau}\right) * Z^{L}(L,c) + \partial_{u}^{\tau}\right]$$

Rank riders depending on the success rate
Choose rider with higher success rate as leading one.
Update the rider constraints
Return Z^{L}
$\tau = \tau + 1$
end if
end if
end for
end while

3 Results and Discussions

3.1 Simulation Procedure

The algorithmic analysis on proposed medical image compression model using ISG-ROA algorithm has been implemented in MATLAB 2018a, and the significant results were obtained. The experiment was done for four medical image types, namely CT (image type 1), MRI (image type 2), US (image type 3) and X-ray (image type 4). The database for CT image was obtained from https://isbweb.org/data/vsj/ and "https://www.kaggle.com/kmader/siim-medical images/version/6 (Access date: 18-12-2018)". The database for MRI image was downloaded from "http://prostatemrimagedatabase.com/Database/index.html", and the database for US image was downloaded from "https://data.mendeley.com/datasets/wmy84gzngw/1 and http://splab.cz/en/download/databaze/ultrasound". In addition, the database for X-ray image was downloaded from "https://www.kaggle.com/paultimothymooney/

chest-xray-pneumonia". The algorithmic analysis was held by varying the values of W at $W = 0.5$, $W = 1.0$, $W = 1.5$ and $W = 2.0$.

3.2 Error Analysis

The statistical error analysis for medical image compression held for CT, MRI, US and X-Ray image types is shown in Tables 1 and 2, respectively. The algorithmic analysis on CR for the presented image compression model on varying W for four image types is shown by Table 1. The US image, the median CR performance of the adopted ISG-ROA approach, is 2.5% superior to $W = 0.5$ and 5% better than $W = 1.5$. Therefore, the enhancement of the presented image compression model in offering reduced CR has been confirmed by the simulation outcomes.

4 Conclusion

This paper has offered an algorithmic analysis on medical image compression system, which includes segmentation, image compression and image decompression processes. Here, the ROI and non-ROI regions of the image were segmented by MRG algorithm. Further, the segmented ROI region was compressed using DCT and SPHIT encoding scheme and the non-ROI regions was compressed by DWT and MHE schemes. Consequently, the filter coefficients of DCT and DWT were optimized by proposed ISG-ROA model. Finally, decompression takes place by performing the reverse process of compression with the same optimized coefficients. Here, the filter coefficients were tuned such that the CR was minimum. In addition, an algorithmic analysis was performed for the adopted scheme and the outcomes were analysed. In the analysis, the best performance of MEP for $W = 0.5$ was 5% better than $W = 1.0$, 20.62% better than $W = 1.5$ and 22.22% better than $W = 2.0$ for CT image. Moreover, for US image, the median CR performance of the adopted ISG-ROA approach was 2.5% better than $W = 0.5$ and 5% better than $W = 1.5$. Thus, the obtained outcomes substantiate the effectiveness of the adopted model.

Table 1 Error analysis of the proposed image compression using CT and X-ray images by varying weight

MEP								
Image type	CT	MRI	CT	MRI	CT	MRI	CT	MRI
Statistics	$W = 0.5$		$W = 1.0$		$W = 1.5$		$W = 2.0$	
Best	18,298	17,939	19,770	21,428	23,052	26,256	23,524	25,346
Worst	2.66 × 106	17,939	3.40 × 106	21,428	4.76 × 106	26,256	4.60 × 106	25,346
Mean	1.74 × 106	17,939	2.19 × 106	21,428	3.16 × 106	26,256	3.09 × 106	25,346
Median	2.14 × 106	17,939	2.68 × 106	21,428	3.93 × 106	26,256	3.88 × 106	25,346
Std-dev	1.18 × 106	0	1.50 × 106	0	2.13 × 106	0	2.08 × 106	0
MASE								
	$W = 0.5$		$W = 1.0$		$W = 1.5$		$W = 2.0$	
Best	2.5537	5.3786	2.5938	5.5126	2.7281	7.0776	2.7644	5.7534
Worst	13.552	21.247	14.732	23.809	23.27	58.603	24.35	54.626
Mean	6.1939	10.646	6.5138	11.454	8.8076	21.487	9.0401	20.344
Median	4.5454	10.189	4.7122	11.45	5.8001	16.14	5.8418	15.942
Std-dev	3.7335	4.5119	4.0704	5.1546	6.6994	15.45	6.8975	14.422
RMSE								
	$W = 0.5$		$W = 1.0$		$W = 1.5$		$W = 2.0$	
Best	46.841	59.593	47.82	63.076	49.228	72.902	50.836	74.836
Worst	152.96	161.68	169.34	184.91	211.54	248.93	213.3	248.64
Mean	96.243	114.15	102.64	129.17	118.41	165.91	120.36	165.81
Median	92.429	117.62	96.089	134.86	106.57	173.21	109.17	168.62
Std-Dev	47.023	47.392	53.07	55.589	68.463	80.988	68.73	80.438

Table 2 Error analysis of the proposed image compression using US and X-ray images by varying weight

MEP								
Image type	US	X-ray	US	X-ray	US	X-ray	US	X-ray
Statistics	$W = 0.5$		$W = 1.0$		$W = 1.5$		$W = 2.0$	
Best	2.30e + 06	14,990	2.86e + 06	17,378	3.90e + 06	25,961	3.79e + 06	25,300
Worst	2.66e + 06	17,977	3.40e + 06	22,070	4.76e + 06	26,870	4.60e + 06	25,890
Mean	2.48e + 06	16,449	3.13e + 06	19,517	4.33e + 06	26,451	4.19e + 06	25,610
Median	2.48e + 06	15,932	3.13e + 06	18,513	4.33e + 06	26,531	4.19e + 06	25,593
Std-dev	2.58e + 05	1327.1	3.79e + 05	1,966	6.06e + 05	356.28	5.69e + 05	176.9
MASE								
	$W = 0.5$		$W = 1.0$		$W = 1.5$		$W = 2.0$	
Best	2.91	11.766	3.0479	9.4013	3.2017	16.811	3.107	9.9915
Worst	13.937	25.171	13.812	26.187	18.914	38.147	17.235	35.261
Mean	8.0643	17.742	7.7143	17.139	10.247	26.674	8.9152	21.39
Median	7.5912	17.53	6.4655	18.987	9.2709	26.479	6.8564	25.2
Std-dev	4.9086	4.3383	4.5217	6.6323	6.7296	6.3323	5.7634	9.7297
RMSE								
	$W = 0.5$		$W = 1.0$		$W = 1.5$		$W = 2.0$	
Best	23.141	96.762	24.423	105.13	23.784	131.75	24.825	133.79
Worst	66.689	117.08	83.278	156.18	100.22	188.39	91.948	172.43
Mean	44.425	105.25	49.639	127.33	55.357	158.58	55.894	153.57
Median	40.577	104.15	43.985	128.11	49.073	155.78	50.902	153.01
Std-dev	18.576	5.9874	22.777	15.452	28.586	15.964	27.173	10.98

References

1. Zuo Z, Lan X, Deng L, Yao S, Wang X (2015) An improved medical image compression technique with lossless region of interest. Opt Int J Light Electron Opt 126:2825–2831
2. Venugopal D, Mohan S, Raja S (2016) An efficient block based lossless compression of medical images. Optik 127:754–758
3. Parikh SS, Ruiz D, Kalva H, Fernández-Escribano G, Adzic V (2018) High bit-depth medical image compression with HEVC. IEEE J Biomed Health Informatics 22:552–560
4. Devaraj SJ, Ezra K, Allvin A (2012) 3-D medical image compression for telemedicine application. Procedia Engineering 38:1444–1449
5. Lucas LFR, Rodrigues NMM, Cruz LAS, Faria SMM (2017) Lossless compression of medical images using 3-D predictors. IEEE Trans Med Imaging 36:2250–2260
6. Balleyguier C, Cousin M, Dunant A, Attard M, Arfi-Rouche J (2018) Patient-assisted compression helps for image quality reduction dose and improves patient experience in mammography. Eur J Cancer 103:137–142
7. Hosseini SM, Naghsh-Nilchi A (2012) Medical ultrasound image compression using contextual vector quantization. Comput Biol Med 42:743–750
8. Zhao C, Wang Z, Li H, Wu X, Sun J (2019) A new approach for medical image enhancement based on luminance-level modulation and gradient modulation. Biomed Signal Process Control 48:189–196
9. Jin X, Jiang Q, Yao S, Zhou D, He K (2018) Infrared and visual image fusion method based on discrete cosine transform and local spatial frequency in discrete stationary wavelet transform domain. Infrared Phys Technol 88:1–12
10. Yang S, Wu RX, Wang M, Jiao L (2010) Evolutionary clustering based vector quantization and SPIHT coding for image compression. Pattern Recogn Lett 31:1773–1780
11. Pajares G, Cruz JM (2004) A wavelet-based image fusion tutorial. Pattern Recogn 37:1855–1872
12. Binu D, Kariyappa BS (2018) RideNN: a new rider optimization algorithm-based neural network for fault diagnosis in analog circuits. IEEE Trans Instrum Meas 68(1):2–6

Deep Learning Method to Identify the Demographic Attribute to Enhance Effectiveness of Sentiment Analysis

Akula V. S. Siva Rama Rao and P. Ranjana

Abstract Sentiment analysis and machine-learning techniques play an important role in analyzing social media networks datasets. The customers, who have different levels of demographic attributes pouring views, reviews and feedback on various products and services in social media networks everyday life, this enormous data emerged as major source to extract knowledge to take appropriate decision by companies and business organizations. Most of the sentiment analysis processes ignoring various demographic attributes of customers such as sex, age, occupation, income, location, etc. Different levels of demographic attributes of a customer have their own custom purchase preferences. Depending on the sex, customers will have different preferences, habits and taste of purchasing items. The proposed method focused on sex demographic attribute analysis of the customer to yield effective low-level analysis results. The major challenge in the proposed method is identifying the sex (Male/Female) of the customer by using South Indian names. The proposed system implemented using multi-layer perceptron deep learning method and achieved best train and test accuracy results than decision tree, random forest, k-neighbors, support vector machine (SVM), Naive Bayes. The low-level demographic attribute feature extraction analysis enhanced the effectiveness of the sentiment analysis.

Keywords Social media networks · Demographic attribute · Feature extraction · Deep learning · Machine learning · NLP · Sentiment analysis

A. V. S. Siva Rama Rao (✉)
Research Scholar, Department of Computer Science and Engineering, Hindustan Institute of Technology and Science, Chennai, India

Associate Professor, Dept. of CSE, SITE, Tadepalligudem, Andhra Pradesh, India

P. Ranjana
Professor, Department of Computer Science and Engineering, Hindustan Institute of Technology and Science, Chennai, India
e-mail: pranjana@hindustanuniv.ac.in

H. S. Saini et al. (eds.), *Innovations in Computer Science and Engineering*,
Lecture Notes in Networks and Systems 103,
https://doi.org/10.1007/978-981-15-2043-3_33

1 Introduction

There are about 4.38 billion people utilizing social media networks in world. Every second, 11 new users added to social media networks. 40 billion dollars were spent on social media advertisements in the year 2018. 73% marketing people agreed that efforts through social media marketing have been very effective for their business. Today about 88% of companies marketing depends on social media and 50% of the social media users consulting companies every month. Artificial intelligence and machine-learning technologies emerged to extract knowledge from the social media datasets [1, 2].

Social media data analytics helps the organization to understand behavior of targeted customers, it also helps to increase brand image and responsiveness. Major data source for analytics is available in form of unstructured nature, which is difficult to preprocess and analyze. Natural language processing and machine-learning techniques have been employed to understand and extract behavior of the potential customers [2].

Social media posts vary with different demographic attributes of the users such as sex, age, occupation, location, income, etc. Understanding these variations of customers is important to target the specific customers. Today, most of social media data analytics miss the targeted customers with the broad data analytics. In order to target different potential customers, there is need to analyze the data at different levels of demographic attributes of the customer.

Most of the researches extract customer's behavior by treating customer as a single feature. Table 1 illustrates different demographic categories of social media users, such as sex and age. Table 2 illustrates the social media usage of different demographic customers. Different demographic category customers purchasing habits, views, reviews and opinions are need not be the same. There is a need to analyze the data at different levels of demographic attributes to target all socioeconomic customers effectively.

Most of social media networks corpora do not contain demographic information of the tweet-author. We proposed deep learning classification model to identify gender

Table 1 Sex and age demographics social media users

Age group in years	Sex	
	Male (%)	Female (%)
13–17	3.1	2.6
18–24	16	10
25–34	19	13
35–44	10	7.5
45–54	5.1	4
55–64	2.7	3
65 above	1.9	2.1
Total	57.8	42.2

Table 2 Location, education and income demographics users

Location	Urban	Suburban	Rural	
	29%	23%	17%	
Education	School	College	College and above	
	18	25	32	
Income	<$30 K	$30 K–$49 K	$50-$74	$75>
	20%	22%	26%	32%

of tweet-author to distinguish male tweets and female tweets. We discussed various sex determination research papers in related works section, and from these discussion, we inferred gender, that is identified by using various classification algorithms, such as SVM, CNN, ensemble model linear model, random forest, ada boost, decision tree, Deep Boost, fuzzy rules and Makov model by using images and handwritten scripts of users [3, 4]. These image classification models can not identify sex of user from textual tweets.

In order to achieve effectiveness of sentiment analysis goal, the paper is organized into different section, i.e. Introduction, Related works, Proposed model, Experiments and evaluation, Conclusion and Future work, References, etc., in the Introduction section, we stress the need of effectiveness in sentiment analysis, where in Related works section, we studied various recent IEEE and Elsevier papers and analyzed various models to identify the gender. We discussed about deep learning classification model to achieved better results than SVM model in the proposed model section, we presented various classification algorithms results by using confusion matrixes in the section Experiments and evaluation, and further work is discussed in the Conclusion and Future work and referred papers were listed in References.

2 Related Works

We analyzed various research efforts to distinguish female and male users on social media networks and presented some of the research abstracts here.

Jhang and Cho proposed convolution neural network model to predict sex with trained color images. And they observed that the gray scale images produced better classification results than convolution neural network with Red, Blue and Green color images [3]. Antipov et al. also done similar kind work [5].

Bi et al. proposed a method called ‘Kernel Mutual Information’ by using feature selection technique to detect gender from handwriting samples. They implemented support vector machine classification model for datasets in Arabic and English [4]. Similar type of research done by Erbilek et al. [6].

Chaudhuri et al. (2018) in the process of investigate probabilities to detect human thermal state by using physiological parameters, where there is need to determine

gender for which they adopted fourfold objective technique and random forest classification algorithm [7].

Nigam et al. (2018), Fang et al. (2018), Antipov et al. (2017), Dileep and Danti (2016), developed a classification model to classify various attributes such as age, sex, makeup, etc., using ensemble model, CNN by using pictures of users [8–11]. Zhao and Kamareddine (2017) predicted the gender by using first names in UK, Malaysia and China languages [12]. Cen and Ruta (2017) developed model to detect gender based on purchase behavior [13].

Reshma et al. (2017), Bouadjenek et al. (2015), Tripathi and Faruqui (2011), proposed a method to detect gender by using support vector machine algorithm [14–16].

From related works, we observed that most of papers used image as source data to identify gender, but textual tweets do not contain image of tweet-author [3, 9, 10, 14]. The proposed deep machine learning model would be the better in two aspects, one is identifying sex from south Indian textual names and better accuracy than SVM.

3 Proposed Model

In order to effectively target customers, customers should be analyzed at the level of customers demographic attributes, e.g. sex, age, income, location, etc. To separately analyze the male-customers' and female-customers' views, reviews and opinions, the sex of the customer is required, social media posts would contain name of tweet-author only but not sex.

In the proposed system, we considered sex demographic attributes to determine the sex of the customer by using south Indian names for the deep analytics. In order to understand South Indian names by machine, the deep machine-learning classification model has been adopted.

3.1 Deep Machine-Learning Classification Model

The proposed deep machine-learning classification model would identify the sex of tweet-author from textual South Indian names by using multi-layered deep learning evaluation model. In this approach, the classification model will be trained with training datasets, i.e. South Indian names. The sex attribute female and male classification model developed based on clues available in the name. In most cases, the female human names end with some vowels like 'a,' 'e,' 'i,' where most male names end with consonants such as 'k,' 'o,' 'r,' 's' and 't.' The classifier identifies and encodes the features of names and the feature extractor function develops feature set for relevant information about name. Table 3 illustrates input datasets structure, where index is serial number, name is name of the person and sex is gender of corresponding name.

Table 3 Structure of datasets

Index	Name	Sex
1	Anand	M
2	Aashika	F
3	Abha	F
4	Abhati	F
5	Abhaya	F
6	Joseph	M
7	Abhidhya	F
8	Abhijna	F
9	Abhilasa	F
10	Rama Rao	M

Features:

```
def features(name):

  name = name.lower()
  return{
    'left-1letter': name[0],
    'left-2letters':name[0:2],
    'left-3letters': name[0:3],
    'right-1letter': name[-1],
    'right-2letters': name[-2:],
    'right-3letters': name[-3:],
      }
```

3.2 Deep Learning Flow

Figure 1 Deep leaning flow illustrates requirements and classification process. To assess the performance of the machine-learning algorithm, the actual dataset will be split into two sets which are training and testing datasets. Generally, the actual data split is 80% and 20% for training ant test, respectively. To overcome over-fitter problem, the dataset divided into two sets which are training and test sets. The neural network will get trained by using training datasets. The test data can be used to check the performance of deep learning system.

The deep learning classification training dataset contains 4,427 South Indian names and their corresponding sex to fit the parameter weights of connection between neurons in deep neural networks. Depending upon output results, the parameters of the model are adjusted. The validation dataset that provides an unbiased model to fit with the number of hidden units in the neural network (NN). Finally, the test dataset provide an unbiased evaluation results of the final model on the training dataset.

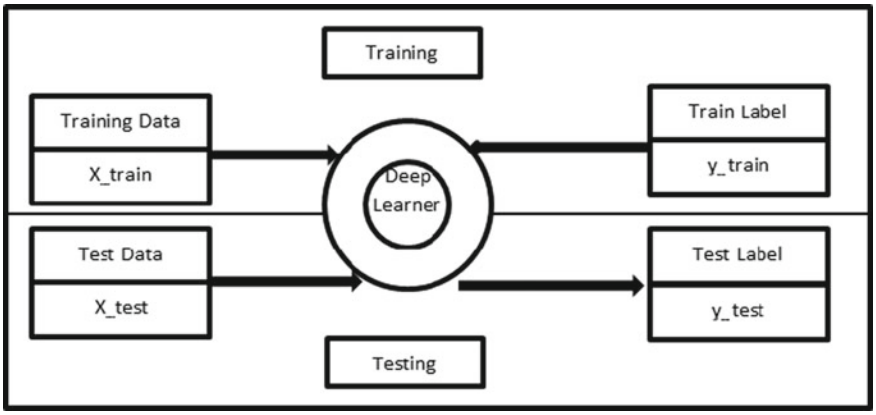


Fig. 1 Deep learning flow

3.3 Deep Learning Multi-layer Perception

Multi-layer perception classification learning algorithm, which learns function $f(\cdot)$: $R^m \rightarrow R^o$ on providing the training on data.

'm' indicates number of inputs and 'o' indicates number of outputs, for set of X features.

The class MLPClassifier() implements the multi-layer perception model and trains the data using back propagation technique.

4 Experiments and Evaluation

To classify the 4,427 South Indian names we consider various supervised machine-learning algorithms such as MLP Neural Network, decision tree, random forest, k-neighbors, support vector machine (SVM), Naive Bayes, etc., to conduct experiments.

4.1 Confusion Matrix

Confusion matrix (CM) is a table to visualize the performance of machine-learning classification algorithms. The row values of the matrix indicate actual class and the column values indicate the predicted class or vice versa. Confusion matrix accuracy can be calculated using the following formula:

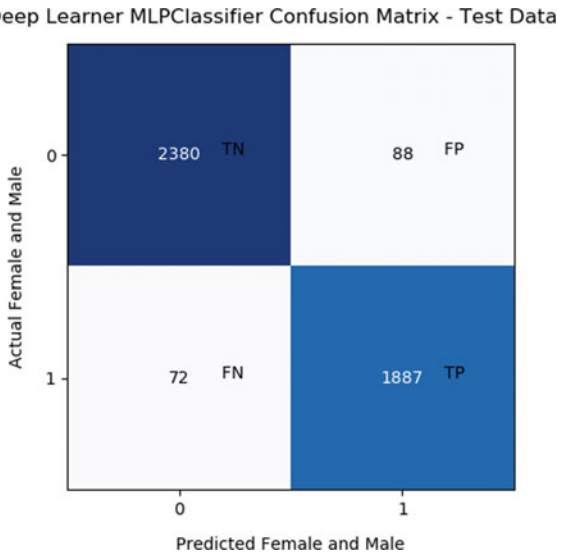


Fig. 2 Deep learner MLPClassifier CM

$$\text{Accuracy(ACC)} = \frac{\sum \text{TP} + \sum \text{TN}}{\sum \text{TP} + \text{TN} + \text{FP} + \text{FN}} \tag{1}$$

4.2 Evaluation of Classification Algorithms

We consider 4,427 South Indian names samples to classify as female names and male names, Fig. 2, 3, 4, 5, 6 and 7 are the performance evaluation confusion matrices of MLP neural network, decision tree, random forest, k-neighbors, support vector machine (SVM), Naive Bayes, respectively, where True Negative (TP) is correctly classified Male South Indian names, True Positive (TP) is correctly classified Female South Indian names, False Positive (FP) is actually they are Female but classified as Male. False Negative (FN) is actually they are Male but classified as Female.

4.3 Classification Algorithms Evaluation Summary

The accuracy in Table 4 has been calculated using is the formula Acc (1) the accuracy values in the table shows decrease from MLPClassifier to Naive Bayes. Multi-layer perception has achieved highest classification accuracy over all other classification models.

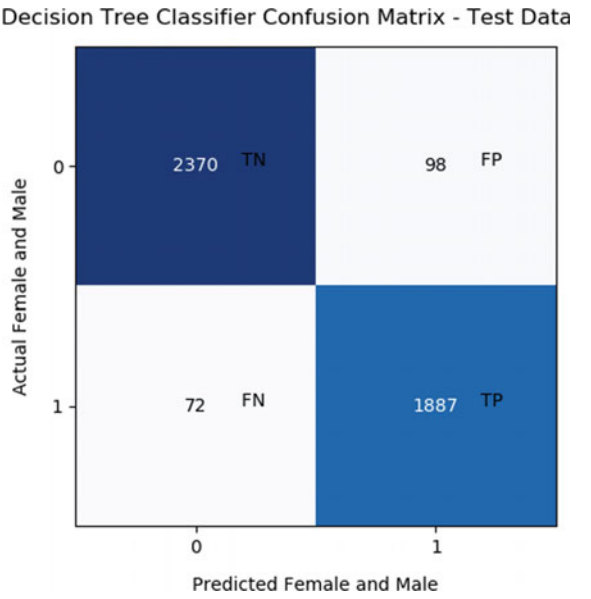


Fig. 3 Decision tree classifier CM

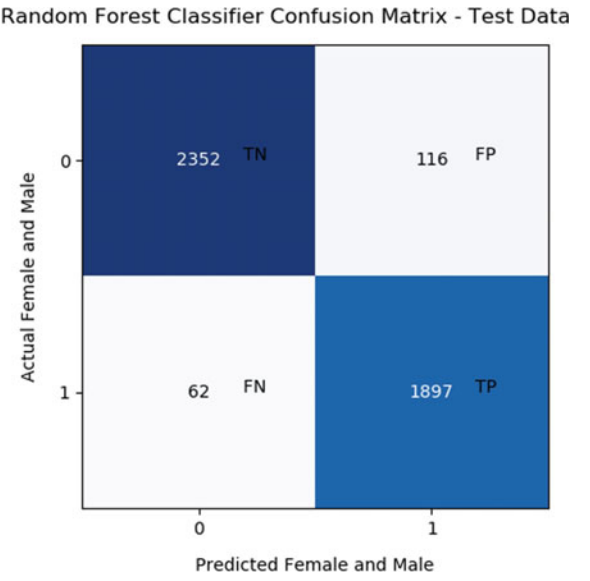


Fig. 4 Random forest classifier CM

5 Conclusion and Future Work

To effectively target customers in business strategies, gender classification sentiment analytics will yield fruitful results as there are lot differences in purchasing habits

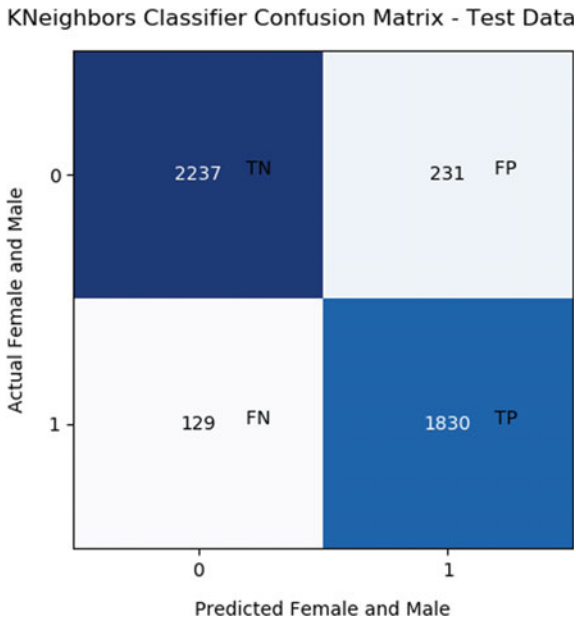


Fig. 5 K-neighbors classifier CM

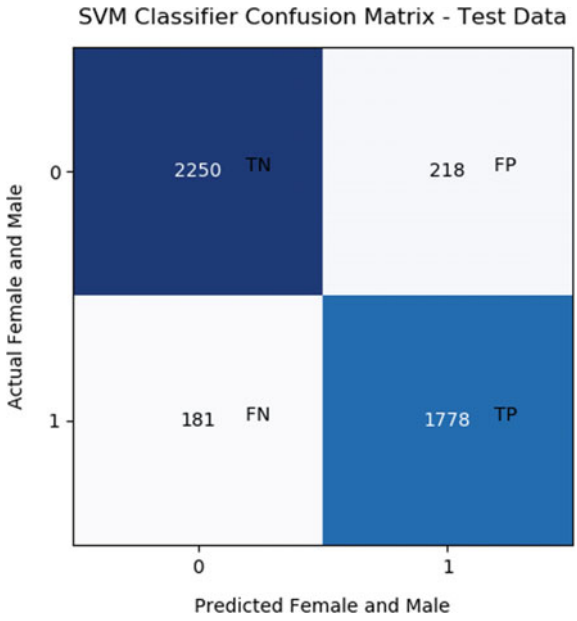


Fig. 6 SVM classifier CM

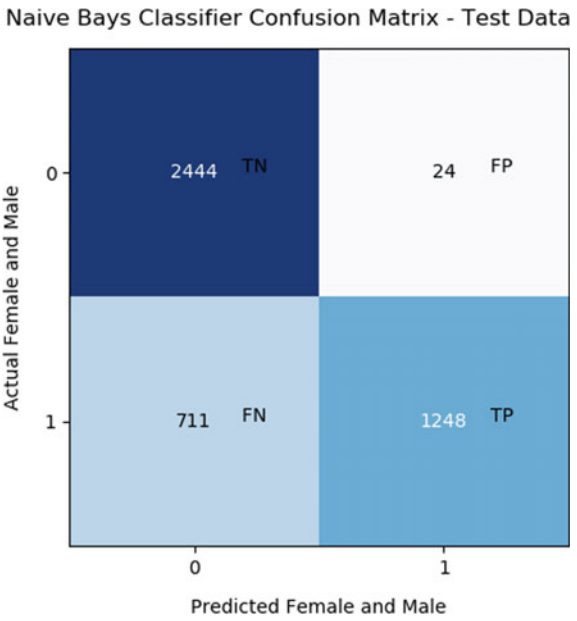


Fig. 7 Naive bayes' classifier CM

Table 4 Evaluation summary of classification algorithms

Total number of samples: 4427					
Female: 1959					
Male: 2468					
Name of the classifier	Female TP	Female FN	Male TN	Male FP	Accuracy
MLPClassifier	1887	72	2380	88	0.9639
Decision tree	1887	72	2370	98	0.9616
Random forest	1897	62	2352	116	0.9598
K-neighbors	1830	129	2237	231	0.9187
SVM	1778	181	2250	218	0.9099
Naive bayes	1248	711	2444	24	0.8340

of the gender. We used six classification functions such as MLP neural network, decision tree, random forest, k-neighbors, support vector machine (SVM) and Naive Bayes to classify South Indian names by using Python scikit-learn tool kit. Finally proved that the deep learner MLPClassifer() has been achieved highest classification accuracy.

Further, there is a lot of scope to focus the research on other demographic attributes classification analytics, such as age, income, occupation and location.

References

1. Jimenez-Marquez JL, Gonzalez-Carrasco I, Lopez-Cuadrado JL (2018) Towards a big data framework for analyzing social media content. https://doi.org/10.1016/j.ijinfomgt.2018.09.003
2. Kurnia PF (2018) Business Intelligence model to analyze social media information. https://creativecommons.org/licenses/by-nc-nd/4.0/
3. Jhang K, Cho J (2019) CNN training for face photo based gender and age group prediction with camera. IEEE. ISBN: 978-1-5386-7822-0
4. Bi N, Suen CY, Nobile N, Tan J (2018) A multi-feature selection approach for gender identification of handwriting based on kernel mutual information. https://doi.org/10.1016/j.patrec.2018.05.005
5. Antipov G, Berrani S-A, Dugelay J-L (2014) Minimalistic CNN-based ensemble model for gender prediction from face images. http://dx.doi.org/10.1016/j.patrec.2015.11.011
6. Erbilek M, Fairhurst M, Li C (2016) Exploring gender prediction from digital handwriting. IEEE. ISBN: 978-1-5090-1679-2
7. Chaudhuri T, Zhai D, Soh YC, Li H, Xie L (2018) Random forest based thermal comfort prediction from gender-specific physiological parameters using wearable sensing technology. https://doi.org/10.1016/j.enbuild.2018.02.035
8. Nigam K, Sharma S, Rana PS (2018) Gender, makeup, age and illumination prediction from faces using ensemble modeling. IEEE. ISBN: 978-1-5386-4273-3
9. Fang J, Yuan Y, Lua X, Feng Y (2018) Muti-stage learning for gender and age prediction. https://doi.org/10.1016/j.neucom.2018.12.073
10. Antipov G et al (2017) Effective training of convolutional neural networks for face-based gender and age prediction. https://doi.org/10.1016/j.patcog.2017.06.031
11. Dileep MR, Danti A (2016) Multiple hierarchical decision on neural network to predict human age and gender. IEEE. ISBN: 978-1-4673-6725-7
12. Zhao H, Kamareddine F (2017) Advance gender prediction tool of first names and its use in analysing gender disparity in computer science in the UK, Malaysia and China. http://dx.doi.org/10.1109/csci.2017.35
13. Cen L, Ruta D (2017) A map-based gender prediction model for big, e-commerce data. IEEE. ISBN: 978-1-5386-3066-2
14. Reshma PA, Divya KV et al (2017) A study of gender recognition from iris: a literature survey. IEEE. ISBN: 978-1-5386-1959-9
15. Bouadjenek N, Nemmour H, Chibani Y (2015) Local descriptors to improve off-line handwriting-based gender prediction. IEEE. ISBN: 978-1-4799-5934-1
16. Tripathi A, Faruqui M (2011) Gender prediction of indian names. IEEE. ISBN: 978-1-4244-8943-5

Encoding Context in Task-Oriented Dialogue Systems Using Intent, Dialogue Acts, and Slots

Anamika Chauhan, Aditya Malhotra, Anushka Singh, Jwalin Arora and Shubham Shukla

Abstract Extracting context from natural language conversations has been the focus of applications which communicate with humans. Understanding the meaning and the intent of the user input, and formulating responses based on a contextual analysis mimicking that of an actual person is at the heart of modern-day chatbots and conversational agents. For this purpose, dialogue systems often use context from previous dialogue history. Thus, present-day dialogue systems typically parse over user utterances and sort them into semantic frames. In this paper, a bidirectional RNN with LSTM and a CRF layer on top is used to classify each utterance into its resultant dialogue act. Furthermore, there is a separate bidirectional RNN with LSTM and attention for the purpose of slot tagging. Slot annotations use the inside-outside-beginning (IOB) scheme. Softmax regression is used to determine the intent of the entire conversation. The approach is demonstrated on data from three different domains.

Keywords Bidirectional RNN · CRF · Conditional random field · Word embedding · Dialogue acts · Slot filling · Intent classification

1 Introduction

The task of encoding utterances and assigning corresponding dialogue acts to utterances has held an inherit importance in the field of chatbots and dialogue systems that use not only current, but also the context obtained from prior utterances to derive suitable context efficiently. This task of assigning semantic labels is considered as a problem of labelling sequences of data. Each conversation between the system and a user is made up of utterances, and each utterance is further made up of words, thus giving rise to a hierarchical structure. This hierarchical structure of conversations is exploited by deploying a hierarchical recurrent neural network with bidirectional

A. Chauhan (✉) · A. Malhotra · A. Singh · J. Arora · S. Shukla
Delhi Technological University, New Delhi, India
e-mail: anamika@dce.ac.in

H. S. Saini et al. (eds.), *Innovations in Computer Science and Engineering*,
Lecture Notes in Networks and Systems 103,
https://doi.org/10.1007/978-981-15-2043-3_34

Table 1 A snippet of a conversation between user and agent with the corresponding dialogue act for each utterance for movie ticket booking domain

Natural language	Dialogue act
User: Are there any scary movies playing right now?	request (moviename; genre = scary; starttime = right now)
Agent: What city and state would you like me to look?	request (city; state)
User: Chicago, IL	inform (city = Chicago; state = IL)
Agent: Here are the movies i found: THE OTHER SIDE OF THE DOOR, THE WITCH.	inform (moviename = {THE OTHER SIDE OF THE DOOR#THE WITCH})
User: The Witch sounds great	inform (moviename = The Witch)

LSTM as base and CRF (conditional random field) as top layer to assign the corresponding dialogue act. Hierarchical recurrent encoders have been used previously by Sordoni et al. [1–3] and have been shown to perform better compared to standard non-hierarchical models. This model is able to detect dependencies among utterances, and among dialogue acts, and thus takes into account the information extracted from previous labels as well. A similar model has been previously used by Kumar et al. [4] and is known to give accurate results when assigning dialogue acts in sequence. Table 1 shows an excerpt from a conversation between a user and the agent with dialogue acts associated with each utterance. The inherent nature of dependencies among successive elements in a sequence hint at using structured prediction models such as conditional random fields that advocate the importance of labelling each item dependently, instead of labelling them independently.

A key component of spoken language understanding (SLU) in user-agent dialogue systems is to fill in a set of slots embedded in a semantic frame with the target of achieving a predetermined objective in human–machine discourse. The purpose of filling slots is to encode labels in inside-outside-beginning (IOB) representation. For instance, Table 2 depicts the slots assigned to each word of an utterance in IOB representation. Slot filling, a kind of named entity recognition task, has been a complex task in NLP. This has motivated the application of several deep learning and neural net approaches [5]. The approach taken in this paper attempted to build the architecture of slot filling using attention-based RNN, which is seen as an improvement over other RNN systems. Attention-based encoder-decoders efficiently map sequences of different lengths, while maintaining and understanding of prior concepts.

Intent classification has always been a crucial field in NLP. To detect the intent of the entire conversation, softmax regression is used, which fed the output from the

Table 2 An example depicting the tagging of slots for each word in an utterance

Sentence	I	Want	To	See	Deadpool	In	Dallas	Today
Slots	O	O	O	O	B-moviename	O	B-city	B-time

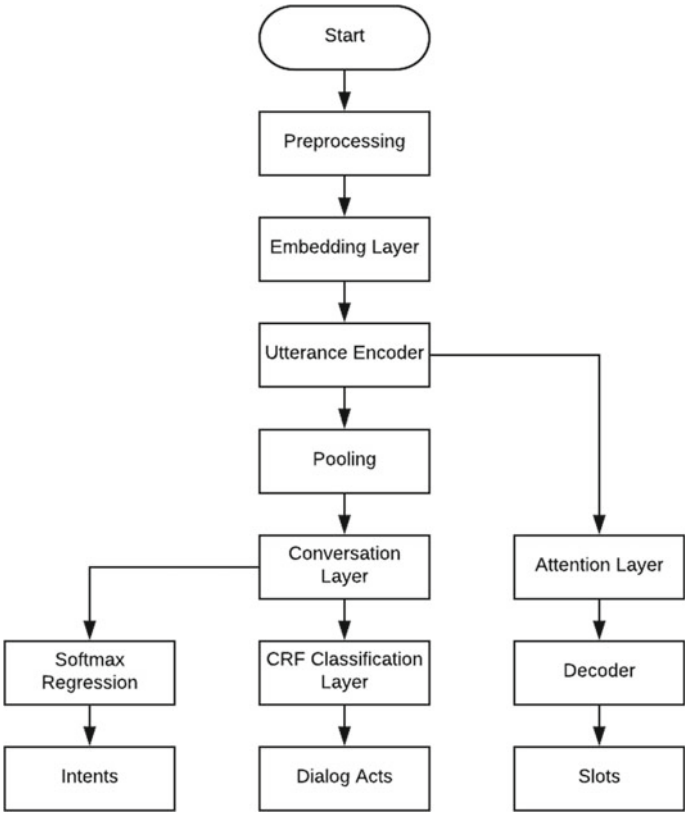


Fig. 1 A flowchart indicating the order of processes executed and the flow of data to obtain intent, dialogue acts, and slots

conversation layer. Figure 1 illustrates the complete process of obtaining dialogue acts, intent, and slots.

The rest of the paper is arranged in the following manner. Section 2 traces the related work that has been previously accomplished in the field. Section 3 describes the dataset used for our research work and illustrates the pre-processing and training procedure. Section 4 explains our approach and the models used in this paper. Finally, Sect. 5 summarizes results and draws conclusions.

2 Related Works

Earlier work in the field of context encoding and intent detection has largely involved the usage of models with a CRF layer [6], which has been shown to have an edge over other probabilistic models to segment and label sequence data. It performs better

than maximum entropy Markov models and hidden Markov models, where strong independence is assumed. Markov assumption states that the next state is determined only by the current state and not by the sequence of events that preceded it. It fails to take dependence between prior utterances into account [7]. CRF models have been used for sequence tagging in [8].

IOB tagging scheme has been previously used to annotate semantic frames with slot, intent, and dialogue acts. Reference [9] uses the technique of modelling intent, dialogue act, and slot prediction jointly, using an encoding module, based on hierarchical RNN, that gathers dialogue context to direct the frame parsing subtasks and can be shared between DST (dialogue state tracker) and SLU, instead of building a separate architecture for each of these tasks. Although this technique is more computationally efficient, memory networks which deploy separate RNN with CRF layer improve accuracy. In this paper, IOB scheme is used for the purpose of annotating the utterances, which will be used to detect the slot outputs.

Attention-based RNNs have demonstrated promising results in speech recognition tasks by significantly improving accuracy. Reference [10] studies the attention-based encoder-decoder, and its benefits in mapping sequences of different lengths. It further depicts the state-of-the-art results achieved from combining RNN slot filling models with the attention mechanism, which is the direction followed in this work.

3 Dataset

The dataset used here is taken from Microsoft Dialogue Challenge. It comprises three *tsv* files, which are well-annotated datasets for three task-oriented domains: restaurant reservation, booking movie tickets, and taxi ordering.

In the dataset, each utterance has a session ID, message ID, message timestamp, information about who the message is from, the text of the message, and the corresponding dialogue acts and intent associated with it. Out of these fields, session ID, the text of the message, dialogue acts, and intent are extracted. The dialogue acts further give information about the slots and the values they contain.

For instance, the data for the movie ticket booking task was accumulated from Amazon Mechanical Turk. The schema contains 11 dialogue acts (e.g. inform, request, confirm_question, confirm_answer, etc.), and 29 slots (e.g. moviename, starttime, theater, numberofpeople) [11, 12].

For this research, a subset of the dataset comprising of 1500+ utterances across the three datasets is used. To correctly match the utterances with their dialogue acts, manual cleaning and preparation of the dataset were done to achieve high split accuracy. Finally, a list of tuples like (session ID, list of tokens, dialogue act, a list of IOB tags, and intent) for each utterance is input to the subsequent model.

The final dataset is utilized for both training and testing purposes. The dataset has been split to use 80% for training, and 20% for testing.

4 Approach

Figure 2 shows the model architecture used in this paper. The different components of the architecture are described here.

Pre-processing: The data is processed into a hierarchical form consisting of a set of conversations, c_i. Each conversation, in turn, contains a set of utterances, u_j, both of the user and the system. The same pattern follows with each utterance consisting of a list of words, w_k. Padding is done, both at the utterance level and conversation level, to ensure consistency of dimension across all instances.

Embedding Layer: Each batch of conversations is passed through an embedding layer which adds more dimensionality to each word of the utterance. Random initialisation of features takes place to convert each word in the vocabulary into the respective embedding.

Utterance Encoder: The padded utterances for each conversation are fed into bidirectional RNN with LSTM whose outputs are further concatenated to one vector. Pre-processed encodings such as Glove and Word2vec can be used as well and can give similar results.

Attention Layer: This layer adds an extra hidden layer before decoding takes place. It helps in considering the significance of each word in the utterance for the word which is to be decoded.

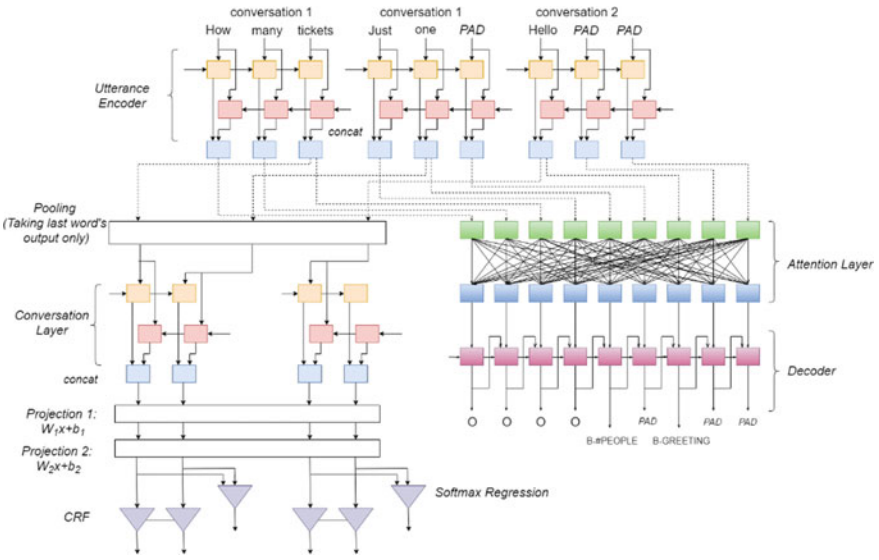


Fig. 2 Flow of data from utterance encoder, which is fed with embedding of words to (1), the conversation layer after being pooled, which is then passed via the CRF and softmax regression classifier for predicting dialogue acts and intent simultaneously and (2), the LSTM decoder with attention for predicting slots

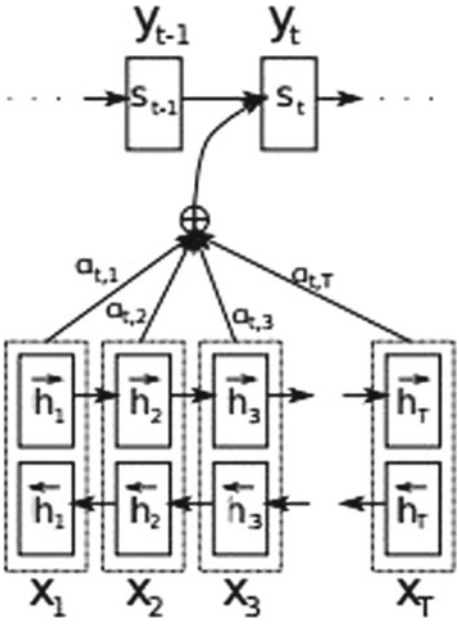


Fig. 3 Bahdanau attention from [13]

Bahdanau attention mechanism, as depicted in Fig. 3, has been used to define the attention mechanism in this paper. Here, each y_i represents the output of the ith time step slot of the utterance, s_i and c_i being the hidden state and context, respectively, and α_{ij} represents the attention on the ith time step by jth word [13].

$$\alpha_{ts} = \frac{\exp(\text{score}(\boldsymbol{h}_t, \bar{\boldsymbol{h}}_s))}{\sum_{s'=1}^{S} \exp(\text{score}(h_t, \bar{\boldsymbol{h}}_{s'}))} \tag{1}$$

$$c_t = \sum_s \alpha_{ts} \bar{\boldsymbol{h}}_s \tag{2}$$

$$\boldsymbol{a}_t = f(\boldsymbol{c}_t, \boldsymbol{h}_t) = \tanh(\boldsymbol{W}_C[\boldsymbol{c}_t; \boldsymbol{h}_t]) \tag{3}$$

Decoder: Decoder is again an RNN composed of LSTM units. Decoder unit takes as input the following: hidden state of the previous step, the output of the previous step, the output of the utterance encoder at ith time step, and the attention layer output of each word to be decoded into the slot. After obtaining the output from the decoder, it is passed through a softmax layer to obtain the predicted Slot value. F1 score is calculated to judge the accuracy of the slots.

Pooling: Given the output of the utterance encoder, the representation of each utterance, x_i, can be computed by combining output embedding of its constituent words in various ways. In this paper, for each utterance, the last time step's output embedding is taken as its representation because effectively it contains the context of all the words preceding it in the utterance.

Conversation Layer: This layer consists of a bidirectional RNN with LSTM. The representation of utterances for each conversation is taken from the previous layer. This sequence of representations is fed into the conversation level encoder, and the forward and backward outputs are concatenated to obtain a new representation of the utterances, y_i. Dropout is used here for regularization.
CRF Classification Layer: Linear chain CRF is proposed as a classifier for dialogue acts in this paper. The main reason for using CRF is to model dependencies between labels of utterances. Linear chain CRF allows modelling dependency between pairs of labels, which is sufficient for the use-case at hand. The following equations have been cited and summarized from [14]. The probability distribution of a sequence of labels, y, given a sequence of utterances, x and parameter, w is given as:

$$P(\bar{y}|\bar{x};\bar{w}) = \frac{\exp(\bar{w}\cdot F(\bar{x},\bar{y}))}{\sum_{\overline{y'}\in Y}\exp(\bar{w}\cdot F(\bar{x},\overline{y'}))} \tag{4}$$

Here, F is the global vector of feature functions $f_{1\ldots}f_d$ and feature function can model dependency between a pair of labels, $y_{i\text{-}1}$ and y_i. To estimate the parameters (lambda), maximum likelihood estimation is used.

$$\bar{\mathrm{w}}^* = \arg\max_{\bar{w}\in\mathbf{R}^d}\sum_{i=1}^{m}\log p(\bar{x}_i|\bar{y}_i,\bar{w}) - \frac{\lambda}{2}||\bar{w}||^2 \tag{5}$$

To calculate the accuracy of prediction, at the time of testing, the Viterbi algorithm is used to compute the optimal sequence of labels.

$$\hat{\bar{y}} = \arg\max_{\bar{y}} P(\bar{y}|\bar{x};\bar{w}) = \frac{\exp(\bar{w}\cdot F(\bar{x},\bar{y}))}{\sum_{\overline{y'}\in Y}\exp(\bar{w}\cdot F(\bar{x},\overline{y'}))} \tag{6}$$

Softmax Regression: The output of the conversation layer is reshaped to represent all the conversations in the batch data. Then, it is passed via a softmax regression layer with a cross entropy loss function. The class having maximum probability accounts for the intent predicted. During testing, accuracy is calculated by comparing the predicted values with the true labels.

5 Results and Discussion

Table 3 shows the achieved accuracy of classification of utterances for all three—

Table 3 Results obtained depicting the accuracy (%) of classifying dialogue acts, slots, and intent

Output calculated	Dialogue acts	Slots	Intent
Accuracy (%)	91.11	97.46	79.99

dialogue acts, slots, and intent of the conversation. The approach described in this paper is able to achieve these results due to the joint training of the above three.

A crucial consideration for comparison is the computational complexity of the dialogue act classification approaches. Memory network-based networks are inherently costly to run. Adding attention layer to slot tagger trades off memory and time for accuracy. An attention layer could also be added in the classification model of dialogue acts to possibly achieve better results. Another improvement could be training with a larger dataset.

6 Conclusion

In this paper, an approach for efficient classification of context in task-oriented user-agent conversations is described. The proposed model, which jointly predicts the dialogue acts, slots, and intent, is explored. While CRF-based classifier uses more memory over other models available, it gives significantly better results. Attention-based encoder-decoder RNN used to classify slots is a notable improvement over other classifiers. This joint model thus delivers state-of-the-art results over independent models.

References

1. Sordoni A, Bengio Y, Vahabi H, Lioma C, Simonsen JG, Nie J-Y (2015) A hierarchical recurrent encoder-decoder for generative context-aware query suggestion. In: Proceedings of the 24th ACM international on conference on information and knowledge management, pp 553–562
2. Serbian V, Sordoni A, Bengio Y, Courville A, Pineau J (2016) Building end-to-end dialogue systems using generative hierarchical neural network models. In: Proceedings of the 13th AAAI conference artificial intelligence, pp 3776–3783
3. Serban V, Sordoni A, Lowe R, Charlin L, Pineau J, Courville A, Bengio Y (2017) A hierarchical latent variable encoder-decoder model for generating dialogues. In: Proceedings of the 31st AAAI conference artificial intelligence, pp 3295–3301
4. Kumar H, Agarwal A, Dasgupta R, Joshi S, Kumar A (2017) Dialogue act sequence labelling using hierarchical encoder with CRF. Preprint at arXiv:1709.04250v2
5. Mesnil G et al (2015) Using recurrent neural networks for slot filling in spoken language understanding. IEEE/ACM Trans Audio Speech Lang Process 23(3):530–539
6. Lafferty J, McCallum A, Pereira FCN (2001) Conditional random fields: probabilistic models for segmenting and labeling sequence data. In: Proceedings of the 18th international conference machine learning, pp 282–289
7. McCallum A, Freitag D, Pereira F (2000) Maximum entropy markov models for information extraction and segmentation. In: Proceedings of the 17th international conference machine learning, pp 591–598
8. Baidu ZH, Baidu WX, Yu K (2015) Bidirectional LSTM-CRF models for sequence tagging. Preprint at arXiv:1508.01991v1
9. Gupta R, Rastogi A, Hakkani-Tur D (2018) An efficient approach to encoding context for spoken language understanding. Preprint at arXiv:1807.00267v1

10. Liu B, Lane I (2016) Attention-based recurrent neural network models for joint intent detection and slot filling. Preprint at arXiv:1609.01454
11. Li X, Panda S, Liu J, Gao J Microsoft dialogue challenge: building end-to-end task-completion dialogue system. Microsoft, Redmond, WA
12. Li X, Lipton ZC, Dhingra B, Li L, Gao J, Chen Y-N (2017) A user simulator for task completion dialogues. Preprint at arXiv:1612.05688v3
13. Bahdanau D, Cho K, Bengio Y (2016) Neural machine translation by jointly learning to align and translate. Preprint at arXiv:1409.0473v7
14. Batista DS (2017) Conditional random fields for sequence prediction. [Online]. Available http://www.davidsbatista.net/blog/2017/11/13/Conditional_Random_Fields. Accessed on 19 May 2019

A Novel Two Layer Encryption Algorithm Using One-Time Pad and DNA Cryptography

Animesh Hazra, Chinmoy Lenka, Anand Jha and Mohammad Younus

Abstract The need of encryption cannot be underestimated in today's time. From a travel ticket to a movie ticket, almost everything of need is easily available. This comes with the cost of sharing important information, which if gets into wrong hand, will cause havoc. The aim of this work is to secure the data by fusing the extracts of one-time pad (OTP) and DNA cryptography. In the first level, a symmetric-key algorithm of OTP has been used to make the text secure which is a very random technique. In the next level, conventional DNA cryptographic techniques with few variations have been used. The target of implementation would be the storing and passing of vital information of customers like the debit/credit card details including the CVV code or the virtual passcode. Using DNA cryptography, large amount of storage can be made in the server with an efficient speed and power.

Keywords Data security · Decryption · DNA cryptography · Encryption · One-time pad

1 Introduction

Cryptography [1] is defined as a mathematical process of encryption or encoding of data to hide the original message behind a random and secured code. The opposite of it is the decoding or decrypting the encoded information, which is called as

A. Hazra (✉)
Department of Computer Science and Engineering, Jalpaiguri Government Engineering College, Jalpaiguri, West Bengal, India

C. Lenka · A. Jha · M. Younus
Department of Information Technology, Jalpaiguri Government Engineering College, Jalpaiguri, West Bengal, India
e-mail: cl1908@it.jgec.ac.in

A. Jha
e-mail: aj1914@it.jgec.ac.in

M. Younus
e-mail: my1950@it.jgec.ac.in

H. S. Saini et al. (eds.), *Innovations in Computer Science and Engineering*,
Lecture Notes in Networks and Systems 103,
https://doi.org/10.1007/978-981-15-2043-3_35

cryptanalysis [2]. The combination of cryptography and cryptanalysis gives rise to cryptology. The main aim of cryptography is to address the four areas of information security, i.e. authentication, data integrity, confidentiality and non-repudiation. Earlier, the cryptography was executed using manual techniques. The intervention of new cryptographic algorithms and functions made the technique a huge superfast and secure. The original data or the plain text will be encrypted into the ciphertext. The process of encryption and decryption revolves around a key, which is used to encode or decode the data. This key is the driving engine of the cryptographic system.

Symmetric-key cryptographic technique applies the unique key to encode and decode the plaintexts, whereas asymmetric-key cryptography uses a public key which is made available to anyone and a secret key that is preserved hidden to incorporate the privacy of information. One of the two keys can be used for encrypting the text, where as the second one is needed for the reverse operation.

This paper focuses on the amalgamation of one-time pad, DNA computing along with DNA cryptography techniques which are explained below in details.

1.1 One-Time Pad

One-time pad or OTP [3, 4] refers to a ciphering mechanism in which a byte of the key stream is utilized to encipher every byte of plain text. Every time, the key is destroyed after used. That is why the method is referred to as one-time pad. In the old times, on the paper, various arbitrary keys were printed and were fixed as a whole to produce a pad, which was named as one-time pad. The interesting feature of OTP is the key stream used which is absolutely arbitrary stream. This means that all the key-byte combination can be represented using the values within the interval 0–255 with the equal probability of having different key-byte values for every other independent value. The expression to generalize the one-time pad algorithm is described below as follows.

$$C_i = E(P_i,\ K_i), V_i \in 1, 2, 3, \ldots, n \tag{1}$$

Here, E refers to the ciphering mechanism, P_i indicates the ith symbol of the plain text, K_i refers to the ith byte of the used key, C_i refers to the ith symbol of the output cipher text and n refers to the key stream size. It is important that the value of K_i and the ciphering mechanism E should be maintained very secret.

1.2 DNA Cryptography

This is defined as a technique of hiding or encrypting a data behind a DNA strand or sequence. Adleman [5], who is considered as the pioneer of DNA cryptography, came up with this process in 1994 to solve very complex problems. Due to the availability of

Table 1 Transformation mechanism from binary code to DNA sequence

DNA nucleotide	Binary value
A	00
G	01
C	10
T	11

infinite variations of DNA sequence, the technique became more secured and tough to crack. It has major advantages [6] which include minimum power requirement, minimum storage requirement and a better speed. Being a new field of research, this technique is making some promising achievements in encryption and decryption of data. The time is not far away when DNA computing would be one of the leading techniques to secure information.

1.3 DNA Computing

The DNA standing for deoxyribonucleic acid consists of nucleotides which are made up of three major elements as nitrogen base, five carbon sugar and phosphate group. The four bases comprise of, i.e. adenine (A), cytosine (C), thymine (T) and guanine (G) bases. For any organism, every critical data is hided inside the mixture of these four bases. The method of DNA computing [7] involves mapping of the DNA bases with the binary values 0 and 1. For example, a data "123" is needed to be encoded into a DNA sequence. Each digit is firstly converted into its corresponding 4-bit binary number. So, 1 is converted and mapped to 0001, 2 to 0010 and 3 to 0011. Now, they are written together as "0001 0010 0011". According to Table 1, 00 is represented as A, 01 is represented as G, 10 is represented as C and 11 is represented as T, every two-bit binary value has been converted to nucleotide base starting from the left side. So, finally, the resultant DNA sequence will be encoded as "AGACAT". This encoded text "AGACAT" is to be transmitted to the recipient which can be decoded to extract the original message.

2 Literature Survey

While conducting the research on cryptographic techniques, various relevant papers have been referred. In this section, we have summarized a few related works which are described as follows.

Pramanik et al. [8] devised a new parallel cryptographic algorithm which was implemented by the key concepts OTP, DNA molecular structure along with DNA hybridization technique. The authors claim to minimize the computation time of their cryptographic operation.

Zhang et al. [9] presented an innovative mechanism which is based on the DNA fragment assembly. In their methodology, the attributes of DNA molecular key, DNA digital coding along with other software approaches are incorporated.

In [10], the researchers have proposed some sophisticated approach of adaptive key length-based technique applicable to encryption of images that uses DNA technology where a chaotic sequence's initial conditions generated by a 72-bit external key and replication, complement rules are applied for further expansion of DNA.

In [11], the authors have implemented the three levels of security. This provides more security than the other cryptographic techniques, but it has more time complexity for the generation of decoding and encoding technique.

Das et al. [12] have used the technique of dynamic DNA sequence along with two-dimensional logistic map to prove the effectiveness of their algorithm on image encryption.

In [13], the researchers have used the DNA concept to transform the data in binary form to the DNA bases with EPCA mechanism for overcoming the drawbacks of Vigenere cipher which performs well on average computational resources.

Wang et al. [14] have designed a secured prototype which uses the mechanism of recombinant DNA concept along with DNA strand to transfer information securely.

3 Proposed Methodology

In this section, a detailed concept on the functioning of the presented method is cited whose architecture is shown in Fig. 1. The algorithm implemented here gives a two-level security, the first level works on the concepts of one-time pad method and the second level uses the concept of DNA cryptology. Hence, the tendered mechanism is the combination of these two techniques. It is described in details below.

Step 1: The plain text P to be encrypted is the input given by the user and it is initially converted into uppercase letters for further operations. This plain text is the original message that is needed to be sent from the sender's side.
Step 2: In an array of integer of same length as that of plain text, the character positions of the plain text P are stored as 0, 1, 2, …, 25 for A, B, C, …, Z.
Step 3: One-time pad (OTP) is generated randomly of same length as that of the plain text. This OTP is utilized for a single session only once and for every new session, a new OTP is generated.
Step 4: The character's positions of the alphabets generated in OTP are cached in a list in the same manner as described in Step 2.
Step 5: Implementing the first level of encryption, the character positions of the array of plain text are XOR-ed with the character positions of the generated OTP and store the result in the variable *E*. Here, modulo 26 division is done so that the resultant character positions are in the domain of 0, 1, 2, …, 25. It is illustrated as follows.

$$E_i = (\mathrm{P}_i \oplus \mathrm{O}_i) \% 26 \tag{2}$$

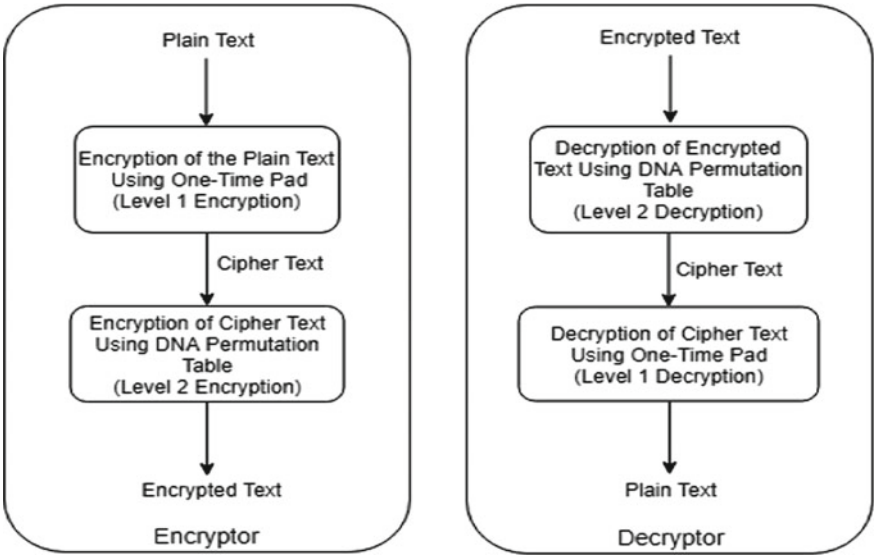


Fig. 1 Architecture of the methodology proposed

Here E_i refers to the ith symbol of the ciphertext, P_i refers to the ith symbol of the message and O_i refers to the ith character of the one-time pad.
Step 6: At present, the encrypted text is obtained by replacing the character positions with the corresponding alphabets.
Step 7: Now, in the next round of encryption, DNA cryptographic mechanism is incorporated on the first-level encoded text and not on the plain text P.
Step 8: Characters of the previously obtained step are mapped to binary string of size 8-bit as P_B using it's corresponding ASCII value.
Step 9: Now, the binary string P_B is converted into 4-bit DNA nucleotide sequence using the scheme described in Table 1.
Step 10: The 4-bit DNA sequence obtained for each character is matched with the values of permutation table, i.e. Table 5 (Table 5 contains all the possible DNA nucleotide quadruples consisting of the DNA bases A, G, C and T. The total number of possible combinations is 256). And the final encrypted text that will be sent to the receiver is the indices of the DNA quadruples obtained from the permutation table.
Step 11: The receiver needs the one-time pad for that particular session and the 4-bit DNA nucleotide sequence obtained from the permutation table, i.e. Table 5, using which the above process is reversed to obtain the original message P.

4 Result

Consider that the sender likes to forward the message "cryptography" to the receiver, then the algorithm would work as following.

Step 1: Here, the plain text P is "cryptography", which is initially converted to it's uppercase letters "CRYPTOGRAPHY" and the size of the cleartext is estimated which is twelve in this example.
Step 2: An array A[] of size twelve is defined and the character positions of the plain text P are stored in A[] as follows 0, 1, 2, …, 25 for A, B, C, …, Z (Table 2).
Step 3: An one-time pad is generated randomly of the equal size as that of the plain text P. This one-time pad is valid for one session and every time it will be changed automatically. In our case, the value of OTP is "DOWKALQUVHES".
Step 4: In an array OTP[], we store the character positions of the generated one-time pad using the same scheme as explained in Step 2 (Table 3).
Step 5: In this step, XOR operation is performed between every character of the arrays A[] and OTP[]. Also, store the result in an array Encrypt1[] (Table 4).
Step 6: The encrypted text is generated by mapping the corresponding character positions with the alphabets of array Encrypt1[]. Here, the resultant first-level encrypted text "BFOFTFWFVIDK" is obtained.
Step 7: For the next level of encryption, the cipher text "BFOFTFWFVIDK" acts as the input and DNA cryptographic technique is implemented on the obtained encrypted text as mentioned, not on the plain text P.
Step 8: All characters of the previously obtained cipher text are mapped to binary string of length 8-bit as P_B by using it's corresponding ASCII value. For example, "*B*" having ASCII value 66 is now converted into 8-bit binary string P_B as "01000010".
Step 9: Now following Table 1, the 8-bit binary sequence P_B is converted into the DNA nucleotide sequence as "GAAC".
Step 10: Finally, from Table 5, store the corresponding index value for the obtained DNA sequence "GAAC", which is 67 in our example. All the processes from Step 8 to Step 10 are repeated for every character of the encoded text "BFOFTFWFVIDK" to retrieve the ultimate encrypted message which is to be transmitted to the receiver.

5 Discussion

The proposed mechanism is executed on the OS having Windows 10 along with 64-bit, 5th generation Intel 64-bit processor and 4 GB RAM as primary memory. The programming was performed on Java JDK 1.8 environment. The code can also be compiled into different programming languages as per the user's convenience like Python, C++, MATLAB, etc.

In this proposed method, two techniques are combined to implement a two-level security. In the first level of security, OTP is arbitrarily produced and applied only

Table 2 Character positions of the plain text "CRYPTOGRAPHY"

Plain text	C	R	Y	P	T	O	G	R	A	P	H	Y
A[]	2	17	24	15	19	14	6	17	0	15	7	24

Table 3 Character position of the OTP "DOWKALQUVHES"

OTP		D	O	W	K	A	L	Q	U	V	H	E	S
OTP[]		3	14	22	10	0	11	16	20	21	7	4	18

Table 4 XOR operation done on each character positions of the arrays A[] and OTP[]

A[]	2	17	24	15	19	14	6	17	0	15	7	24
OTP[]	3	14	22	10	0	11	16	20	21	7	4	18
Encrypt1[]	1	5	14	5	19	5	22	5	21	8	3	10

Table 5 Permutation table of 4-bit DNA nucleotide sequences

Index	Value	Index	Value	Index	Value	Index	Value	Index	Value	Index	Value	Index	Value	Index	Value
1	AAAA	33	ACAA	65	GAAA	97	GCAA	129	CAAA	161	CCAA	193	TAAA	225	TCAA
2	AAAG	34	ACAG	66	GAAG	98	GCAG	130	CAAG	162	CCAG	194	TAAG	226	TCAG
3	AAAC	35	ACAC	67	GAAC	99	GCAC	131	CAAC	163	CCAC	195	TAAC	227	TCAC
4	AAAT	36	ACAT	68	GAAT	100	GCAT	132	CAAT	164	CCAT	196	TAAT	228	TCAT
5	AAGA	37	ACGA	69	GAGA	101	GCGA	133	CAGA	165	CCGA	197	TAGA	229	TCGA
6	AAGG	38	ACGG	70	GAGG	102	GCGG	134	CAGG	166	CCGG	198	TAGG	230	TCGG
7	AAGC	39	ACGC	71	GAGC	103	GCGC	135	CAGC	167	CCGC	199	TAGC	231	TCGC
8	AAGT	40	ACGT	72	GAGT	104	GCGT	136	CAGT	168	CCGT	200	TAGT	232	TCGT
9	AACA	41	ACCA	73	GACA	105	GCCA	137	CACA	169	CCCA	201	TACA	233	TCCA
10	AACG	42	ACCG	74	GACG	106	GCCG	138	CACG	170	CCCG	202	TACG	234	TCCG
11	AACC	43	ACCC	75	GACC	107	GCCC	139	CACC	171	CCCC	203	TACC	235	TCCC
12	AACT	44	ACCT	76	GACT	108	GCCT	140	CACT	172	CCCT	204	TACT	236	TCCT
13	AATA	45	ACTA	77	GATA	109	GCTA	141	CATA	173	CCTA	205	TATA	237	TCGA
14	AATG	46	ACTG	78	GATG	110	GCTG	142	CATG	174	CCTG	206	TATG	238	TCTG
15	AATC	47	ACTC	79	GATC	111	GCTC	143	CATC	175	CCTC	207	TATC	239	TCTC
16	AATT	48	ACTT	80	GATT	112	GCTT	144	CATT	176	CCTT	208	TATT	240	TCTT
17	AAGA	49	ATAA	81	GGAA	113	GTAA	145	CGAA	177	CTAA	209	TGAA	241	TTAA
18	AGAG	50	ATAG	82	GGAG	114	GTAG	146	CGAG	178	CTAG	210	TGAG	242	TTAG
19	AGAC	51	ATAC	83	GGAC	115	GTAC	147	CGAC	179	CTAC	211	TGAC	243	TTAC
20	AGAT	52	ATAT	84	GGAT	116	GTAT	148	CGAT	180	CTAT	212	TGAT	244	TTAT
21	AGGA	53	ATGA	85	GGGA	117	GTGA	149	CGGA	181	CTGA	213	TGGA	245	TTGA

(continued)

Table 5 (continued)

Index	Value	Index	Value	Index	Value	Index	Value	Index	Value	Index	Value	Index	Value	Index	Value
22	AGGG	54	ATGG	86	GGGG	118	GTGG	150	CGGG	182	CTGG	214	TGGG	246	TTGG
23	AGGC	55	ATGC	87	GGGC	119	GTGC	151	CGGC	183	CTGC	215	TGGC	247	TTGC
24	AGGT	56	ATGT	88	GGGT	120	GTGT	152	CGGT	184	CTGT	216	TGGT	248	TTGT
25	AGCA	57	ATCA	89	GGCA	121	GTGA	153	CGCA	185	CTCA	217	TGCA	249	TTCA
26	AGCG	58	ATCG	90	GGCA	122	GTCG	154	CGCG	186	CTCG	218	TGCG	250	TTCG
27	AGCC	59	ATCC	91	GGCG	123	GTCC	155	CGCC	187	CTCC	219	TGCC	251	TTCC
28	AGCT	60	ATCT	92	GGCC	124	GTCT	156	CGCT	188	CTCT	220	TGCT	252	TTCT
29	AGTA	61	ATTA	93	GGTA	125	GTTA	157	CGTA	189	CTTA	221	TGTA	253	TTTA
30	AGTG	62	ATTG	94	GGTG	126	GTTG	158	CGTG	190	CTTG	222	TGTG	254	TTTG
31	AGTC	63	ATTC	95	GGTC	127	GTTC	159	CGTC	191	CTTC	223	TGTC	255	TTTC
32	AGTT	64	ATTT	96	GGTT	128	GTTT	160	CGTT	192	CTTT	224	TGTT	256	TTTT

once for a single session. This makes the algorithm more secure. The use of XOR operation over normal addition ensures the method a difficult one to crack. In the next round of security, DNA cryptographic technique is used which have high storage capacity and fast computation time. The one-time pad and DNA permutation table, i.e. Table 5, used as a key that is distributed between the two communicating parties. By analysing the proposed method, the complexity of encrypting algorithm is explained and also some critical security concerns have also been presented as follows.

(a) The algorithm is executed on the size of the plain text P; therefore, the complexity of the code depends on the size of P and is directly proportional to P. Hence, the algorithm's complexity is O(n), such that n is the size of cleartext P.
(b) To crack the algorithm, it is required to break through the indices of the DNA nucleotide sequences which takes ${}^{256}P_n$ number of permutations (since there are 256 combinations of A, G, C and T of length 4 with repetitions allowed) where n is the size of cleartext. Also, there will be 4! i.e. 24 combinations of DNA bases (i.e. Table 1 can be arranged in 24 possible ways) are required to convert the DNA sequence into binary string. Therefore, the complexity to crack the second round of encryption, i.e. the permutation tables (Table 1 and 5) will be $({}^{256}P_n * 24)$ i.e. $O({}^{256}P_n)$, ignoring the constant term 24. To break the first level of encryption, the exact OTP of length n needs to be generated and the total number of possible combinations for creating the OTP will be 26^n, i.e. $O(26^n)$. So, the total complexity to break the permutation tables and OTP is $O(26^n + {}^{256}P_n)$, i.e. $O(26^n)$, which is an extreme large value for a small value of n. So, it is really very hard for the attacker to crack the proposed encryption scheme.

6 Conclusion

Network security and cryptography are the need of hour, because data is the most important asset of information industry. Proper mechanisms are needed to secure the data during transmission. In this proposed methodology, an algorithm based on two levels of security is designed and the detailed explanation and analysis of it are presented. This algorithm combines the best of two techniques, namely one-time pad which is being preferred since it is random and DNA cryptography for its fast execution and high-density data storage capacity. One-time pad is used in the initial round of safety to convert the plain text into encrypted text, on which the DNA cryptographic technique is applied in the next round of security. The main application of such algorithm is to send important information such as payment details or a secure message over the channel. In this digital age where people often tend to buy products of basic requirements ranging from clothes to medicine from online stores, they want to secure their important information from being hacked. Therefore, the algorithm provided here having an enhanced security is highly recommended in the above scenario.

7 Future Scope and Limitation

During this study, it has been observed that the one-time pad method even though being very random, the receiver needs to have the same one-time pad, which implies that the one-time pad needs to be exchanged as a plain text and if hacked will lead to the loss of security. This should be researched upon and covered up in the coming future ahead with the advancement of more secured algorithms.

References

1. Kahate A (2016) Cryptography and network security, 3rd edn. New Delhi
2. Hazra A, Ghosh S, Jash S (2018) A new DNA cryptography based algorithm involving the fusion of symmetric-key techniques. Adv Comput Commun Parad Adv Intell Syst Comput 706:605–615
3. Mingxin L, Xuejia L, Guozhen X, Lei Q (2007) Symmetric-key cryptosystem with DNA technology. Sci China Ser F: Inf Sci 50(3):325–333
4. Anam B, Sakib K, Hossain M, Dahal K (2010) Review on the advancements of DNA cryptography. In: Proceedings of international conference on software, knowledge, information management and applications (SKIMA)
5. Adleman LM (1994) Molecular computation of solutions to combinatorial problems. Science 266(5187):1021–1025
6. Cui GZ (2006) New direction of data storage: DNA molecular storage technology. Comput Eng Appl 42:29–32
7. Guozhen X, Mingxin L, Lei Q, Xuejia L (2006) New field of cryptography: DNA cryptography. Chin Sci Bull 51(12):1413–1420
8. Pramanik S, Setua KS (2012) DNA cryptography. In: 7th International conference on electrical and computer engineering, Dhaka, pp 551–554
9. Zhang Y, Fu B, Zhang X (2012) DNA cryptography based on DNA fragment assembly. In: IEEE international conference on information science and digital content technology (ICICDT), vol 1, pp 179–182
10. Jain A, Rajpal N (2013) Adaptive key length based encryption algorithm using DNA approach. In: International conference on machine intelligence and research advancement, Katra, pp 140–144
11. Srilatha N, Mrali G, Deepthi M (2017) A framework to improve E-seva services through E-governance by using DNA cryptography, pp 1–4. https://doi.org/10.1109/icammaet.2017.8186748
12. Das S, Mondal NS, Sanyal M (2019) A novel approach of image encryption using chaos and dynamic DNA sequence. In: Amity international conference on artificial intelligence (AICAI), Dubai, United Arab Emirates, pp 876–880
13. Sharieh AAA, Edinat KA, AlFarraji S (2018) An enhanced polyalphabetic algorithm on vigenerecipher with DNA-based cryptography, pp 1–6. https://doi.org/10.1109/aiccsa.2018.8612860
14. Wang Y, Han Q, Cui G, Sun J (2019) Hiding messages based on DNA sequence and recombinant DNA technique. IEEE Trans Nanotechnol 18:299–307

Fuzzy Resembler: An Approach for Evaluation of Fuzzy Sets

Roshan Sivakumar and Jabez Christopher

Abstract The efficiency of a fuzzy logic-based system is catalyzed by the system design. Fuzzy sets generalize classical crisp sets by incorporating concepts of membership for a fuzzy variable. Each fuzzy set is associated with linguistic concepts that are germane to a particular application. This paper presents an approach for evaluating the region of certainty and uncertainty represented in design of fuzzy linguistic variables. Fuzzy Resembler (FuzR) attempts to capture the goodness of a fuzzy system design using a geometric approach; it can be used for evaluating the design of fuzzy membership space. FuzR is the ratio between region of certainty to region of uncertainty. From the results, it can be inferred that FuzR presents meaningful observations of a fuzzy variable, characterized by trapezoidal, triangular, and gaussian membership functions. FuzR can be used as a design evaluation parameter for evolving fuzzy systems. Knowledge engineers can use it to optimize design of fuzzy systems in the absence of domain experts. Moreover, the level of abstraction provided by FuzR makes it an intuitive design parameter. The significance of this work lies more in its point-of-view than voracious results; the theory and formulation are still young and much more is yet to be conceptualized and tested.

Keywords Fuzzy sets · Membership functions · Certainty · Geometric modelling

R. Sivakumar (✉)
Department of Electrical and Electronics Engineering, BITS-Pilani, Hyderabad Campus, Hyderabad, Telangana, India

J. Christopher
Department of Computer Science and Information Systems, BITS-Pilani, Hyderabad Campus, Hyderabad, Telangana, India
e-mail: jabezc@hyderabad.bits-pilani.ac.in

H. S. Saini et al. (eds.), *Innovations in Computer Science and Engineering*,
Lecture Notes in Networks and Systems 103,
https://doi.org/10.1007/978-981-15-2043-3_36

1 Introduction

Fuzzy systems are significant areas where fuzzy logic and fuzzy set theory can be applied [1]. Fuzzy logic and fuzzy sets are used for representing the vagueness, uncertainty, and imprecise information mathematically [2]. Many decision-making systems, intelligent systems, recommender systems, and machine-learning approaches incorporate fuzzy logic and principles of fuzzy systems. Hence, fuzzy systems are used in an increasing number of fields, such as engineering [3], management [4], and medicine [5]. Fuzzy systems use linguistic rules; these rules are more suitable for representing complex system-problems where it is challenging to model the uncertainty and vagueness present in the system using traditional mathematical approaches.

The steps involved in a fuzzy system are as follows: first, fuzzification, where all input values are mapped with a degree of membership using appropriate membership functions; second, evaluation and execution, where linguistic rules in the rule base are used to compute the fuzzy outputs; finally, defuzzification, where the fuzzy output values are mapped to appropriate crisp values.

Design of fuzzy systems needs to address many objectives: generation of optimal fuzzy rules, choice of appropriate membership functions, reasonable number of parameters to be adjusted, and parameter tuning. The number of rules is generally proportional to the number of variables involved in the system. Experts find it difficult to define and elaborate a complete rule set for good system performance. Moreover, the lack of domain experts, and the communication gap between domain experts, knowledge engineers and developers makes it imperative to develop an automated way to design fuzzy systems.

Membership functions characterize fuzzy sets. The goodness of the design of a fuzzy model is strongly dependent on the design of the model's fuzzy sets. Performance of fuzzy models depends on the partitioning and designing of the space of system variables into fuzzy regions by fuzzy sets. The solution proposed in this paper utilizes the FuzR measure, which is the ratio of the certainty area to the uncertainty area; it is an intuitive approach that allows knowledge engineers and developers to easily build efficient and optimal fuzzy systems, having meagre expert-knowledge in designing such a model, or understanding how to modify the parameters for a good system performance.

1.1 Conventions of Fuzzy Terms

Let X represents a set of points, with an element denoted by x; $X = \{x\}$. A fuzzy set 'M' in X is characterized by a membership function $\mu_M(x)$ which associates each point in X, a real number in the interval [0, 1] with a value $\mu_M(x)$ at x which is known as the 'degree of membership' of x in M [1]. The extent the value of $\mu_M(x)$ is closer to one, the higher is the grade of membership in M.

Human measurements, measures and quantifications are often associated with linguistic terms and concepts such as very small, small, quite small, big, too big, large, very large, short, tall, very tall and so on, which results in linguistic variables. A base variable is a concept in the classical sense typified by a real-world phenomenon such as temperature, speed, frequency, height, weight, etc. Each variable in a system is regarded as a quintuple (v, T, X, g, m) in which the base variable is represented by v. T is the set of linguistic terms that belongs to the base variable v. The value of the base variable ranges over an universal set X. The grammar for generating the linguistic terms is represented by g, and m is generally the semantic rule that assigns to each linguistic term $t \in T$ its definition $m(t)$ which is a fuzzy set on X [6, 7].

Interpretation of similarity in fuzzy systems can use set-theoretic approaches or geometric approaches. In the former approach, the similarity of the intersection between two fuzzy sets M and N with membership functions μ_M and μ_N, respectively, is defined as the minimum of the two individual membership functions: $\mu_{M \cap N} = \min(\mu_M, \mu_N)$; whereas in the latter approach, the Euclidean space enclosed by each variable v and the geometric area of fuzzy sets corresponding to each linguistic term $t \in T$ are considered.

2 Related Work

There are several works in literature that address similarity estimation of fuzzy sets [8]. Different similarity measures provide different values that reveal intuitive closeness or similarity [9]. The choice of using a metric or a measure to estimate similarity depends on the designer. This section presents a few recent works in literature that deals with similarity estimation approaches and their application in fuzzy sets.

Garibaldi and John in their work present a study on few membership functions. They state that, in modelling of the human decision-making process, the current fuzzy systems and traditional membership functions do not provide sufficient choices for the developers [10]. The design of fuzzy sets may also involve combining or aggregation of sets. Merging fuzzy sets might result in similar rules in the rule base which increases redundancy. Furthermore, designing a rule base with reasonable coverage and prediction model accuracy is important. Setnes et al. in their work have investigated the effect of similarity on rule-base simplification in fuzzy systems [11]. They use measures based on set-theoretic operations on union and intersection to define the similarity between two fuzzy sets. Their work does not emphasize on the developers' efforts in re-estimating the consequent parameters of the rule base, neither does it look into the aspect of using appropriate fuzzy sets for partitioning of the space of base variables into fuzzy regions.

Shanmugapriya et al. in their work present a geometric approach for estimation of similarity between fuzzy sets [12]. They proposed SimE: an estimator that computes the overlapping area in the space of the fuzzy system's base variables using geometric approaches. Their ideas were reinforced by experimental evaluations with different

data distributions for four commonly used membership functions, namely triangular, trapezoidal, gaussian, and bell. Though their work accounted for the region of uncertainty, it fails to capture the overall certainty present in a fuzzy variable. From a designer's viewpoint, SimE cannot be used to control the entire space of the fuzzy system's base variables efficiently; hence, the intuition of using geometric approaches remains incomplete. FuzR attempts to address this issue; it effectively captures the intuitionism of the space of base variables partitioned into fuzzy regions using fuzzy sets characterized by membership functions. The notations used in our paper are adapted from SimE [12].

3 Fuzzy Resembler

Fuzzy Resembler computes the region of uncertainty and certainty between fuzzy sets that represent each linguistic terms $t \in T$. The input to the system is the lower and upper limits, $\mathcal{L}$ and $\mathcal{U}$. Three popularly applied membership functions (MFs), namely triangular, trapezoidal, and gaussian are used to characterize the fuzzy sets of a base variable 'v'. The functions $constrimf(\mathcal{L},\mathcal{U})$, $constrapmf(\mathcal{L},\mathcal{U})$, and $consgaussmf(\mathcal{L},\mathcal{U})$ construct the corresponding membership functions for each linguistic terms $t \in T$. Figures 1, 2, and 3 show the parameters and variables used in the construction of triangular, trapezoidal, and gaussian MFs, respectively. For each base variable 'v' in the fuzzy system, $AreaC(v, \mathbb{MF})$ and $AreaUC(v, \mathbb{MF})$ compute the area of certainty and uncertainty, respectively. The function *interest*() takes two lines as an argument and returns the point of intersection. The function *line*() takes two points as arguments and returns a line.

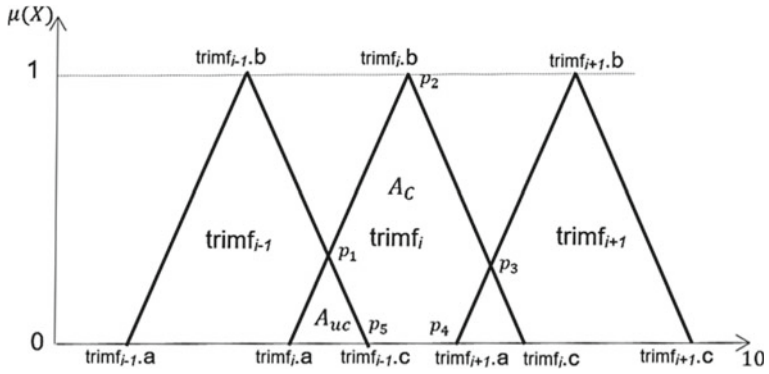


Fig. 1 Parameters of triangular membership function

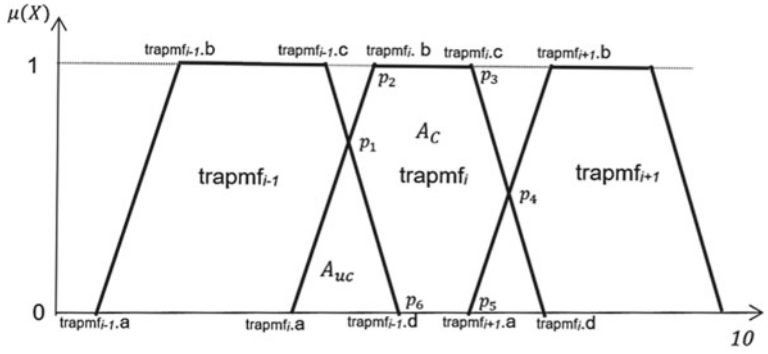


Fig. 2 Parameters of trapezoidal membership function

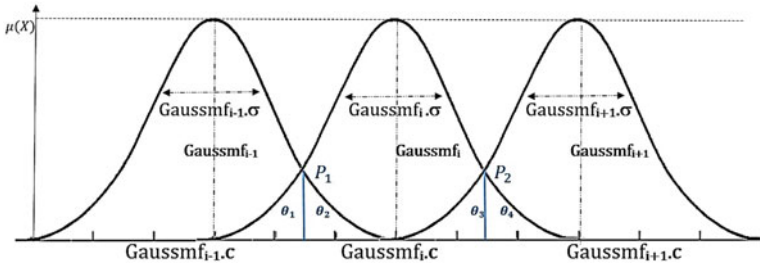


Fig. 3 Parameters of gaussian membership function

Computation of FuzR

Require: *A set of finite intervals* $\mathcal{L}$ *and* $\mathcal{U}$;
where $\mathcal{L} \ni \{l_1, l_2, .. l_n\}, \mathcal{U} \ni \{u_1, u_2, .. u_n\}$ $|n > 0$
$\mathbb{T} -$ *set of triangular MFs*; $\mathbb{T} \ni \{\text{trimf}_1, \text{trimf}_2, \text{trimf}_3 \ldots \text{trimf}_n\}$
$\mathbb{G} -$ *set of gaussian MFs*; $\mathbb{G} \ni \{\text{gaussmf}_1, \text{gaussmf}_2, \text{gaussmf}_3 \ldots \text{gaussmf}_n\}$
$\mathbb{Tr} -$ *set of trapezoidal MFs*; $\mathbb{Tr} \ni \{\text{trapmf}_1, \text{trapmf}_2, \text{trapmf}_3 \ldots \text{trapmf}_n\}$
Begin
1: ***Construct fuzzy sets***
1.1: $\mathbb{T} \leftarrow constrimf(\mathcal{L}, \mathcal{U})$
1.2: $\mathbb{Tr} \leftarrow constrapmf(\mathcal{L}, \mathcal{U})$
1.3: $\mathbb{G} \leftarrow consgaussmf(\mathcal{L}, \mathcal{U})$
1.4: $\mathbb{MF} \ni \{\mathbb{T}, \mathbb{Tr}, \mathbb{G}\}$

2: ***Calculate FuzR***
2.1: $A_C \leftarrow AreaC(v, \mathbb{MF})$
2.2: $A_{uc} \leftarrow AreaUC(v, \mathbb{MF})$
2.3: $FuzR = {}^{A_C}/_{A_{uc}}$

End

$constrimf(\mathcal{L}, \mathcal{U})$ /*Construction of Triangular MF*/
1: ***for each*** $l_i \in \mathcal{L}, u_i \in \mathcal{U}$ ***do***
2: $trimf_i.a \leftarrow l_i$
3: $trimf_i.b \leftarrow \frac{(l_i + u_i)}{2}$
4: $trimf_i.c \leftarrow u_i$
5: $\mathbb{T} \leftarrow trimf_i$
6: ***end for***
7: ***return***$(\mathbb{T})$

$constrapmf(\mathcal{L}, \mathcal{U})$ /* Construction of Trapezoidal MF*/
1: ***for each*** $l_i \in \mathcal{L}, u_i \in \mathcal{U}$ ***do***
2: $trapmf_i.a \leftarrow l_i$
3: $trapmf_i.b \leftarrow l_i + \frac{1}{4}|l_i - u_i|$
4: $trapmf_i.c \leftarrow u_i - \frac{1}{4}|l_i - u_i|$
5: $trapmf_i.d \leftarrow u_i$
6: $\mathbb{T}\mathbb{r} \leftarrow trapmf_i$
7: ***end for***
8: ***return***$(\mathbb{T}\mathbb{r})$

$consgaussmf(\mathcal{L}, \mathcal{U})$ /*Construction of Gaussian MF*/
1: ***for each*** $l_i \in \mathcal{L}, u_i \in \mathcal{U}$ ***do***
2: $gaussmf_i.\sigma \leftarrow \frac{|l_i - u_i|}{4}$
3: $gaussmf_i.c \leftarrow \frac{l_i + u_i}{2}$
4: $\mathbb{G} \leftarrow gaussmf_i$
5: ***end for***
6: ***return***$(\mathbb{G})$

AreaUC $(v, \mathbb{MF})$
Require: Set of membership functions $\mathbb{MF}$: $\mathbb{MF} \ni \{\mathbb{T}, \mathbb{Tr}, \mathbb{G}\}$; P_{uc} is the set of points on the perimeter of the uncertainty region: $P_{uc} \ni \{p_1, p_2, p_3\}$;

1: ***if*** $\mathbb{MF}$ *is* $\mathbb{T}$ ***then***
2: ***for*** *each* $trimf$ *in* $\mathbb{T}$ ***do***
3: $p_1 \leftarrow intersect(line\ (trimf_i.a,\ trimf_i.b),\ line\ (trimf_{i-1}.b, trimf_{i-1}.c))$
4: $p_2 \leftarrow trimf_i.a$
5: $p_3 \leftarrow trimf_{i-1}.c$
6: $A_{uc} = A_{uc} + Area(P_{uc})$
7: ***end for***
8: ***end if***
9: ***if*** $\mathbb{MF}$ *is* $\mathbb{Tr}$ ***then***
10: ***for*** *each* $trapmf$ *in* $\mathbb{Tr}$ ***do***
11: $p_1 \leftarrow intersect(line\ (trapmf_i.a,\ trapmf_i.b),\ line\ (trapmf_{i-1}.c, trapmf_{i-1}.d))$
12: $p_2 \leftarrow trapmf_i.a$
13: $p_3 \leftarrow trapmf_{i-1}.d$
14: $A_{uc} = A_{uc} + Area(P_{uc})$
15: ***end for***
16: ***end if***
17: ***if*** $\mathbb{MF}$ *is* $\mathbb{G}$ ***then***
18: ***for*** *each* $gaussmf$ *in* $\mathbb{G}$ ***do***
19: $\theta_1 = \int_0^{P_1} e^{\left(-\frac{1}{2}\left(\frac{x - gaussmf_i.c}{gaussmf_i.\sigma}\right)^2\right)}$
20: $\theta_2 = \int_{P_1}^{10} e^{\left(-\frac{1}{2}\left(\frac{x - gaussmf_{i-1}.c}{gaussmf_{i-1}.\sigma}\right)^2\right)}$
21: $A_{uc} = A_{uc} + \theta_1 + \theta_2$
/* P_1 is the point of intersection of curves; Refer Figure **3** ***/**
22: ***end for***
23: ***end if***
24: ***return*** (A_{uc})

AreaC $(v, \mathbb{MF})$
Require: Set of membership functions $\mathbb{MF}$: $\mathbb{MF} \ni \{\mathbb{T}, \mathbb{Tr}, \mathbb{G}\}$
/*P_C is the set of points on the perimeter of the certainty region*/
1: ***if*** $\mathbb{MF}$ *is* $\mathbb{T}$ ***then***
$P_C \ni \{p_1, p_2, p_3, p_4, p_5\}$

2: **for** *each trimf in* $\mathbb{T}$ **do**
3: $p_1 \leftarrow intersect(line\ (trimf_i.a,\ trimf_i.b),$
$line\ (trimf_{i-1}.b, trimf_{i-1}.c))$
4: $p_2 \leftarrow trimf_i.b$
5: $p_3 \leftarrow intersect(line\ (trimf_i.b,\ trimf_i.c),$
$line\ (trimf_{i+1}.a, trimf_{i+1}.b))$
6: $p_4 \leftarrow trimf_{i+1}.a$
7: $p_5 \leftarrow trimf_{i-1}.c$
8: $A_C = A_C + Area(P_C)$
9: **end for**
10: **end if**
11: **if** $\mathbb{MF}$ *is* $\mathbb{Tr}$ **then**
$P_C \ni \{p_1, p_2, p_3, p_4, p_5, p_6\}$
12: **for** *each trapmf in* $\mathbb{Tr}$ **do**
13: $p_1 \leftarrow intersect(line\ (trapmf_i.a,\ trapmf_i.b),$
$line\ (trapmf_{i-1}.c, trapmf_{i-1}.d))$
14: $p_2 \leftarrow trapmf_i.b$
15: $p_3 \leftarrow trapmf_i.c$
16: $p_4 \leftarrow intersect(line\ (trapmf_i.c,\ trapmf_i.d),$
$line\ (trapmf_{i+1}.a, trapmf_{i+1}.b))$
17: $p_5 \leftarrow trapmf_{i+1}.a$
18: $p_6 \leftarrow trapmf_{i-1}.d$
19: $A_C = A_C + Area(P_C)$
20: **end for**
21: **end if**
22: **if** $\mathbb{MF}$ *is* $\mathbb{G}$ **then**
/* P_1 and P_2 are the points of intersection of the curves; Refer Fig 3*/
23: **for** *each gaussmf in* $\mathbb{G}$ **do**
24: $\theta_1 = \int_0^{P_1} e^{\left(-\frac{1}{2}\left(\frac{x-gaussmf_i.c}{gaussmf_i.\sigma}\right)^2\right)}$
25: $\theta_2 = \int_{P_1}^{10} e^{\left(-\frac{1}{2}\left(\frac{x-gaussmf_{i-1}.c}{gaussmf_{i-1}.\sigma}\right)^2\right)}$
26: $\theta_3 = \int_0^{P_2} e^{\left(-\frac{1}{2}\left(\frac{x-gaussmf_{i+1}.c}{gaussmf_{i+1}.\sigma}\right)^2\right)}$
27: $\theta_4 = \int_{P_2}^{10} e^{\left(-\frac{1}{2}\left(\frac{x-gaussmf_i.c}{gaussmf_i.\sigma}\right)^2\right)}$
28: $\theta_5 = \int_0^{10} e^{\left(-\frac{1}{2}\left(\frac{x-gaussmf_i.c}{gaussmf_i.\sigma}\right)^2\right)}$
29: $A_C = A_C + (\theta_5 - (\theta_1 + \theta_2 + \theta_3 + \theta_4))$

30: ***end for***
31: ***end if***
32: ***return*** (A_C)

4 Results and Discussion

The computation and analysis of FuzR are presented in this section. The area of certainty and uncertainty was computed for two scenarios.

Table 1 presents the results for computation of FuzR for four fuzzy sets, $\{t_1, t_2, t_3, t_4\}$, characterized by three membership functions triangular, trapezoidal, and gaussian membership functions. We consider this computation between the limits zero to ten.

The values for real-world attributes and features, such as temperature, voltage, heart beat rate, height, weight, etc., may differ significantly. The range of the base variable is then normalized using min–max normalization for the computation of FuzR. Results presented in Table 2 show how a base variable can be scaled to a

Table 1 Computation of FuzR for limits 0–10

			trimf		*trapmf*		*gaussmf*	
l_i	u_i	$\boldsymbol{T}$	$\boldsymbol{A_{uc}}$	$\boldsymbol{A_C}$	$\boldsymbol{A_{uc}}$	$\boldsymbol{A_C}$	$\boldsymbol{A_{uc}}$	$\boldsymbol{A_C}$
0.00	1.00	t_1	–	0.432	–	0.614	–	0.433
0.50	3.20	t_2	0.067	1.180	0.135	1.686	0.178	1.237
2.40	6.00	t_3	0.101	1.582	0.203	2.264	0.271	1.643
5.00	10.0	t_4	0.116	2.383	0.232	3.517	0.342	2.72
		Total	0.285	5.579	0.570	8.083	0.792	6.033
		FuzR	19.546		14.159		7.617	

Table 2 Computation of FuzR for normalized inputs

					trimf		*trapmf*		*gaussmf*	
Original		Normalized		$\boldsymbol{T}$	$\boldsymbol{A_{uc}}$	$\boldsymbol{A_c}$	$\boldsymbol{A_{uc}}$	$\boldsymbol{A_c}$	$\boldsymbol{A_{uc}}$	$\boldsymbol{A_c}$
l_i	u_i	l_i	u_i							
6	25	0	1.74	t_1	–	0.802	–	1.169	–	0.878
19	48	1.19	3.85	t_2	0.068	1.030	0.137	1.394	0.189	1.047
35	73	2.66	6.14	t_3	0.231	1.429	0.462	1.986	0.431	1.506
65	98	5.41	8.44	t_4	0.082	1.403	0.165	2.050	0.248	1.508
94	115	8.07	10.00	t_5	0.027	0.936	0.054	1.390	0.141	1.039
				Total	0.410	5.601	0.820	7.992	1.009	5.978
				FuzR	13.659		9.744		5.924	

range between zero and ten. The area of certainty and uncertainty for computing FuzR is also presented in Table 2. Figures 4, 5, and 6 show the five fuzzy sets, $\{t_1, t_2, t_3, t_4, t_5\}$ for triangular, trapezoidal, and gaussian MFs, respectively.

FuzR can further be tuned by using pre-defined constants at the numerator and denominator. This will impact the area under certainty and uncertainty. Efficient manipulations of such factors will enhance the design of the fuzzy sets which would catalyze the performance of the fuzzy system. This is not presented in this work; the authors are currently analysing and working on such related factors, parameters, and measurement properties for enhancing the concept of Fuzzy Resemblers.

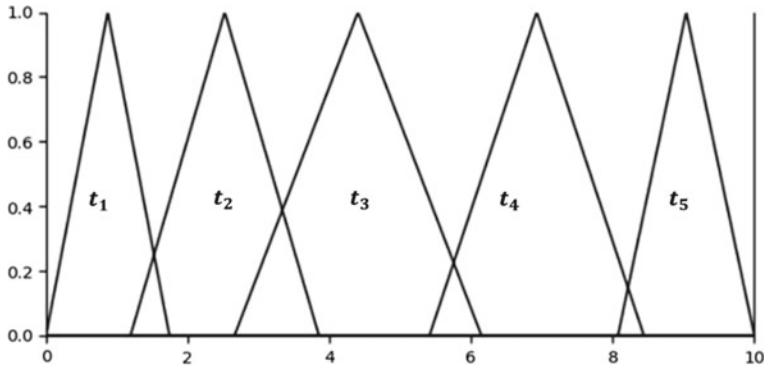


Fig. 4 Normalized triangular membership function

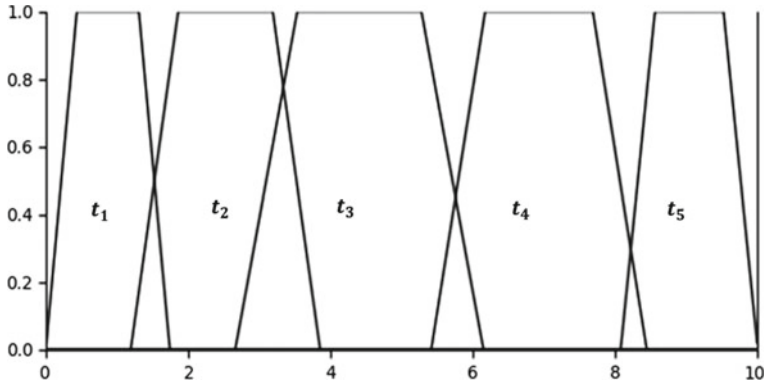


Fig. 5 Normalized trapezoidal membership function

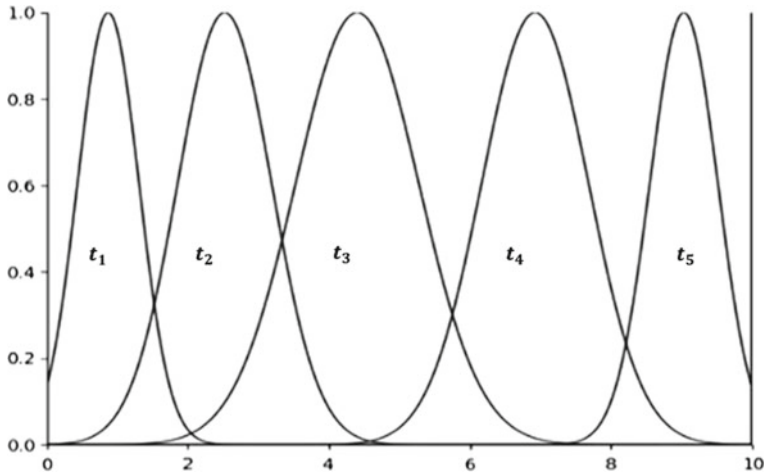


Fig. 6 Normalized gaussian membership function

5 Concluding Remarks

This paper presents a measure to evaluate fuzzy sets and design of membership functions. Unlike most research works that contain rigorous proofs and experimental results this article contains none. Essentially, the purpose is to introduce a concept that may eventually address many design problems in fuzzy controllers and inference systems. FuzR evaluates the goodness of a fuzzy system design using a geometric approach. The area of uncertainty and certainty represented by the fuzzy sets for a given base variable can be modified by the system developer based on FuzR value. A FuzR value for a particular domain of application can be computed from existing systems based on the algorithms and methods shown in this paper. This value can be used as a guideline for enhancing the design of fuzzy sets and membership functions in future. Use of FuzR can open novel directions in evaluating the design and development process of evolving fuzzy systems, and also design of fuzzy systems where concepts of intelligence and machine-learning models are used.

References

1. Zadeh LA (1965) Fuzzy sets and systems. In: Fox J (ed) System theory. Polytechnic Press, Calgary, AB, Canada, pp 29–39
2. Dubois D, Prade H (1980) Fuzzy sets and systems: theory and applications. Academic, New York, USA
3. Li X, Wen H, Hu Y, Jiang L (2019) A novel beta parameter based fuzzy-logic controller for photovoltaic MPPT application. Renew Energy 130:416–427
4. Lima-Junior FR, Carpinetti LCR (2016) Combining SCOR® model and fuzzy TOPSIS for supplier evaluation and management. Int J Prod Econ 174:128–141

5. Szczepaniak PS, Lisboa PJ (eds) (2012) Fuzzy systems in medicine. vol 41. Physica
6. Lootsma FA (1996) Fuzzy set theory and its applications. In: Zimmermann HJ (ed). Kluwer Academic Publishers, Boston, London, 435 p, US (1997): 227–228. ISBN: 0-7923-9624-3
7. Klir GJ, Yuan B (1996) Fuzzy sets and fuzzy logic: theory and applications. Possibility Theory Probab 32(2)
8. Balopoulos V, Hatzimichailidis AG, Papadopoulos BK (2007) Distance and similarity measures for fuzzy operators. Inf Sci 177:2336–2348
9. Jenhani I, Benferhat S, Elouedi Z (2010) Possibilistic similarity measures, foundations of reasoning under uncertainty. Stud Fuzziness Soft Comput 249:99–123
10. Garibaldi JM, John RI (2003) Choosing membership functions of linguistic terms. In: The 12th IEEE international conference on fuzzy systems, vol. 1. IEEE, pp 578–583
11. Setnes M, Babuska R, Kaymak U, van Nauta Lemke HR (1998) Similarity measures in fuzzy rule base simplification. IEEE Trans Syst Man Cybern Part B (Cybern) 28(3):376–386
12. Shanmugapriya M, Nehemiah HK, Bhuvaneswaran RS, Arputharaj K, Christopher JJ (2016) SimE: a geometric approach for similarity estimation of fuzzy sets. Res J Appl Sci Eng Technol 13(5):345–353

A Novel Approach to Identify Facial Expression Using CNN

V. Mareeswari, Sunita S. Patil, Lingraj and Prakash Upadhyaya

Abstract Facial expression recognition (FER) has been one of the actively research topics due to its wide range of application. FER is a very challenging task because of less training datasets. The result of facial expression is the well-classified loss function based on the robust prior knowledge at the end-to-end neural network architecture. The proposed methodology is able to address the task of facial expression recognition and aim to classify images of faces into five discrete emotion categories (happy, sad, angry, neutral, and surprise). Result of this paper is compared with the multiple training datasets and return the maximum appeared face emotion and with highest accuracy. The efficiency a well as the effectiveness of the proposed methodology is more accurate.

Keywords Facial expression recognition (FER) · Convolutional neural network (CNN) · Human–computer interaction (HCI) · Virtual reality (VR) · Augment reality (AR) · Advanced driver assistant systems (ADASs)

1 Introduction

The intentions of facial emotions that help us understand others are significant factors in human communication. Different facial expressions depict various human emotions, each one of those are distinct than the other one. The various surveys suggest that more than 60% of human communications are non-verbal. The facial expressions are one of the key data channels in interpersonal communication among several non-verbal components, by showcasing the meaning of emotions.

The human–computer interaction (HCI), virtual reality (VR), augment reality (AR), advanced driver assistant systems (ADASs), and entertainment are the artificial intelligent techniques which are growing rapidly with automatic facial emotion recognition (FER).

The FER is composed of three major steps, (1) facial component and face detection, (2) extraction of features, and (3) in conventional FER approaches classification

V. Mareeswari (✉) · S. S. Patil · Lingraj · P. Upadhyaya
ACS College of Engineering, VTU Affiliation, Bengaluru, India

H. S. Saini et al. (eds.), *Innovations in Computer Science and Engineering*,
Lecture Notes in Networks and Systems 103,
https://doi.org/10.1007/978-981-15-2043-3_37

of expression. First, detection of face image using input image, and landmarks or facial components detection from the region of face. Second, the different various structures are mined from the facial components. Third, the pre-trained FE classifiers yield the recognition results using the mined features.

2 Literature Survey

Ferreira [1], Cowie [2] were the one who had originated the technology of recognizing face expressions (known as FER), this went on to be one of the predominant topics of research and has application in a vast number of fields. Because of the present FER dataset being too small, the most difficult challenge is to train the deep network algorithm. The transfer learning model can be used as a substitute but the accuracy of the models will be again lesser than the actual potential. For that reason, we have presented a paper with point-to-point neuron networking architectures along with a meaningful loss function which will be based on the past knowledge about face expression bringing the result of some motion in face muscle and other parts. The loss function is explained to take the full process of learning in a perfect order so that the explained neural network is able to learn the emotions or expression attributes on the faces. The accuracy of this model will work for all laboratory controlled and all strange environments. The neural network presented is usually in use for the ongoing technologies as it gives most effective outputs.

Yang [3], Verma [4], Hsu [5] proposal for recognizing face expressions (FER) which is an important factor to machines for understanding the change in emotions of human beings. The accuracy of extracting results out of the face expressions is very laborious on consideration of the images with less brightness scale or partial faces and various different shortcomings. As a consequence, the attributes that can be used to draw out the actual outputs need to be put into action. Method: A weighted mixture deep neural network (WMDNN) has been presented to take out the attributes from facial images automatically that makes it easy to perform with the help of FER. There are lots of restrictions for FER because of too many available pre-processing approaches like detecting faces, rotating, and data augmenting.

Appearance associated attributes of face pictures are taken out by tuning a semi VGG16 Web, and the variables for this are applied using VGG16 representation which do train on dataset of net images. The results of all the mediums are combined in a prominence manner and the outputs of ultimate recognition are anticipated with the help of SoftMax differentiation. Outputs: Investigational output shown in the presented algorithm can identify four basic face expressions like happiness, sadness, neutral, and being surprised with high efficiency.

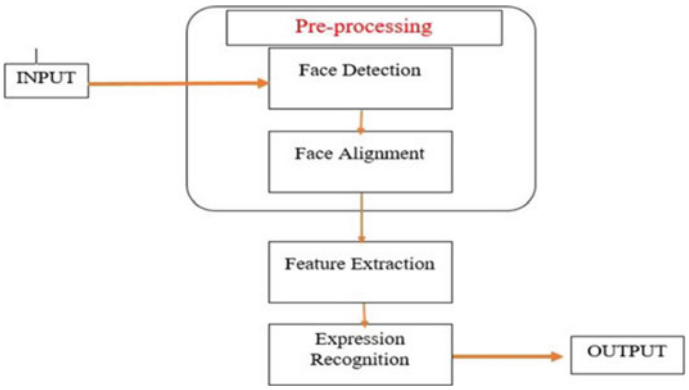


Fig. 1 Identification of facial expression flow diagram

3 Materials and Methods

Identification of facial expression is classified into pre-processing, face and facial component detection, feature extraction, and classification as shown in Fig. 1.

A. **Pre-processing**: This step is performed to improve the quality of the image. It concentrates on only essential data required while removing any noise. It removes extra details of the image which are redundant. It also facilitates normalization and filtration.
B. **Face and Facial component detection**: The organs on the face are recognized along with other key facial features. Other important features are also identified. Now to map the recognized features, we use tools such as FE Classifiers, SVM, and AdaBoost.
C. **Feature Extraction**: It is the most interesting feature of the process. Features such as color, motion, and shape are extracted. When compared to original copy, this extraction has lesser but precise data, hence lesser storage.
D. **Classification**: It takes as input the output of previous stage. The recognized features are grouped into classes based on certain parameters. This stage is comparatively difficult with the other stages since it is influenced by many other factors.

4 Classification Utilizing Deep Learning

A convolutional neural network is one of the forward feeding artificial neural network. This idea is encouraged by biological human brain organization. Convolutional neural network is same as the organization of human neural system in which it consists of neurons with the weights and the biases. Each neuron is fed with the input to the

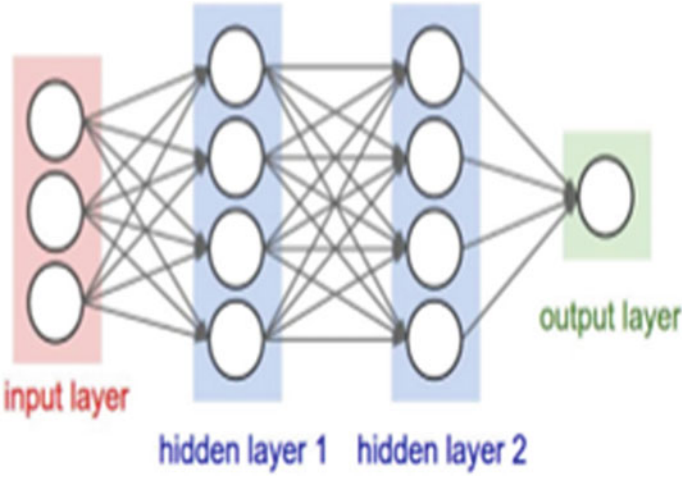


Fig. 2 Convolutional neural network basic layout

next neuron, i.e., the output of the previous neuron is served as the input to the next neuron, by this feature of biological concept the highest accurate and efficient result is obtained because of the multiple layer between the input and the output layer in which the most refined features are extracted to obtained the correct output as shown in Fig. 2.

Input Layer: FER contains haarcascade_frontalface_default.xml file is used in openCV which contains pre-trained images and also helpful to find and crop the images.
Hidden layer: The numPy array gets conceded into hidden layer to specify the number of filters. Each filter generates (3, 3) receptive fields. Convolutional produces a feature map that characterizes how pixel values are improved.
Output layer: The output represents itself as a probability for each expression class. The model is able to demonstrate the feature conformation of the expressions in the face.

5 Results and Discussions

Simple face expression recognition is proposed. The proposed system was implemented using three steps they are facing component detection, feature extraction, and classification. Result of this project is compared with the training and testing example which are already given as a sample input with similar expressions. The experimental results are produced by our own students in the department which is shown from Figs. 3, 4, 5, 6 and 7.

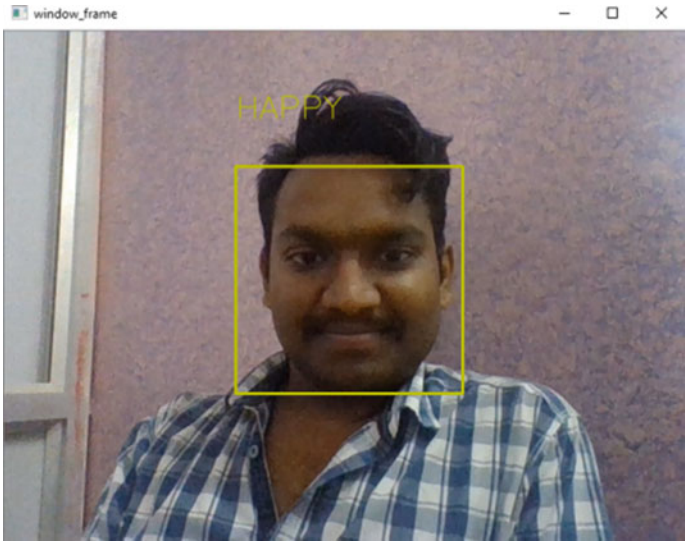


Fig. 3 Happy face

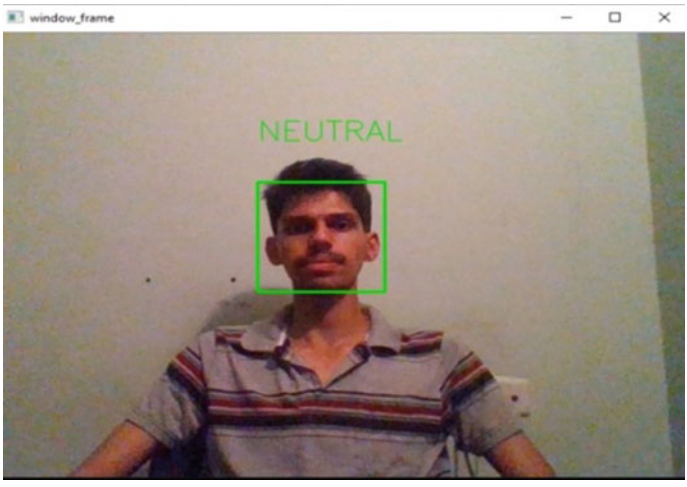


Fig. 4 Neutral face

Since the person in Fig. 3 is smiling, the system recognizes the pixels around is mouth and eyes and results in happy face. The face expression is detected as neutral as shown in Fig. 4 since the person is not giving any expressions to be recognized. This state is displayed only when a person is not ready to express their reaction at a particular time interval.

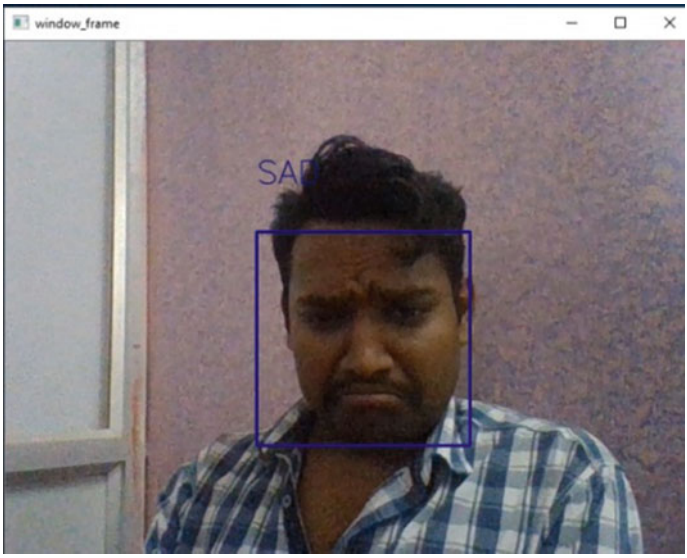


Fig. 5 Sad face

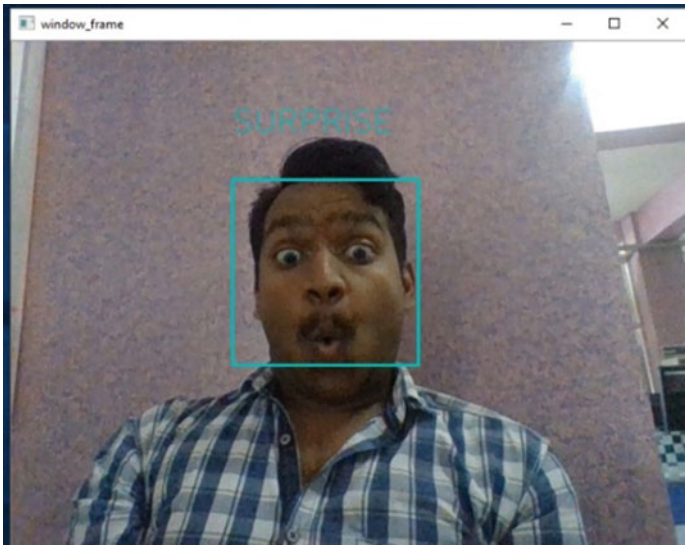


Fig. 6 Surprised face

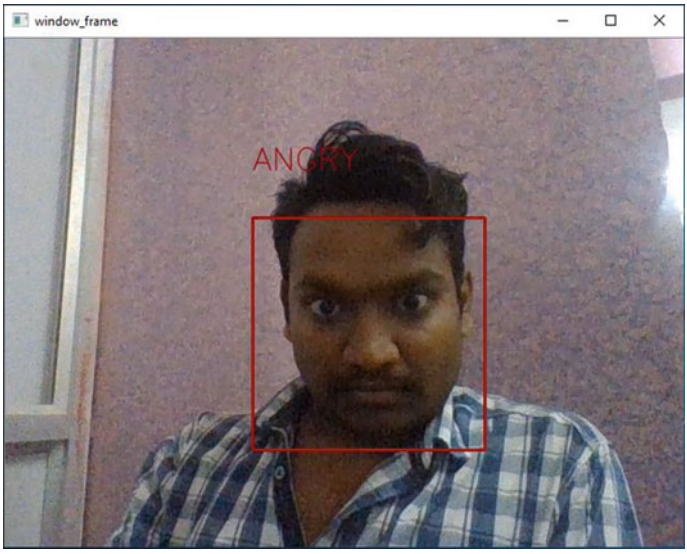


Fig. 7 Angry face

By calculating a number of pixels value in the given persons expression, it is concluded that a person is in a sad mood as shown in Fig. 5. The above screenshot is displayed a sad expression in a square box which specifies that only fixed square of a considered for an expression calculation. A person in Fig. 6 is expressing the surprised reaction for certain incident. This expression is displayed when a person reacted with an enlarged eye and surprised form of reaction is expressed.

In Fig. 7, a person is reacted in the angry state. The changes in the eye surrounded pixels are evaluated in the above person expression and resulted in the conclusion that a person is in an angry mood.

The final result which gives the expression of the person and counts the appearance of that particular expression and also calculates the average for maximum appeared expression by considering total number of count and the count of the individual expression as shown in Fig. 8 and final experimental result is shown in Table 1.

6 Conclusion

In this paper, we have spoken the task of facial expression recognition and aimed to classify images of faces into five discrete emotions categories that represent universal human emotions. We experimented with various techniques such as facial expression recognition (FER) methods and achieved our highest accuracy about on a CNN

Fig. 8 Experimental result

Table 1 Expression calculation in terms of percentage

Expression of the person	Number of times appeared	Average in percentage (%)	Output
Neutral	20	20/100 = 20%	The person with highest average value that is happy with 35%
Happy	35	35/100 = 35%	
Sad	15	15/100 = 15%	
Surprised	17	17/100 = 17%	
Angry	13	13/100 = 13%	
	Total = 100		

trained from the beginning with four convolutional layers. The final result calculates the average time with different expressions and returns the highest value.

Future work

In the future, a mobile application to recognize the face expression and also detection of gender during the facial expression will be developed. Finally, all these records will show in the form of a graph for better understand and more accuracy.

References

1. Ferreira PM, Marques F, Cardoso JS (2018) Physiological inspired deep neural networks for emotion recognition
2. Cowie ED, Cowie R, Fellenz W, Kollias S, Taylor JG, Tsapatsoulis N, Votsis G (2001) Emotion recognition in human computer interaction. IEEE Signal Proc Mag

3. Yang B, Cao J, Ni R, Zhang Y (2018) Facial expression recognition using weighted mixture deep neural network based on double-channel facial images
4. Verma K, Khunteta A (2017) Facial expression recognition using gabor filter and multi-layer artificial neural network
5. Hsu RL, Jain AK, Mottaleb MA (2002) Face detection in color images. IEEE Trans Pattern Anal Mach Intell

A Statistical Approach to Graduate Admissions' Chance Prediction

Navoneel Chakrabarty, Siddhartha Chowdhury and Srinibas Rana

Abstract In the current scenario, grad students often experience difficulty in choosing a proper institution for pursuing masters based on their academic performances. Although there are many consultancy services and Web applications suggesting students, institutions in which they are most likely to get admitted. But, not always the decisions are staunch since there are different kinds of students with different portfolios and performances in their academic careers and institution selection is done on the basis of historical admissions' data. This study aims to analyze a student's academic achievements as well as university rating and give the probability of getting admission in that university, as output. The gradient boosting regressor model is deployed, which accomplished a R^2-score of 0.84 eventually surpassing the performance of the state-of-the-art model. In addition to R^2-score, other performance error metrics like mean absolute error, mean square error, and root mean square error are computed and showcased.

Keywords Gradient boosting regressor · R^2-score · Mean absolute error · Mean square error · Root mean square error

1 Introduction

In the world of competitions, the real challenges are faced by the students themselves. Time to time, they have their entrance tests and they are under pressure to get admission for their graduation. In this process of getting admission, the students take all kinds of risks. The biggest one of those risks is applying in institutions for

N. Chakrabarty (✉) · S. Chowdhury · S. Rana
Jalpaiguri Government Engineering College, Jalpaiguri, West Bengal, India
e-mail: nc2012@cse.jgec.ac.in

S. Chowdhury
e-mail: sc2024@cse.jgec.ac.in

S. Rana
e-mail: srinibas.rana@cse.jgec.ac.in

H. S. Saini et al. (eds.), *Innovations in Computer Science and Engineering*,
Lecture Notes in Networks and Systems 103,
https://doi.org/10.1007/978-981-15-2043-3_38

graduate admission and waiting for them without applying in sufficient number of other institutions of higher or lower rating. Under such circumstances, if not selected then there is a huge wastage of time and resources. Also if selected, but in a university of low rating in spite of the fact that the student deserves admission in comparatively high-rated institutes, poses a problem. Therefore, due to the lack of proper prognosticators, students opt for either very ambitious institutions or very low-ranked institutions. In order to encounter such onerous things, chance-estimate prediction of graduate admission comes into play.

In this paper, the gradient boosting regressor-based machine learning model is developed in which parameters necessary for the admission purpose like GRE Score, TOEFL Score, University Rating, Statement of Purpose and Letter of Recommendation Strength, Undergraduate GPA and Research Experience are taken into consideration. The trained model, when tested on unknown test instances, fetches appreciable statistical results for the chance (probability) value prediction of admission and hence gives an impartial notion of the selection criteria [1].

2 Literature Review

Previously, there have been several experimental attempts involving analytical techniques for developing a statistically successful and reliable graduate admission prediction system. A few of them include:

- Acharya et al. [1] proposed a comparative approach by developing four machine learning regression models: linear regression, support vector machine, decision tree and random forest for predictive analytics of graduate admission chances.
- Gupta et al. [2] constructed a decision support system powered by machine learning for prediction of graduate admissions in USA via classification by taking certain parameters like standardized test scores, GPA and Institute Reputation into consideration.
- Ghai [3] developed an American graduate admission prediction model that enables students to choose the apt University by foretelling whether he/she will be admitted there or not.
- Bibodi et al. [4] composed two different predictive models regarding graduate admissions:

  1. A statistical analytical model based on naive Bayes that filters (selects) out universities that are suitable for the students based on their marks and other biographical information.
  2. A machine learning classification model powered by random forest, decision tree, naive Bayes, SVM-linear, and SVM-radial algorithms that can be deployed by universities for selecting the deserving students for their admission programs.

– Roa et al. [5] developed a College Admission Predictor System in the form of a Web application by taking the scores obtained by the candidate and his/her personal information as input, and the possible admissions in colleges are predicted as output.

The article is organized as introduction and literature review, followed by proposed methodology, implementation details, statistical results and analysis, and finally concluded in conclusion.

3 Proposed Methodology

3.1 The Dataset

The data for our experiment was retrieved from graduate admissions' dataset, created by Mohan S Acharya and publicly available at Kaggle [6]. The dataset consists of 500 grad students' records containing information about the GRE scores (in 340 scale), TOEFL scores (in 120 scale), university rating (on scale of 5), statement of purpose strength (on scale of 5), letter of recommendation strength (on scale of 5), CGPA (undergraduate grade point), research experience (yes or no in which 1 denotes Yes and 0 denotes No) and chance of admit (a value between 0 and 1), being the target variable. So, there are six features that are continuous with only one feature, research experience, as categorical.

3.2 Feature Selection

Random forest regressor is used for feature selection according to the feature importances returned by the trained model on the whole dataset. The random forest regressor assigns the feature importance scores based on their qualification for being the best split at each step in the ensemble of decision trees.
The algorithm for random forest regressor is given below in Algorithm 1.

– Training Set: $\mathbf{Z} = \{(x_1,y_1),...,(x_n,y_n)\}$
– B: no. of iterations
– $T_b(x)$: b^{th} Decision Tree

1. for b=1, …, B:
2. A bootstrap sample of size n is drawn from Z.
3. A decorrelated decision tree, $T_b(x)$ is grown.
4. $\mathbf{f(x)} = \sum_{b=1}^{B} T_b(x)$

Algorithm 1. Random Forest Regressor

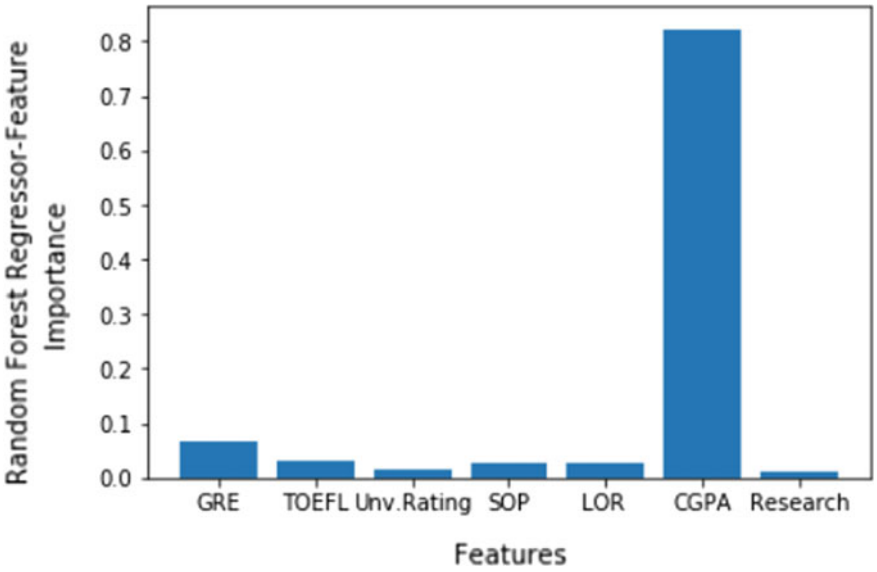


Fig. 1 Bar plot showing features and their importance scores given by random forest regressor

Out of 7 features, 6 features are selected for model development and further analysis as per random forest regressor's feature importance scores shown in Fig. 1.

As for research experience the random forest regressor model clocked the least feature importance score, it is discarded (not selected).

3.3 Model Development

3.3.1 Shuffling and Splitting

The dataset is consistently shuffled and split into training, and test set such as 80% of the 500 instances (400 instances) is present in the training set, and remaining 100 instances are present in the test set.

3.3.2 Learning Algorithm

Gradient boosting regressor is implemented as the learning algorithm.
The gradient boosting regressor algorithm is given in Algorithm 2.

- Training Set: $\mathbf{Z} = \{(x_1, y_1), \ldots, (x_n, y_n)\}$
- M: no. of iterations
- v: learning rate

1. $f_0(x) = (1/n) * \sum_{i=1}^{n} y_i$
2. for m = 1,…,M:
3. $y^p = y - f_{m-1}(x)$ (residual)
4. A decision tree $h_m(x)$ is fitted to the targets, y^p
5. $f_m(x) = f_{m-1}(x) + v * h_m(x)$
6. return $f_M(x)$

Algorithm 2. Gradient Boosting Regressor

3.4 Training the Model

The GBR model is hyper-parameter tuned by threefold grid search cross-validation on the training set for obtaining the best set of hyper-parameters. After model training using grid search with fixed learning rate of 0.1, maximum depth of 3 and 30 estimators is obtained as the best hyper-parameters fetching maximum grid search score (R^2 score) as shown in Fig. 2.

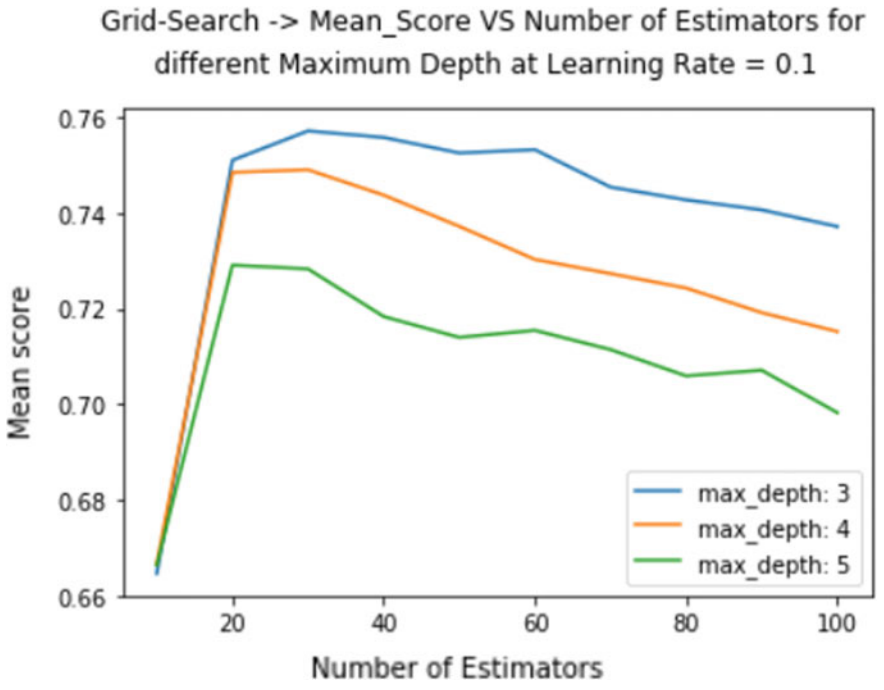


Fig. 2 Grid search summary based on R^2 score

4 Implementation Details

The overall model development is done using Python's machine learning toolbox, scikit-learn on a machine with Intel(R) Core (TM) i5-8250U processor, CPU @ 1.60 GHz 1.80 GHz and 8 GB RAM. The visualizations are done using Python' s visualization library, Matplotlib.

5 Statistical Results and Analysis

The gradient boosting regression model performance analysis is done on the following metrics:

1. Mean absolute error
2. Mean square error
3. Root mean square error
4. Coefficient of determination or R^2.

After training, the trained gradient boosting regressor model is validated on the validation/test set. The model performance analysis is shown in Table 1.

5.1 Nature of Regression Fit

There are three natures of regression fits for evaluating model performance:

– Under Fit: This refers to the nature of the fit in which the model under-performs with both the training set instances and test set instances.
– Perfect Fit: This refers to the nature of the fit in which the model works excellently with both the training and test set instances.
– Over Fit: This refers to the nature of the fit in which the model works excellently with only the training set instances and under-performs with the test set instances.

Table 1 Model performance analysis

Performance metric	Training	Test
Mean absolute error	0.0377	**0.0438**
Mean square error	0.0029	**0.0032**
Root mean square error	0.0538	**0.0570**
R^2 score	0.8533	**0.8405**

Bold indicates the most recent successful research on the domain

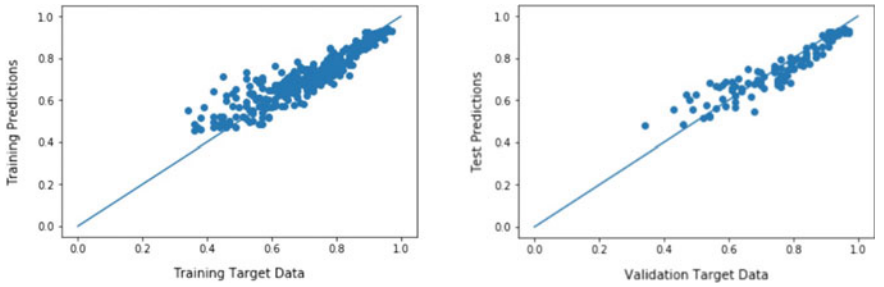


Fig. 3 Fitting diagram for the model over training set (left) and test set (right)

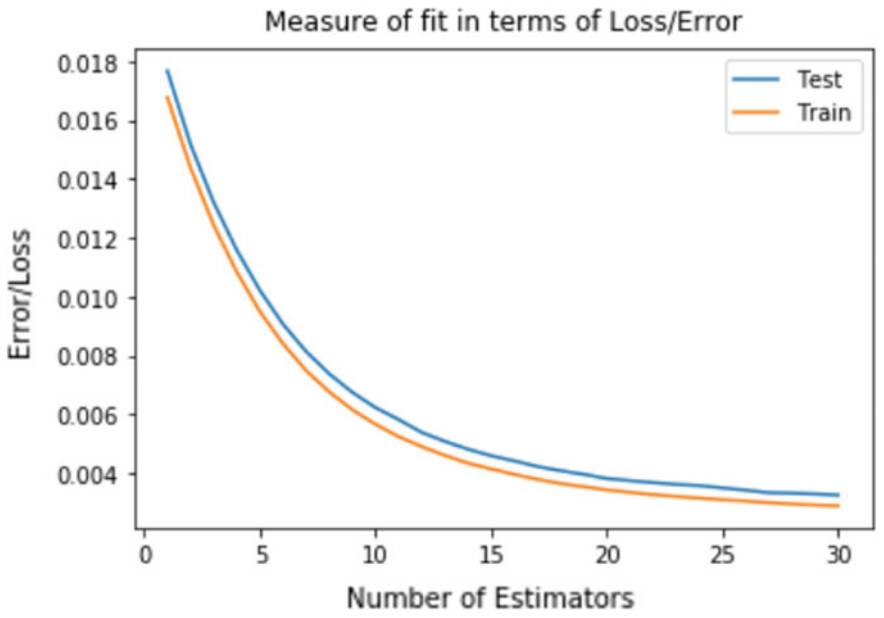


Fig. 4 Training and test loss convergence diagram

The nature of regression fits for the gradient boosting regressor model is visualized in the form of fitting diagrams and training & test loss (mean square error) convergence diagrams in Figs. 3 and 4, respectively.

From Fig. 3, it can be interpreted that this regression fit is close to a perfect fit.

From Fig. 4, it can be concluded that finally (with 30 estimators), the training and test MSE/loss are almost comparable, making it very close to a perfect fit.

A juxtaposition of the proposed methodology with the best existing methodology (Acharya et al. [1]) developed using the same dataset is shown in Table 2.

Table 2 Model comparison

Comparison parameters	Acharya et al. [1]	Model
Methodologies	Linear regression	Gradient boosting regression
MSE	0.0048	**0.0032**
R^2 score	0.7249	**0.8405**

Bold indicates the most recent successful research on the domain

6 Conclusion

This paper presented a deployment of ensemble regression technique, gradient boosting regressor which is hyper-parameter tuned using grid search on graduate admissions' data. Finally, a coefficient of determination ($R^2 Score$) of 0.84 is obtained, which is by far the best statistical result fetched by any graduate admission chance prediction model till date.

References

1. Acharya MS, Armaan A, Antony AS (2019) A comparison of regression models for prediction of graduate admissions. In: 2019 IEEE International conference on computational intelligence in data science (ICCIDS). IEEE
2. Gupta N, Sawhney A, Roth D (2016) Will I get in? modeling the graduate admission process for American universities. In: 2016 IEEE 16th international conference on data mining workshops (ICDMW). IEEE
3. https://pdfs.semanticscholar.org/39b2/cd2a11ebdeb4d31c761527195e06a7136314.pdf
4. http://athena.ecs.csus.edu/~pateljd/images/Admission_prediction_system.pdf
5. Roa, Annam Mallikharjuna, et al. "College Admission Predictor." Journal of Network Communications and Emerging Technologies (JNCET) www.jncet.org 8.4 (2018)
6. https://www.kaggle.com/mohansacharya/graduate-admissions

Lightweight Encryption Algorithms, Technologies, and Architectures in Internet of Things: A Survey

Rishabh and T. P. Sharma

Abstract Internet of things is a fast-growing field of industry as a lot of IoT applications are introduced in the market. Its popularity is also growing because of its ease of use and its applications serving in vast domains. The demand for IoT deployment over a large scale is increasing at a swift pace. A lot of issues and challenges have worked on, and a lot remains to be explored and solved. It has become a focus of research. A considerable number of researches have contributed a lot in the field of IoT. However, still it is lagging in the security domain, so is the reason for concern for many researchers. There are few other concerns in IoT which are related to the security goals, requirements, challenges, and issues. This paper provides an overview of IoT along with presenting various privacy and security issues in it. The paper also shows how the security in IoT differs from the security in conventional systems. Various lightweight encryption techniques for IoT, limitations of IoT, IoT technologies, and architectures are discussed and compared in the paper.

Keywords Lightweight encryption algorithms · Internet of things · Technologies and architectures · Privacy · Security

1 Introduction

The concept of IoT has become very popular in the past decade as the number of IoT devices connected to the Internet is increasing at a faster rate. With this rate of growth of IoT devices, it becomes essential to provide security to these devices. As these devices contain/transmit essential information regarding their owner's health status [1] as well as the information regarding the devices user owns, e.g., heart rate monitor, smart watch, and smart home devices. When all this information collected from various IoT devices/sensors are combined, it can reveal all the things related to

Rishabh (✉) · T. P. Sharma
Department of Computer Science and Engineering, National Institute of Technology Hamirpur, Hamirpur, Himachal Pradesh 177005, India

T. P. Sharma
e-mail: teek@nith.ac.in

H. S. Saini et al. (eds.), *Innovations in Computer Science and Engineering*,
Lecture Notes in Networks and Systems 103,
https://doi.org/10.1007/978-981-15-2043-3_39

the owner right from his health condition to his daily activities schedule. Moreover, this information if gets to the wrong people, it can put the owner's life at risk.

IoT has become more popular due to the presence of some representative applications in the market, which makes the lives of people more comfortable, e.g., smart home, smart parking, and intrusion detection systems. Providing all these services to users without compromising on the quality of service and their security needs is difficult, but can be achieved. Also, keeping and maintaining the security standards to ensure the data generated by the user remains secure and that without compromising with the efficiency and user experience is also an essential yet complex task, considering the number of devices connected to the Internet [2]. IoT means considerable number of different networks and systems interconnected which forms different patterns of communication [3]. With the small size of components in IoT, its applications have shown significant improvements utilizing unique strategies, systems, and models inferred from device-driven embedded frameworks [4]. WSNs are considered to be the first building blocks in the development of IoT devices. They gather essential data from their surroundings and transmit it to the user.

2 Security in IoT Versus Conventional Systems

There exist a lot of crucial differences between the security in IoT and that of conventional/traditional networks (wireless) in the way of proceeding with privacy and security. The IoT devices setup includes low-power and lossy network (LLN), while the latter has a dynamic topology that relies on the application up to a large extent. The main constraints in LLNs are limited memory, processing power, and dynamism [5].

The security requirements, concerns, and features of both the conventional network and IoT are a lot different [1, 6]. Lightweight encryption technology and advanced-lightweight encryption technology include the original/modified lightweight encryption algorithms for use in IoT devices [7]. Node authentication and data confidentiality are the vital parts in restricting the access to unauthorized nodes. There is also the need for different naming policy, as the current naming policy cannot handle the significant number of devices connected in IoT. Also, there are few attacks to which the IoT is vulnerable. These attacks do not have any impact on the conventional networks, e.g., RFID spoofing and sinkhole attack, and these were some physical and network attacks [8].

To summarize, the design of the conventional/traditional security architecture is based on users' perspective and cannot be used for communication between machines. There can be quite a similarity in the security issues for both the networks, but the handling of the security issues is very different [8].

3 Limitations in IoT

Trappe et al. [9] represented the issues and constraints of the IoT devices and also their effects when using the same cryptology tools which are in use in the conventional internet. There are various issues, but the main limitations are of battery capacity and computation power, as resolving other issues is easy if we can resolve the latter ones.

3.1 Battery Capacity

Yang et al. [10] explain that IoT devices rely on limited energy to work. It is due to the reason that the region in which they are deployed may not have the resources required to charge the devices. So, the devices working in such environment drains its resources at a fast pace. They suggested ways to resolve the issue with the first being, not implementing many security essentials on the devices, which is not the right way to deal with the problem, especially when the device is transmitting sensitive data. The next way is by increasing the capacity of the battery. However, the devices are devised to be small in size and lightweight, and they do not have much space left/available for a large size battery. The last way is to yield energy from the surroundings or the natural resources, i.e., heat, light, and wind speed. However, this kind of advancement would require upgrading the hardware and will increase the cost of the device significantly.

3.2 Computation Power

Trappe et al. [9] represented that the traditional cryptography techniques would not work on IoT devices and systems, as they have a restricted memory space, and it cannot handle the computational needs of the advanced cryptographic algorithms. The authors suggested reusing existing functions to uphold the security systems for IoT devices, e.g., using authentication on the network layer. There is an alternate method, by using specific analog characteristics of transmitters to encode the information effectively.

Shafagh et al. [11] proposed an algorithm for query processing in the Internet of things. The approach allows secure storage and encryption of information in the cloud. It also allows the efficient query processing of the encrypted data. In this, the client-side is responsible for performing data encryption and decryption.

An approach was proposed, which reduced the latency in IoT by applying latency-hiding technique while performing query processing over encrypted data [12]. This technique creates small data sets from massive query results. The technique fetches the data sets while still in the process of doing the computations. The algorithm also has a sub-module which decides the appropriate data size for each iteration to reduce

the latency. The experiment results demonstrated that the algorithm had outmatched the existing solutions for queries with extensive data in terms of latency [10].

4 Lightweight Encryption Technique for IoT

Advanced encryption standard (AES) after Rijndael's approval gets "certificate of quality" and was set as a standard. The cipher encrypts and decrypts the data in blocks of 128 bits, and the operation consists of 4 × 4 matrix [13]. High security and lightweight (HIGHT) has a simple operational approach. The key generation takes place during the encryption/decryption process. However, its vulnerability to saturation attacks is still there [3]. Tiny encryption algorithm (TEA) is a well-known block cipher algorithm which uses a 128-bit key and serves with 32-bit unsigned integers. It has a disadvantage that it suffers from equivalent key attack as each key has three other equivalent keys [14]. Another block cipher with a symmetric algorithm type is PRESENT, which has a block size of 64 bits. The number of rounds in PRESENT is 31, and it has two different keys of 80 and 128 bits [15]. Rivest Cipher 5 (RC5) is an algorithm with a symmetric block structure. It is appropriate for the implementations in software/hardware, because of its speed. The word size in RC5 is variable, and it uses data-dependent rotations for the number of rounds and the length of the secret key [16]. Rivest–Shamir–Adleman (RSA) is an asymmetric block cipher and has a key size of 1024 bits, and it uses two sizable prime numbers to perform the modulo operation. It is vulnerable to modulus attack [17]. The key size in ECC is very small, it requires less memory, and it has a fast processing speed. Its vulnerability to timing attacks is still there [15] (Table 1).

Twofish is another block cipher algorithm, and it has the key size of up to 256 bits. It uses four S boxes [18]. Yao et al. [19] proposed a scheme based on lightweight attribute-based encryption. The scheme associates a central attribute authority and end user, and it improves the execution time and efficiency along with reducing the transmission cost. Yang et al. [20] proposed a system for health IoT, which is lightweight and includes a distributed, secure data management system. The scheme ensures data protection in different domains. Baskar et al. [21] proposed an algorithm which is a lightweight and uses minimum number of calculations. Authors also implemented the chaos map-based key in FPGA. The proposed algorithm is for use in resource-constrained environments. The algorithm has robust security and increased performance.

Lightweight encryption algorithm for the smart home was suggested by Al Salami [22]. It has two algorithms KEYEncrypt and DATAEncrypt. The algorithms have flexible key management and efficiency, and they are cost-effective [22]. Yang et al. [20] proposed a system which enables the distributed access control and data management from the health IoT devices. The proposed system reduced the computational overhead and provided enhanced security. Cloud servers are used for processing and storing the IoT data. Liang et al. [23] proposed the improvements in RSA, which generates sizable prime numbers and has three phases: search, pretreatment, and

Table 1 Lightweight cryptographic techniques for IoT

Algorithm name	Algorithm type	Number of rounds	Key size (bits)	Block size (bits)	Vulnerabilities
Advanced encryption standard	Symmetric algorithm	10 rounds	128	128	Man in the middle attack
High security and lightweight (HIGHT)	Symmetric algorithm	32 rounds	128	64	Saturation attack
Tiny encryption algorithm	Symmetric algorithm	32 rounds	128	64	Equivalent key attack
PRESENT	Symmetric algorithm	32 rounds	80	64	Differential attack
Rivest Cipher 5	Symmetric algorithm	20 rounds	16	32	Differential attack
Twofish	Symmetric algorithm	16 rounds	256	128	Side-channel attack
Rivest–Shamir–Adleman	Asymmetric algorithm	–	1024	–	Modulus attack
Elliptical curve cryptography	Asymmetric algorithm	–	160	–	Timing attack

detection. It improved the performance of the algorithm and provided enhanced security.

Fugkeaw et al. [24] improved lightweight proxy re-encryption; they focused more on key updating rather than a key generation and also reduced the root decryption key size. It provided enhanced security and scalability [24]. Huang [25] suggests a technique for secure and efficient data collaboration. In the technique, the authorized user can conduct various actions on the IoT data, e.g., encryption and decryption. The scheme is efficient and provides data confidentiality. Liang et al. [26] introduced an efficient and secure system which enhanced network security. However, a cloud computing technique was provided by Baharon et al. [27] which is a mobile technique and focuses more on the assessment of total accomplishments. It is efficient, requires less computation power, reduced the transmission time, and provided data encryption. For mobile devices, Zegers et al. [28] introduced the lightweight encryption technique which requires fewer computations, provides enhanced data security, and encrypts large volume of data. Sahraoui et al. [29] proposed a compression-based model and a distribution-based scheme for 6LoWPAN and HIP-based approaches, respectively. It is efficient and consumes less energy and provides protection against DoS attacks [28]. Lightweight ABE method is proposed by Yao et al. [19], which involves a centralized attribute authority. It is efficient and provides enhanced security (Table 2).

Table 2 Summary of schemes on lightweight encryption for IoT

References	Brief	Description	Features
ERNEST [19]	Lightweight cryptography algorithms—for IoE	Suggestions on lightweight fundamentals for next-generation lightweight cryptography	–
Baskar [21]	Lightweight cryptography—for the resource restraint environments	A lightweight cryptographic algorithm is proposed using minimum calculations. Implementing the chaos map-based key in FPGA	Increased performance, enhanced security
Al Salami [22]	Lightweight encryption algorithms—for the smart home	Lightweight encryption algorithms are suitable for smart home applications. It has two algorithms KEYEncrypt and DATAEncrypt	Key management, improved efficiency, cost-effective
Yang et al. [20]	Lightweight system—health IoT, distributed secure data management system	Distributed access control and data management are enabled. Information is protected in different domains	Computational overhead reduced, enhanced security
Liang et al. [23]	Lightweight hybrid encryption—algorithms for the data in the cloud storage	Improvements in RSA generate sizable prime numbers and have 3 phases: search phase, pretreatment phase, and detection phase	Efficiency improved, enhanced privacy, and security
Fugkeaw et al. [24]	Lightweight proxy re-encryption—for mobile revocation management in cloud computing	More focused on key updating rather than key generation, root decryption key size is reduced	Key updating, enhanced security, scalable
Huang [25]	For the adequate data association with the hierarchical attribute-based encryption in the cloud computing	Data collaboration introduced, encryption, decryption, and write operations can now be performed	Efficient, data confidentiality, enhanced security

(continued)

Table 2 (continued)

References	Brief	Description	Features
Liang et al. [26]	Cipher text-policy-attribute-based proxy re-encryption for cloud data sharing	Efficient and protected system introduced	Efficient, secure network profile, enhanced security
Baharon [27]	Lightweight homomorphic cryptography—for mobile cloud computing	Focuses more on the assessment of total accomplishments	Efficient, less computation power
Zegers [28]	Lightweight cryptography—for smartphone and cloud	Lightweight encryption algorithm provides enhanced data security and encrypts large volume of data	Less power consumption, enhanced data security
Sahraoui [29]	Point-to-point lightweight security—for HIP-based approach in IoT	6LoWPAN compression model and distribution technique for HIP-based approach	Efficient, less energy consumption, protection against DoS attacks
Yao [19]	Lightweight attribute-based encryption—for IoT	Lightweight attribute-based encryption method is proposed and associates a central attribute authority and end user	Key generation attributes, enhanced safety, efficiency

5 Technologies and Architectures in IoT

A probability-based resource estimation system was proposed for customers in fog computing. It has high latency rate [30]. Jiang et al. [31] revised the "Shamir's secret sharing scheme" and achieved scalability in the revised scheme, but it increased the computational overheads. The technique is suitable for use in data mining and analysis.

Lightweight scheme for securing channel establishment was proposed by Bose et al. [32] for regulating the privacy of the information obtained from the sensors and its secure exchange. It offers enhanced security and has less resource consumption. It can be used in smart energy meters [32]. To solve the security-related issues in IoT, Yao et al. [19] proposed a no-pairing lightweight attribute-based cryptography scheme. The scheme is based on elliptic curve cryptography. It also reduces computing and transmission overhead but is not scalable.

Gubbi et al. [33] worked on cloud implementations adopting the Aneka platform for determining the ongoing IoT applications' direction. It has an advantage that it utilizes both the public/private cloud's resources together, whereas it has a limitation

in security protection. It can be used in a smart environment. Chakrabarty et al. [34] proposed a "Black SDN architecture" for addressing of the vulnerabilities in the conventional IoT systems. SEA architecture was suggested by Moosavi [35] to secure the authorization frameworks in healthcare IoT systems, whereas smart city system architecture was proposed by Gaur et al. [36] for easing the interactions between the different communication technologies and remote sensor systems.

Service-oriented architecture for smart transportation was proposed by Ramao et al. It emphasized on securing the services by the middleware architecture, whereas Vučinić [37] proposed "object security architecture" for the smart grids with the prime aim of introducing access control, and innovative, scalable security architecture in IoT. Medagliani et al. [38] suggested a conceptual organizations' framework for business organizations and provided different layers of architecture identification, whereas Valdivieso Caraguay [39] proposed the SDN architecture for the smart environments (Table 3).

Table 3 Summary of IoT technologies and architectures

References	Domain	Objective
Aazam et al. [30]	Healthcare	Proposing a model of probabilistic resource estimation for fog
Jiang et al. [31]	Data mining and analytics	Achieving data scalability and simplifying key management in conventional cryptographic systems and delivering reliability features at the data level
Bose et al. [32]	"Smart energy" system	Regulating privacy from sensor information and secured exchange of information
Yao et al. [19]	Single authority application	Addressing various security-related issues in IoT and reducing computation and communication overhead
Gubbi et al. [33]	Smart system	Identifying the existing IoT applications' direction and requirements for blending in various technologies
Chakrabarty et al. [34]	"Smart city" system	Addressing vulnerabilities in traditional IoT systems
Moosavi et al. [35]	Healthcare	Securing verification and authorization framework in healthcare IoT schemes

(continued)

Table 3 (continued)

References	Domain	Objective
Gaur et al. [36]	"Smart city" system	Easing the interactions between communications, technologies, and remote sensor systems
Ramao	"Service-oriented" architecture	Security middleware architecture is defined and analyzing the utilities related to IoT middleware
Vučinić [37]	"Object security" architecture	Proposing scalable security architecture and access control in IoT
Vishavakarma et al.	System architecture	Different layered architectures identification
Valdivieso et al. [39]	SDN architecture	Eliminating rigidity in traditional IoT networks

6 Conclusion

Internet of things has turned into a focus of research. It has achieved massive popularity because it allows different sensors to communicate with each other without even the need for human intervention. The devices in IoT are small and compact and hence have limited memory and battery power, which leads it to perform limited computations. Its demand for deployment is increasing at a fast pace and so are the issues related to security and concerns. The privacy and security of IoT devices depend on the implemented security mechanisms, technologies, and protocols in the device. This paper mentions and classifies many of the attacks on IoT along with summarizing various lightweight encryption techniques, their advantages, and disadvantages. The paper also discusses various IoT technologies and architectures.

References

1. Yan Z, Zhang P, Vasilakos AV (2014) A survey on trust management for internet of things. J Netw Comput Appl 42:120–134
2. Whitmore A, Agarwal A, Da Xu L (2015) The internet of things—a survey of topics and trends. Inf Syst Front 17(2):261–274
3. Horrow S, Sardana A (2012) Identity management framework for cloud based internet of things. In: Proceedings of the first international conference on security of internet of things. ACM, pp 200–203
4. Mansfield-Devine S (2016) Securing the internet of things. Comput Fraud Secur 2016(4):15–20
5. Lu C (2014) Overview of security and privacy issues in the internet of things. Washington University
6. Suo H, Wan J, Zou C, Liu J (2012) Security in the internet of things: a review. In: 2012 international conference on computer science and electronics engineering, vol 3. IEEE, pp 648–651

7. Zhao K, Ge L (2013) A survey on the internet of things security. In: 2013 Ninth international conference on computational intelligence and security. IEEE, pp 663–667
8. Deogirikar J, Vidhate A (2017) Security attacks in IoT: a survey. In: 2017 international conference on I-SMAC (IoT in social, mobile, analytics and cloud) (I-SMAC). IEEE, pp 32–37
9. Trappe W, Howard R, Moore RS (2015) Low-energy security: Limits and opportunities in the internet of things. IEEE Secur Priv 13(1):14–21
10. Yang Y, Wu L, Yin G, Li L, Zhao H (2017) A survey on security and privacy issues in Internet-of-Things. IEEE Internet Things J 4(5):1250–1258
11. Shafagh H, Hithnawi A, Dröscher A, Duquennoy S, Hu W (2015) Poster: towards encrypted query processing for the internet of things. In: Proceedings of the 21st annual international conference on mobile computing and networking. ACM, pp 251–253
12. Kotamsetty R, Govindarasu M (2016) Adaptive latency-aware query processing on encrypted data for the internet of things. In: 2016 25th international conference on computer communication and networks (ICCCN). IEEE, pp 1–7
13. Daemen J, Rijmen V (2013) The design of Rijndael: AES-the advanced encryption standard. Springer Science & Business Media
14. Wheeler DJ, Needham RM (1994) TEA, a tiny encryption algorithm. In: International workshop on fast software encryption. Springer, pp 363–366
15. Singh S, Sharma PK, Moon SY, Park JH (2017) Advanced lightweight encryption algorithms for IoT devices: survey, challenges and solutions. J Ambient Intell Hum Comput 1–18
16. Rivest RL (1994) The RC5 encryption algorithm. In: International workshop on fast software encryption. Springer, pp 86–96
17. Sarkar S (2014) Small secret exponent attack on RSA variant with modulus. Des Codes Crypt 73(2):383–392
18. Schneier B, Kelsey J, Whiting D, Wagner D, Hall C, Ferguson N (1998) Twofish: A 128-bit block cipher. NIST AES Propos 15(1):23–91
19. Yao X, Chen Z, Tian Y (2015) A lightweight attribute-based encryption scheme for the internet of things. Futur Gener Comput Syst 49:104–112
20. Yang Y, Zheng X, Tang C (2017) Lightweight distributed secure data management system for health internet of things. J Netw Comput Appl 89:26–37
21. Baskar C, Balasubramaniyan C, Manivannan D (2016) Establishment of light weight cryptography for resource constraint environment using FPGA. Procedia Comput Sci 78:165–171
22. Al Salami S, Baek J, Salah K, Damiani E (2016) Lightweight encryption for smart home. In: 2016 11th international conference on availability, reliability and security (ARES). IEEE, pp 382–388
23. Liang C, Ye N, Malekian R, Wang R (2016) The hybrid encryption algorithm of lightweight data in cloud storage. In: 2016 2nd international symposium on agent, multi-agent systems and robotics (ISAMSR). IEEE, pp 160–166
24. Fugkeaw S, Sato H (2016) Improved lightweight proxy re-encryption for flexible and scalable mobile revocation management in cloud computing. In: 2016 IEEE 9th international conference on cloud computing (CLOUD). IEEE, pp 894–899
25. Huang Q, Yang Y, Shen M (2017) Secure and efficient data collaboration with hierarchical attribute-based encryption in cloud computing. Futur Gener Comput Syst 72:239–249
26. Liang K, Au MH, Liu JK, Susilo W, Wong DS, Yang G et al (2015) A secure and efficient ciphertext-policy attribute-based proxy re-encryption for cloud data sharing. Futur Gener Comput Syst 52:95–108
27. Baharon MR, Shi Q, Llewellyn-Jones D (2015) A new lightweight homomorphic encryption scheme for mobile cloud computing. In: 2015 IEEE international conference on computer and information technology; ubiquitous computing and communications; dependable, autonomic and secure computing; pervasive intelligence and computing. IEEE, pp 618–625
28. Zegers W, Chang SY, Park Y, Gao J (2015) A lightweight encryption and secure protocol for smartphone cloud. In: 2015 IEEE symposium on service-oriented system engineering. IEEE, pp 259–26

29. Sahraoui S, Bilami A (2015) Efficient HIP-based approach to ensure lightweight end-to-end security in the internet of things. Comput Netw 91:26–45
30. Aazam M, St-Hilaire M, Lung CH, Lambadaris I (2016) PRE-Fog: IoT trace based probabilistic resource estimation at Fog. In: 2016 13th IEEE annual consumer communications & networking conference (CCNC). IEEE, pp 12–17
31. Jiang H, Shen F, Chen S, Li KC, Jeong YS (2015) A secure and scalable storage system for aggregate data in IoT. Futur Gener Comput Syst 49:133–141
32. Bose T, Bandyopadhyay S, Ukil A, Bhattacharyya A, Pal A (2015) Why not keep your personal data secure yet private in IoT? Our lightweight approach. In: 2015 IEEE tenth international conference on intelligent sensors, sensor networks and information processing (ISSNIP). IEEE, pp 1–6
33. Gubbi J, Buyya R, Marusic S, Palaniswami M (2013) Internet of things (IoT): a vision, architectural elements, and future directions. Futur Gener Comput Syst 29(7):1645–1660
34. Chakrabarty S, Engels DW (2016) A secure IoT architecture for smart cities. In: 2016 13th IEEE annual consumer communications & networking conference (CCNC). IEEE, pp 812–813
35. Moosavi SR, Gia TN, Rahmani AM, Nigussie E, Virtanen S, Isoaho J et al (2015) SEA: a secure and efficient authentication and authorization architecture for IoT-based healthcare using smart gateways. Procedia Comput Sci 52:452–459
36. Gaur A, Scotney B, Parr G, McClean S (2015) Smart city architecture and its applications based on IoT. Procedia Comput Sci 52:1089–1094
37. Vučinić M, Tourancheau B, Rousseau F, Duda A, Damon L, Guizzetti R (2015) OSCAR: object security architecture for the internet of things. Ad Hoc Netw 32:3–16
38. Medagliani P, Leguay J, Duda A, Rousseau F, Duquennoy S, Raza S et al (2014) Internet of things applications-from research and innovation to market deployment. The River Publishers
39. Valdivieso Caraguay AL, Benito Peral A, Barona Lopez LI, Garcia Villalba LJ (2014) SDN: Evolution and opportunities in the development IoT applications. Int J Distrib Sens Netw 10(5):735142

Identifying User's Interest in Using E-Payment Systems

K. Srinivas and J. Rajeshwar

Abstract Web usage mining is used to analyse the user/customer behaviour which is required for business intelligence (BI). The usage of e-payment applications through electronic devices has become more important in organisations and is growing with unprecedented pace. Discovering web usage patterns can result in making strategic decisions for business growth. Especially organisations that need ground truth for exploiting/influencing the customer behaviour. Many researchers contributed towards web usage mining. However, working on real-world data sets provides more useful outcomes. Based on this, we proposed a framework with an EPUD algorithm to perform web usage mining. We have collected electronic payment indicators from RBI dataset and converted it into synthesised server logs suitable for web usage mining. Our algorithm mines the server logs discovers the electronic payment usage and our experimental results reveal the trends in identifying the behaviour of customers in using e-payment systems. The insights in this paper help in understanding the patterns of electronic payment usage for different payment indicators.

Keywords Web usage mining · E-payment systems · User interests · Usage patterns

1 Introduction

World Wide Web (WWW) is rich in content and goldmine to academicians and researchers, as it can be mined to have valuable insights. Especially web mining can extract hidden patterns that can provide useful business intelligence. Web mining has three sub-topics known as web usage mining [1, 2], web content mining [3, 4] and web structure mining [5]. Web structure mining focuses on discovering structural summary from web content. Web content mining, on the other hand, is aimed at discovering useful knowledge from the content of web pages. Web usage mining throws light into discovery of user access patterns based on web usage logs available in web server.

K. Srinivas (✉) · J. Rajeshwar
Department of CSE, Guru Nanak Institutions Technical Campus, Hyderabad, India

H. S. Saini et al. (eds.), *Innovations in Computer Science and Engineering*,
Lecture Notes in Networks and Systems 103,
https://doi.org/10.1007/978-981-15-2043-3_40

Overview of Web Usage Mining This section provides a general overview of web usage mining. The web or business servers in the real world are used to deploy web applications. Once the applications are deployed in the systems, the applications will generate various types of files due to usage of the applications. The application events, reflected as files are written to server log files. The log entries provide useful information to analyse the user operations or actions. Log entries at server side can be used for mining and discover patterns to make well-formed decisions.

As shown in Fig. 1, it is evident that the client requests that come from browsers (user agents) go to web server through Internet service provider (ISP). Then the web server may invoke business logic from business servers. The log entries related to user events are stored in web server. The web log data is pre-processed to make it ready for web usage mining. The web usage mining is the process of discovering trends or patterns that are obtained from the web log entries. The result of the algorithms is the business intelligence that helps in making expert decisions. In this paper, we focus on web usage mining. There are some approaches that combine both web usage and web content mining for effective discovery of knowledge as explored in [4]. However, in this paper, we propose a framework that performs web usage mining to discover trends or patterns in using e-payment systems.

Problem Statement In web e-commerce, the e-payment system usage is increasing rapidly. This is very useful to business intelligence in all the e-commerce applications. However, there is no decision-making pattern which can identify the user interests in using e-payment systems by the banking systems. Organisation requires a decision-making pattern which supports business intelligence. The business intelligence report

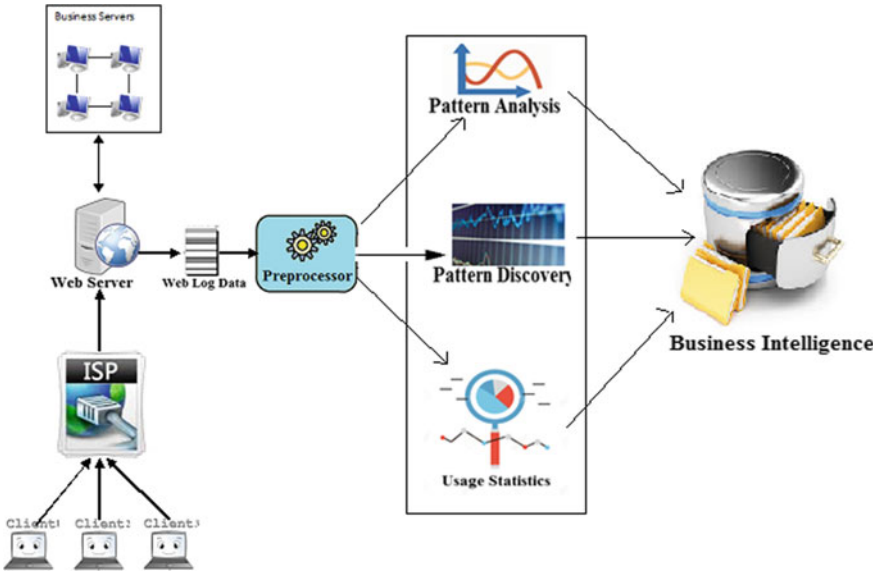


Fig. 1 Overview of web usage mining

plays an important role for the future of web e-commerce. We have taken RBI dataset to identify the customers/user's interest in usage of e-payment systems.

Our contributions in this paper are as follows.

1. We proposed a framework that has mechanisms for pre-processing, temporal clustering, electronic payment usage mining and knowledge discovery. We used synthesised web server logs created based on the payment indicators of RBI.
2. We proposed an algorithm named Electronic Payment Usage Discovery (EPUD) to discover patterns of usage with respect to different payment indicators.
3. We produced experimental results which reveal the proposed methodology which is useful in generating patterns that reflect user's interest in using e-payment systems.

2 Related Works

This section provides review of literature on web usage mining issues and methods that exist. Web usage mining is achieved in [1] by using data mining algorithms such as Apriori and FP-Growth. These are actually frequent item set mining algorithms employed for web usage mining. Similar kind of work is found in [6]. An algorithmic approach is explored in [7] for data processing to discover trends in web usage. The process of analysing web logs helps in understanding user's behaviour and their web usage pattern. In [8], web usage mining is made with a purpose of improving e-commerce web application to promote its business. Page rank algorithms are explored for web mining in [9]. Web usage mining is coupled with eye-tracking technologies in [10] for improved means of extracting business intelligence. An impact of node behaviours in networking applications is made in [11]. There are many web content mining tools that help in understanding the trends in web content. Those tools are studied in [3]. In [4], both web content mining and web usage mining are integrated to know more useful information about user's interest. A recommendation system is built in [5] to provide informative web pages based on domain knowledge. Activities of web visitor reconstruction and web log mining are made in [12] for evaluating user behaviour and data processing. Web usage mining is explored for predicting student marks in education domain [13]. Improving search result delivery and ensuring that users get more interesting web content is the work done in [2]. The concept of semantic web mining is explored in [14–16] where semantic knowledge is used in web usage mining. Various pre-processing techniques that are used before web usage mining are explored in [7, 17, 18]. The significance of web usage mining and anomaly detection through web usage mining are studied in [19, 20], respectively, while web mining for discovering user's point of interest is explored in [21]. Similar kind of work is found in [16, 18, 22–25]. It has been found that there is a significant contribution in the area of web usage mining from the literature.

3 Proposed Methodology

We proposed a framework to investigate on web usage mining to discover electronic payment usage and interests of customers. The framework is as shown in Fig. 2. It takes web log files (synthesised dataset based on RBI payment indicators) and produce business intelligence required to understand the trends in the customer interests in using different kinds of electronic payment system. The web log files are subjected to pre-processing to remove unwanted content from each log entry so as to reduce processing time and effort. Since the electronic payments are distributed across different time periods (we considered from January 2015 to March 2017) we proposed temporal clustering mechanism. It is an unsupervised machine learning approach that makes groups of log entries temporally. After getting clusters of electronic payments systems based on temporal clustering mechanism the clusters are subjected to electronic payment usage mining to produce usage patterns of user's interest. The trends or patterns thus produced can help in knowledge discovery, required for business intelligence.

3.1 Temporal Clustering

Temporal clustering involves explicit attention to the temporal aspects during knowledge extraction from huge data. Whether the clustering is based on temporal or static data, the results provide a snapshot analysis for a period of time. If the same analysis is applied to the next time period, we will get different clustering results. The resultant clusters will be different from one and another formed during different time periods. Temporal cluster is employed to have electronic payment usage patterns over a period of time (Table 1).

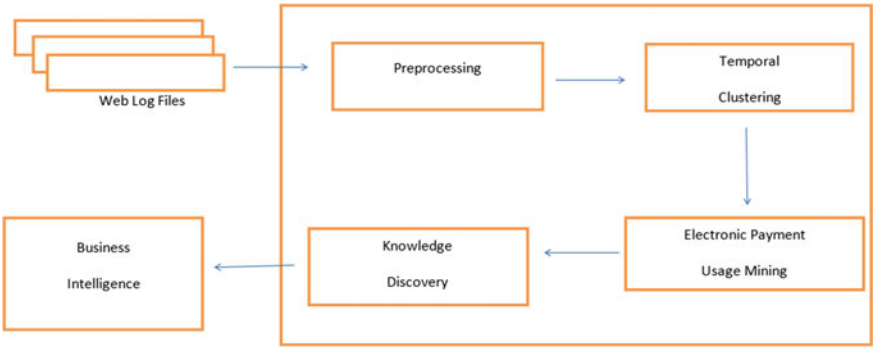


Fig. 2 Framework for discovering electronic payment usage mining

Table 1 Notations used in temporal model

Notation	Description
q_{ij}	j is the probability of input i belonging to cluster j
z_i	Signal in the latent space Z
α	s the number of degrees of freedom of the students t distribution
siml()	The temporal similarity metric which is used to compute the distance between the encoded signal z_i and centroid w_j
w_j	Centroid
ED	Euclidean distance
CF(x, y)	Complexity factor
CE(x) and CE(y)	Complexity estimates of a time series x and y
N	Length of the sequence
ρ	Pearson's correlation
Cov	Covariance
p_{ij}	A target distribution
L	KL divergence loss
n, k	Number of samples in dataset and number of clusters, respectively
$\frac{dL_c}{dw_i}$, $\frac{dL_{ae}}{dz}$	Gradients

1. We compute the probability of input x_i to the cluster j. The closer the latent representation z_i of input x_i is to the centroid w_j, the higher the probability of x_i belonging to cluster j
2. We update the centroids by using a loss function, which maximises the high confidence assignments using a target distribution p

$$q_{ij} = \frac{\left(1 + \frac{\text{siml}(z_i, w_j)}{\alpha}\right)^{-\frac{\alpha+1}{2}}}{\sum_{j=1}^{k}\left(1 + \frac{\text{siml}(z_i, w_j)}{\alpha}\right)^{-\frac{\alpha+1}{2}}} \tag{1}$$

Here, q_{ij} is the probability of input i belonging to cluster j, z_i corresponds to the signal in the latent space Z, obtained from temporal auto encoder after encoding the input signal $x_i \in X$. The parameter α is the number of degrees of freedom of the students t distribution

$$(x, y) = \text{ED}(x, y)\text{CF}(x, y) \tag{2}$$

where CF(x, y) is a complexity factor defined as $\frac{\max(\text{CE}(x),\text{CE}(y))}{\min(\text{CE}(x),\text{CE}(y))}$ and CE(x) and CE(y) are the complexity estimates of a time series x and y. we implement this to increase the complexity differences between series

$$\mathrm{CE}(x) = \sqrt{\sum_{t=1}^{N-1} (x_{t+1} - x_t)^2} \tag{3}$$

where N is length of the sequence

$$\mathrm{COR} = \sqrt{2(1-\rho)} \tag{4}$$

where $\rho_{x,y} = \frac{\mathrm{cov}(x,y)}{\sigma_x \sigma_y}$.

Correlation-based similarity (COR) computes similarities using the estimated Pearson's correlation ρ between the latent representation z_i and the centroids w_j

$$p_{ij} = \frac{q_{ij}^2 / f_j}{\sum_{j=1}^{k} q_{ij}^2 / f_j} \tag{5}$$

where $f_j = \sum_{i=1}^{n} q_{ij}$.

To minimise the KL divergence loss between q_{ij} and a target distribution p_{ij} as shown in above.

$$\mathrm{L} = \sum_{i=1}^{n} \sum_{j=1}^{k} p_{ij} \log \frac{p_{ij}}{q_{ij}} \tag{6}$$

We compute the divergence loss calculated as below. Where n and k are number of samples in dataset and number of clusters, respectively,

$$\frac{\mathrm{d}L_c}{\mathrm{d}w_i} = \frac{\alpha}{1+\alpha} \sum_j \left(1 + \frac{\mathrm{siml}(z_i, w_j)}{\alpha}\right) * (p_{ij} - q_{ij}) \frac{\mathrm{d}(\mathrm{siml}(z_i, w_j))}{\mathrm{d}w_i} \tag{7}$$

$$\frac{\mathrm{d}L_{ae}}{\mathrm{d}z} = \frac{\mathrm{d}\left(\frac{1}{2}||x - x'||_2^2\right)}{\mathrm{d}z} \tag{8}$$

to minimise both the clustering loss and the MSE loss we implement above two Eqs. 7, 8.

3.2 *Electronic Payment Usage Pattern Discovery*

Electronic payment usage patterns are discovered by using the proposed algorithm known as Electronic Payment Usage Discovery (EPUD) algorithm which is based on Karma Lego algorithm.

Algorithm 1 Electronic Payment Usage Discovery (EPUD) Algorithm

Algorithm: Electronic Payment Usage Discovery (EPUD)
Inputs: Web logs ***L***
Output: Usage patterns of electronic payment indicators map ***(EM)***
01 Associate numeric values with discrete values
02 Initialize Electronic Payment Indicator vector (EPI)
03 L_k: dataset of size ***k***
04 m=1
05 While L_k!=NULL
06 For each log ***l*** in ***L***
07 For each P_i in EPI
08 Update **EPI**
09 End For
10 Add ***pi*** and ***EPI*** to ***EM***
11 End For
12 End While
13 Return ***EM***

The proposed algorithm discovers usage patterns temporally for each payment indicator (P_i). The result of each payment indicator is saved to a map known as electronic payment indicators map (EM). That map is used to identify trends or patterns of customer's/user's interest in the using of electronic payment systems. Thus, the experimental results reveal which e-payment systems are widely used by the user's.

4 Experimental Results

Experiments are made with the RBI datasets on electronic payment indicators converted to synthetic web logs. The proposed methodology is employed to work on the web logs to get temporal clusters and then generate statistics for each electronic payment indicator. The dataset we considered is from January 2015 to March 2017. The electronic payments in this period reflect increase of electronic payments in India (Figs. 3 and 4).

5 Conclusion and Future Work

In this paper, we proposed framework to perform web usage mining for discovering patterns of electronic payments systems which is used most widely by the user's. We used synthesised web logs created by using electronic payment indicators provided by RBI. The dataset covers web logs from January 2015 to March 2017. Therefore, the dataset provides possibility to mine usage patterns of electronic payments of two financial year's 2015–16 and 2016–our experimental result shows that NEFT and RTGS transactions are performed in thousand billions of rupees in comparison

Fig. 3 Temporal patterns of electronic payments with National Electronic Fund Transfer (NEFT)

Fig. 4 Temporal patterns of electronic payments with real-time gross settlements (RTGS)

with other e-payment systems the transactions are performed only in hundred billion of rupees. This signifies that NEFT and RTGS transactions are widely performed by the user's. Our proposed methodology and EPUD algorithm helps in identifying user's interest in using the e-payment systems. In future, there may be a provision for discovery of new web service in the banking system which should be depended on analysing user interest.

References

1. Santhosh Kumar B, Rukmani KV (2010) Implementation of web usage mining using APRIORI and FP growth algorithms. Int J Adv Netw Appl 1(6):400–404
2. Mele I (2013) Web usage mining for enhancing search-result delivery and helping users to find interesting web content. ACM, pp 765–769
3. Herrouz A, Khentout C (2013) Overview of web content mining tools. Int J Eng Sci 2(6):1–6
4. Taherizadeh S, Moghadam N (2010) Integrating web content mining into web usage mining for finding patterns and predicting users' behaviors. Int J Inf Sci Manag 7(1):52–66
5. Nguyen TTS, Lu HY, Lu J (2014) Web-page recommendation based on web usage and domain knowledge. IEEE Trans Knowl Data Eng 1–14
6. Mishra R, Choubey A (2012) Discovery of frequent patterns from web log data by using FP-growth algorithm for web usage mining. Int J Adv Res Comput Sci Softw Eng 2(9):1–6

7. Tyagi NK, Solanki AK, Tyagi S (2010) An algorithmic approach to data preprocessing in web usage mining. Int J Inf Technol Knowl Manag 2(2):279–283
8. Carmona CJ, Ramírez-Gallego S, Torres F, Bernal E, del Jesus MJ, García S (2012) Web usage mining to improve the design of an e-commerce website. OrOliveSur.com. Elsevier, pp 11243–11249
9. Jain R, Purohit GN (2011) Page ranking algorithms for web mining. Int J Comput Appl 13(5):22–25
10. Velásquez JD (2013) Combining eye-tracking technologies with web usage mining for identifying Website Keyobjects. Elsevier, pp 1–10
11. Mishra MK, Pattanayak BK (2010) Measure of impact of node misbehavior in ad hoc routing, a comparative approach. Int J Comput Sc Issues 7(4):1–58
12. Munka M, Kapustaa J, Švec P (2012) Data preprocessing evaluation for web log mining: reconstruction of activities of a web visitor. In: International conference on computational science, pp 2273–2280
13. Romero C, Espejo PG, Zafra A, Romero JR, Ventura S (2010) Web usage mining for predicting final marks of students that use Moodle courses. Comput Appl Eng Educ 135–146
14. Velásqueza JD, Dujovnea LE, L'Huillier G (2012) Extracting significant website key objects, a semantic web mining approach. Preprint submitted to J Eng Appl Artif Intell 1–23
15. Shirgave S, Kulkarni P (2013) Semantically enriched web usage mining for predicting user future movements. Int J Web Semant Technol 4(4):59–72
16. Samizadeh R, Ghelichkhani B (2010) Use of semantic similarity and web usage mining to alleviate the drawbacks of user-based collaborative filtering recommender systems. Int J Ind Eng Prod Res 21(3):137–146
17. Ramya C, Shreedhara KS, Kavitha G (2011) Preprocessing, a prerequisite for discovering patterns in web usage mining process. In: International conference on communication and electronics information, pp 1–5
18. Chandrama W, Devale PR, Murumkar R (2014) Data preprocessing method of web usage mining for data cleaning and identifying user navigational pattern. Int J Innov Sci Eng Technol 1(10):73–77
19. Aldekhail M (2016) Application and significance of web usage mining in the 21st century, a literature review. Int J Comput Theory Eng 8(1):41–47
20. Singh AP, Jain RC (2014) A survey on different phases of web usage mining for anomaly user behavior investigation. Int J Emerg Trends Technol Comput Sci 3(3):70–75
21. Rae A, Murdock V (2012) Mining the web for points of interest. ACM, pp 1–11
22. Bruns A, Moe H (2013) Structural layers of communication on Twitter. In Weller K, Bruns A, Burgess J, Mahrt M, Puschmann C (eds) Twitter and society. Peter Lang, New York, pp 15–28
23. Radinsky K, Horvitz E (2012) Mining the web to predict future events. ACM, pp 1–10
24. Singh B, Singh HK (2010) Web data mining research, a survey. In: IEEE international conference on computational intelligence and computing research, pp 661–670
25. Jiang D, Pei J, Li H (2013) Mining search and browse logs for web search, a survey. ACM 4(4):1–37

Classification of Clothing Using Convolutional Neural Network

P. Dhruv, U. Nanditha and Veena N. Hegde

Abstract This paper presents classification of an image as shirt, T-shirt or trouser for a specific objective by training a convolutional neural network (CNN). The classifier implemented is a significant component of the assistive instrument developed to help people with dementia become more independent with dressing. The work presented in this paper brings out tuning the hyperparameters of the CNN used in the system. A dataset was prepared for the three classes of clothing by capturing the images, pre-processing and labelling the images. Data augmentation was performed on a subset of the original dataset to reduce the overfitting problem. A standard architecture was chosen with convolution, max-pooling and dropout filters which help in dimension reduction, thus enabling faster training of the model. Upon evaluation of the model on the testing dataset, an accuracy of 93.31% was achieved. In order to describe the performance of the classification model, a confusion matrix was plotted.

Keywords Assistive technology · Classifier · CNN · Confusion matrix · Data augmentation

1 Introduction

Recognition of clothes in images is a widely used application, especially over the Internet for the purpose of fashion e-commerce and other related areas. Lot of research has been carried out to classify clothes, predict the attributes and retrieve clothes from large databases [1]. This is of immense advantage to the fashion industry. Large datasets which have rich labelling and annotations have also been created in order to improve the prediction performance of these algorithms [2]. Other methods such as implementing extreme learning machines [3] have also been used along with CNNs to improve speed and efficiency of clothing image recognition. A method called clothing co-segmentation which localizes the human and background Gaussian mixture models are estimated [4] using which individual clothing elements are

P. Dhruv (✉) · U. Nanditha · V. N. Hegde
BMS College of Engineering, Bengaluru, India

H. S. Saini et al. (eds.), *Innovations in Computer Science and Engineering*,
Lecture Notes in Networks and Systems 103,
https://doi.org/10.1007/978-981-15-2043-3_41

extracted from an image with varying patterns, varying human poses and cluttered backgrounds.

These approaches are mainly focused on improving clothing image recognition by means of algorithm development and/or dataset improvement to serve the purpose of classification of clothes for the fashion industry. These may mainly be deployed to find, identify and recognize various fashion images. This may be relevant to the e-commerce websites and other fashion portals and establishments.

Building CNNs, for the range of tens of thousands of labelled images, has been carried out with varying datasets (NORB [5], Caltech [6, 7]). The well-known MNIST handwritten digit dataset has been widely used to build and train neural networks, with the best error rate (<0.3%). The MNIST database contains 60,000 training pictures and 10,000 testing pictures.

The Fashion MNIST training set developed after the MNIST dataset contains 55,000 instances, and the test set contains 10,000 instances. Each picture is related to a tag from 10 classes ranging from T-shirts to ankle boots and has been used to achieve accuracy over 98%.

The aim of creating a custom-made clothe classifier for three classes of clothes is to build a specific assistive technology product that serves the purpose of helping persons with dementia in dressing. This problem does not require a dataset with various classes of clothing like in the above-mentioned cases of previous research works. There is thus a need to build a custom training model for a convolutional neural network with classes of clothes that are commonly used by elderly people.

References to previous works for dressing aids for persons with dementia [8] which made use of a dress prototype of only a shirt also containing obtrusive fiducials. The assistive technology can only be used along with the dress prototype and with all the supporting hardware in order to process the fiducials on the dress prototype. Also, other clothing items are not considered. Hence, there is a requirement for creating an assistive technology which contains assistance for all types of clothing items. To provide an unobtrusive assistance technology, there is a unique requirement to identify the clothing to avoid dependence on user or external input. This also enables the development of a more user-friendly solution as compared to the existing methodology. Thus, the creation of a very accurate clothing classification algorithm is an important requirement.

The paper proposes to build a custom CNN which classifies clothing image under three classes (shirt, T-shirt and trouser) and to build a custom dataset in order to train and test the model.

2 Methodology

The following section describes in detail the work carried out by the authors. Section 2.1 contains the details of the database created for the training of the CNN model.

Section 2.2 describes the CNN architecture built. Section 2.3 describes in detail the process of training the model and related details.

2.1 Dataset

A custom data was to be built to achieve the objective. A database was created with a total of 11,300 images belonging to three classes. The datasets consist of 4800 images of T-shirt, 3300 images of shirt and 3200 images of trousers. Another dataset was built consisting of higher-definition images downloaded from the Web. Unique poses from the first dataset were chosen, and data augmentation was performed on this set to increase the size of the dataset and to prevent overfitting. Data cleaning is carried out to remove improper and corrupted images from the dataset. Threefold increase in size of the data was observed using data augmentation technique. The images thus obtained from data augmentation were used to train the model to make it invariant to 2D image transformations such as translation, scaling and rotation. An example of data augmentation can be seen in Fig. 1.

The processing of the images was carried out in the following manner. The images were down-sampled to obtain images of fixed resolutions of 64 × 64. This will aid in faster training of the network and to obtain better accuracy. The labelling of the images in the entire dataset was carried out in situ in the program for training the classifier. Online (on the fly) data augmentation was performed on mini-batches of the dataset that were fed to the model. Horizontal flip, width shift, height shift and rotation transformations were performed on the dataset. Both the datasets were then split into training and testing sets in the ratio of 4:1.

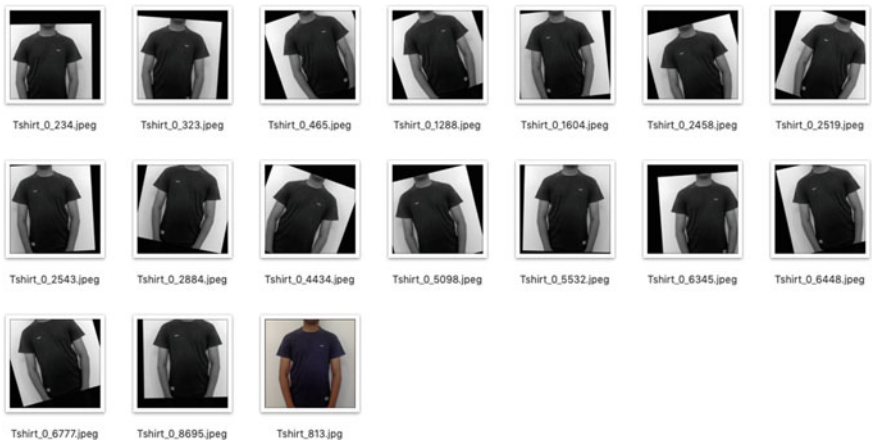


Fig. 1 Data augmentation performed on a single image

2.2 Architecture

An architecture with the sequential model is deployed to create a simple CNN model. Figure 2 shows an overview of the entire architecture network. The network consists of an input layer, two hidden layers with convolution, max-pooling and dropout filters, two fully connected layers and one output layer. The architecture uses sequential model to create a simple CNN model.

CNN refers to convolutional neural network. Features in the input sample (image here) are represented in matrix form as a result of the operation of convolution. The operation can primarily be described as multiplication of matrices. The weights in the filter matrix play a significant role in extracting wide-ranging features present in the input. Filters can be hard-coded, yet the transformation of CNN is to gain proficiency in determining the filters on the go during the process of training with respect to a particular classification problem. A larger image can result in greater number of parameters to train which will result in more computational and memory requirements. Operation of convolution on the image addresses this problem by reducing the number of parameters.

The size of the output image after passing through a single CNN layer is given by Eq. (1).

$$\left[\frac{n+2p-f}{s}+1\right]\times\left[\frac{n+2p-f}{s}+1\right]. \tag{1}$$

where

n input image dimension
p padding
f filter size
s stride.

Padding is done in order to avoid information loss on the corners. Stride indicates the number of steps taken while performing the convolution. It helps in reducing the size of the image.

The first layer has shape according to the input image dimensions. The next layer is a convolution layer consisting of 64 filters with ReLU activation. After

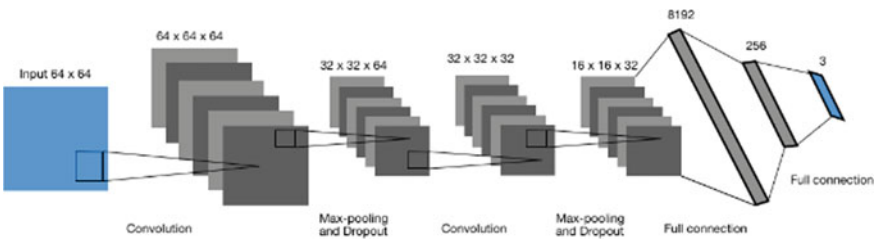


Fig. 2 An illustration of our CNN that describes the layers and their dimensions

a convolution layer, a max-pooling layer is used to down-sample the input, thus reducing its dimensionality and the computing power required. It is followed by a dropout layer. Overfitting of the training data occurs when the network consists of fully connected layer. This is due to the nature of the fully connected layer, wherein a significant number of parameters or factors are occupied and as a result the neurons acquire codependency nature.

To prevent overfitting, dropout is required. There is another set of convolution and max-pooling layers followed by dropout. The model is then flattened and connected to a dense layer with 256 nodes.

The last layer is a dense layer with softmax activation that classifies the three categories of data in the dataset. Softmax function figures the probability scattering of the event over '*n*' occurrences. This layer will compute the probabilities of each focus class over all conceivable target classes. Later, the determined probabilities will be useful for deciding the focus class for the given input. Softmax results in an output probability which ranges from 0 to 1, and summation of all probabilities equals unity. In a multi-grouping problem, each class has its own probability value whereas the highest probability occurs for the target class.

The layers of the CNN are listed in Table 1.

The convolution layer in this architecture uses ReLU activation. Rectified linear unit or ReLU is a nonlinear activation function that is most commonly used. It is half rectified. It is represented graphically in Fig. 3. The function is governed by Eq. (2).

Table 1 CNN architecture

Layer (type)	Output shape	Param. #
Conv2d layer	(None, 64, 64, 64)	320
Max_pooling2d layer	(None, 32, 32, 64)	0
Dropout	(None, 32, 32, 64)	0
Conv2d_1 layer	(None, 32, 32, 32)	8224
Max_pooling2d_1 layer	(None, 16, 16, 32)	0
Dropout_1	(None, 16, 16, 32)	0
Flatten	(None, 8192)	0
Dense layer	(None, 256)	2,097,408
Dropout_2	(None, 256)	0
Dense_1 layer	(None, 3)	1028
Conv2d layer	(None, 64, 64, 64)	320
Max_pooling2d	(None, 32, 32, 64)	0
Dropout	(None, 32, 32, 64)	0
Conv2d_1 layer	(None, 32, 32, 32)	8224

Total parameters trained: 2,106,980
Trainable parameters: 2,106,980
Non-trainable parameters: 0

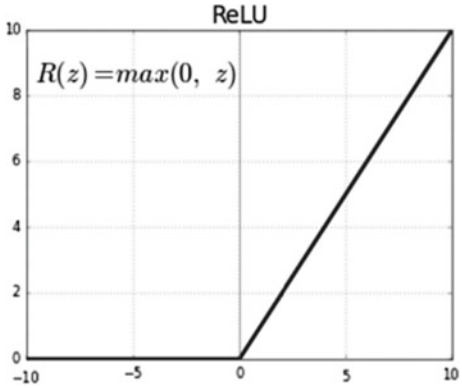


Fig. 3 ReLU function

$$F(z) = \begin{Bmatrix} 0,\ z < 0 \\ z,\ z > 0 \end{Bmatrix} \tag{2}$$

2.3 Training the CNN

Each image from the dataset is pre-processed to ensure faster and efficient training of the model. Initially, the images are converted to greyscale after they are read in the BGR format using OpenCV for Python. The dimension of each image in the dataset was 640 × 640. In order to minimize the processing power required to train the image classifier, the images were reduced to 64 × 64 dimension. Figure 4 outlines the training algorithm adopted. The Set 1 of the dataset is split, and the training set is taken to train the model using the CNN architecture. Training the model on images which have similar features and orientation would lead to the problem of overfitting. Thus, the Set 2 which has been cleaned and pre-processed is split to train the previously trained and saved model. The data augmentation performed on this subset as a part of the pre-processing is to help avoid overfitting of the data. The utilization of data augmentation empowers the CNN to vigorously categorize regardless of the orientations. The characteristics of such a CNN to exhibit invariance property are the proposition of data augmentation. The technique is therefore used to make the dataset more sizable and have distinctive images.

The testing set contains the images on which the model would be evaluated to obtain a confusion matrix. A confusion matrix is an ordered representation of performance of a classification model in tabulated form. Actual values for the test data on which the model is evaluated to obtain the confusion matrix must be known. The model is trained on the training set and assessed on both testing and training sets.

The trained model along with its complete specifications including the weights, optimization technique and structure is saved with the .h5 extension.

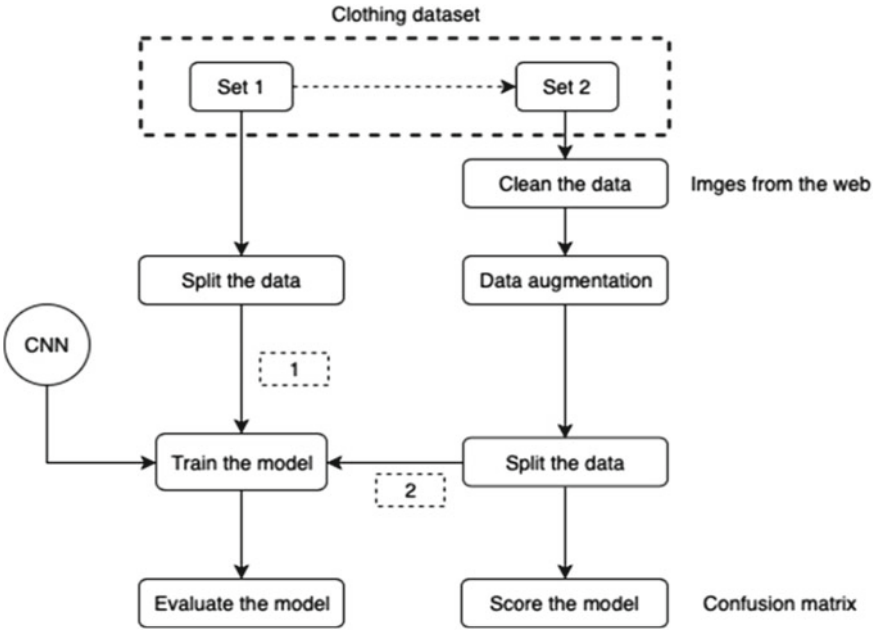


Fig. 4 Training technique adopted for our CNN

3 Results

The confusion matrix of the training and testing records is given in Tables 2 and 3. It can be observed that while shirts and trousers can be very accurately predicted, there are some errors in predicting T-shirts correctly.

Figure 5 illustrates the results the CNN model predicts for a trouser as an input image. The model is able to precisely predict the trouser.

Table 2 Confusion matrix—training set

	T-shirt	Shirt	Trouser
T-shirt	66	25	1
Shirt	0	125	3
Trouser	0	0	127

Table 3 Confusion matrix—testing set

	T-shirt	Shirt	Trouser
T-shirt	14	12	0
Shirt	2	28	1
Trouser	0	0	32

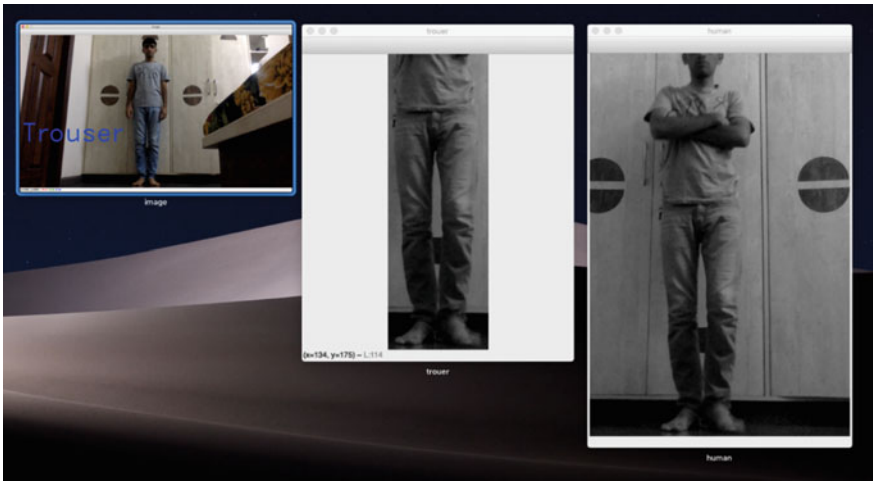


Fig. 5 Classification results for trouser

Similarly, the exercise carried out for a shirt as an input image is illustrated in Fig. 6.

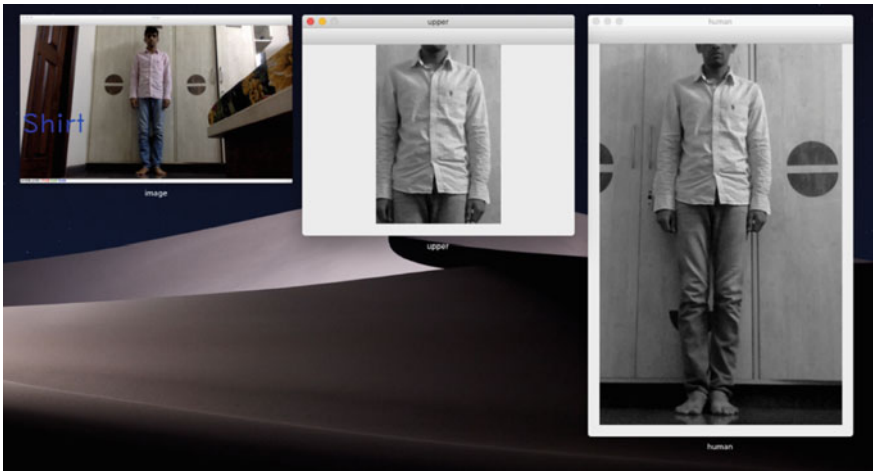


Fig. 6 Classification results for shirt

4 Conclusion

We were able to develop a CNN-based classifier which can be used to predict clothing items. The model is used in assistive technology-based device developed in further stages of the work. We were able to achieve clothe detection accuracy of 93% for detection of the three types of clothing. Data augmentation made the model invariant to 2D image transformations. Future work will include increasing the accuracy of the model by training it on larger dataset consisting of more varieties of clothing.

Acknowledgements The authors would like to acknowledge and thank Dr. G. N. Rathna, Principal Research Scientist, Department of Electrical Engineering, IISc Bangalore, for helping us in architecture selection of CNN and data augmentation.

References

1. Bossard L, Dantone M, Leistner C, Wengert C, Quack T, Van Gool L (2012) Apparel classification with style. In: ACCV, pp 321–335
2. Liu Z, Luo P, Qiu S, Wang X, Tang X (nd) DeepFashion: powering robust clothes recognition and retrieval with rich annotations. In: 2016 IEEE conference on computer vision and pattern recognition (CVPR), pp 1096–1104
3. Li R, Lu W, Liang H, Mao Y, Wang X (2018) Multiple features with extreme learning machines for clothing image recognition. IEEE Access 6:36283–36294
4. Zhao B, Wu X, Peng Q, Yan S (2016) Clothing cosegmentation for shopping images with cluttered background. IEEE Trans Multimedia 18(6):1111–1123
5. LeCun Y, Huang FJ, Bottou L (2004) Learning methods for generic object recognition with invariance to pose and lighting. In: Proceedings of the 2004 IEEE computer society conference on computer vision and pattern recognition, 2004, CVPR 2004, vol 2, pp II–97. IEEE
6. Fei-Fei L, Fergus R, Perona P (2007) Learning generative visual models from few training examples: an incremental bayesian approach tested on 101 object categories. Comput Vis Image Underst 106(1):59–70
7. Griffin G, Holub A, Perona P (2007) Caltech-256 object category dataset. Technical Report 7694, California Institute of Technology. http://authors.library.caltech.edu/7694
8. Burleson W, Lozano C, Ravishankar V, Lee J, Mahoney D (2018) An assistive technology system that provides personalized dressing support for people living with dementia: capability study. JMIR Med Inform 6(2):e21

Study and Review of Learning Management System Software

Mahima Sharma and Gaurav Srivastav

Abstract Learning management system (LMS) provides educational, training and development courses online. It enables the conference, management and display of course content making it easier for all sizes and types of businesses to manage course content. The major share of the LMSs today knuckles down on the corporate market. LMS constitute the greatest wedge of the learning system market. This paper aims to learn the various usability, implementation and adaptation frequencies and the obstacles and facilitators within the LMS domain, specifically in workplaces, by means of comparing a few research articles. The first section tends to introduce six LMS software. The second section comprises of detailed review of LMS platforms. The third section narrows down the results of our comparative review work in a tabular form. The fourth and fifth section gives a graphical representation of our results, concludes the paper and discusses the future scope of LMS.

Keywords TalentLMS · Schoology · Docebo · Litmos LMS · Blackboard · WebCT

1 Introduction

Various alma maters and other institutions can certainly benefit when they use a strong and steady learning management system. Not only universities and schools can use it to provide high-level education more easily even to the other side of the globe, but also in many companies LMS software is used to simplify their training strategies and to look for new skills among their apprentices. Here, we discuss four of the most promising LMS software which is widely used for these arenas.

M. Sharma (✉) · G. Srivastav
Inderprastha Engineering College, Ghaziabad, Uttar Pradesh, India

G. Srivastav
e-mail: gaurav.srivastav@ipec.org.in

H. S. Saini et al. (eds.), *Innovations in Computer Science and Engineering*,
Lecture Notes in Networks and Systems 103,
https://doi.org/10.1007/978-981-15-2043-3_42

1.1 Talent LMS

Talent LMS is an LMS which is a super-efficient tool to tutor the students, customers, partners or employees. The system can be fully custom-made for user's needs and offers comprehendible analytics about all facets of the e-learning environment [1].

1.2 Schoology

Schoology is a very innovative LMS and social networking application software. This LMS makes it smooth and swift to yield and share the academic course content. It offers a synergistic and synthesized environment for learning, hence making the traditional LMS more efficient. Moreover, this LMS provides a very versatile solution that also integrates content management.

1.3 Docebo [2]

Docebo is a well-known SAAS LMS and an e-learning solution supplier and an efficacious far-reaching system for training supervision. Many of world's top corporations use Docebo to secure viable efficiency. Docebo is a protactile and a very robust LMS that also incorporates a privilege to trigger an Enterprise Cloud Solution (ECS) app and concedes the system to function on a zealous cloud instance. To top it all, it delivers a very user-friendly, single page web app to transport, supervise and track e-learning activities.

1.4 Litmos LMS [3]

Litmos LMS is a cloud-based LMS. It is a prominent corporate LMS and salesforce participant for safe data exchange and services training. This LMS can imbrute both public as well as private learning programs, and hitherto, it is a user-friendly LMS that does not demand pricey installations or committed training.

1.5 Blackboard

Blackboard Learn is a virtual environment established by Blackboard Inc. It is a web server-based LMS software that showcases traits like course management, personalize open architecture and extensible software design that concedes integration with students' reports and authentication protocols.

1.6 WebCT

WebCT (course tools) is an online dominion virtual learning environment that is licensed mostly to educational institutions and also used in many schools and colleges for e-learning [4]. In the WebCT, tutors can add tools such as discussion boards, mailing systems and live AV chat to their courses. The latest variants of the WebCT are now called web courses. WebCT is unique and symbolic as it was the first universally prosperous learning management system for higher study courses. Today, it is used by over 30 million scholars in 80 countries.

2 Literature Review

"Usage of learning management system has become universal in the present-day school experience and essential elements of modern school experience. Whether distant or regular student, residentiary or commuter, bachelor or master, these systems have speedily been welcomed throughout higher education" [4]. Online courses have restored their ways to pass course contents such as satellite or video surveillance, in the last decade. The introduction of learning management systems, along with upsurged use of computers in the homes and in businesses, has led to a rising number of pupils and scholars to the online learning and teaching environment [4].

Both technology and learning management systems have had swift renewals over the last two decades. LMSs have been unfolded from course systems that were originally proposed in the late 1990s. Generally, these terms are used interchangeably, but they have symbolic variations. Course management systems have less focus of transmission of course contents. On the other hand, learning management systems concede for risen focus on the learning needs of the pupils and demands of the e-learning tutor regarding undertakings [5]. Initially, in the late 1990s, Stanford Online Web Page in a Box and Topclass which were uncomplicated web pages and content libraries were created which gradually transformed into LMS. "In 1997, Indiana University established the Oncourse Project, promoting the view of the template-based course management system that would become the infrastructure for later learning management systems including WebCT and Blackboard." Blackboard, a commercial software company, has overshadowed the learning management system market in the USA; however as in 2009, there has been an exponential surge in the usage of open source learning management systems in higher educational institutions in the USA, with the leading product being Moodle which is an open source product [6]. In contrast, the LMSs in the European market are established by the academies themselves or are traded by young commercial start-ups. Learning management system application varies throughout courses, but the use of LMS has turned into ideal way in various alma maters.

Since learning management systems have become customary in the education field, this is a vital research subject. The wisdom and worries of academies, teachers and scholars are some of the most urgent topics of this subject. "First, the selection process and implementation of a course management system are a basis for consideration. Next, integrating the course management system into theoretical approaches commonly used in face-to-face courses presents challenges. Finally, regulating the occasionally paradoxical demands and apprehensions about the wisdom in the learning management system is another view of this compelling problem" [7].

Applying a learning management system is a huge verdict for an educational institute. A large cogitation of this verdict is the monetary worth. Many peddlers overture a vigorous learning management system, but desire simple costs and annually spot authorizations. These may be peculiarly cost exorbitant if it is a sole unit or a small educational institution which is scrutinizing to acquire the learning management system. To surmount these problems, some seminaries have flourished their

own open source learning management system, such as OpenUSS [7]. Universities should scrutinize absolutely what targets they aspire to accomplish through the LMS before picking up a system. An investigation recommends the following points as the most significant scrutinization when picking an LMS: supervisory goals and targets, technological stipulations and backing, design stipulations, transparent and simple GUI, user-friendly course repository, course legislation proficiency, wherewithal of synergy among users, appraisal and assessment, student's silhouette and pedagogy [5]. Whether establishing an in-house system, preferring an open source explication or procuring a large system, these matters forge the learning management system verdict.

After selecting the learning management system to actualize, an open-ended matter for many institutions is how to use it in a way that will help in learning and also spawn an excellent wisdom for both scholars and professorates. There has been a lot of research done to recognize ways to use learning management systems in a way which promotes smart learning. The setup for many learning management systems, such as the specification of WebCT and Blackboard, generally repudiates these regulations and underlines information distribution rather than true learning [8]. Exploiting productive regulations with a spotlight on true responsibilities, subjective truth and termination of mistrust can facilitate more contingencies for an accurate experience within a learning management system. Planning deeper learning in a learning management system raises protests in the online environment. Deeper learning regulations can be scrutinized in many kinds of styles in a learning management system, but generally instructors must see out of the box to apply these schemes. Virtual AV chat, discussion boards and announcement postings all concede for the social learning aspect, spurring synergy among professorates and scholars. Bilateral analysis with prompt feedback helps effective learning where system and real-world tasks are accentuated. Carefully picked hyperlinks to Web sites facilitate scholars to analyze supplementary information in a circumstantial manner, uniting the wisdom into the scholar's world.

Employing learning, tributing various skills in a protest, little risk environment can be reached with the help of AV tools and multimedia. Scrutinizing the learning management system to upgrade the understanding of scholars to pursue solutions speedily can vest them separately and concede them to take restraint of student-owned learning. In addition to assuring that scholars are attaining worthwhile learning, it is also of ultimate value that they are having a constructive understanding in the LMS environment. E-learning will have a better repercussion of the learning of students going ahead, and it is visible that LMSs as a wealth to scholars are coherent. Components are handy at any while, irrespective of whereabouts, lectures or troublesome cases can be watched again for superlative percipience, and the synthesis of AV slides and notes presents students with various learning ways [9].

Scholars have uttered interest in matters about learning management systems. A study suggests that students found the design not be user-friendly, having a complex layout and faced difficulty reading from the screen. The quality of course material from instructors online also varied considerably. The ability of learning management

systems to provide a central repository for information and course announcements was highly appreciated by students [8].

Both distant as well as on-campus scholars endowed the synergistic mechanisms such as wikis and discussion boards and place to share learning experience by group tasks [10].

There are six weighty merits of LMS: intractability, receptiveness, feasibility, stamina, ability to upkeep and versatility, which substantially integrate the theory of LMS. An LMS upholds data in sundry formats: text, video, audio, etc. One can access the notes at one's convenience. Tutors can revise the data, and students can access the revised data. The appraisement of students is uncomplicated and unbiased, depending on student's presence and online quizzes. Students and teachers can rephrase the study data whenever they require. Students can study together by configuring a Web site with the LMS software and help keep institutions versed with compliance settlements.

There are a few demerits of LMS as well. Carrying out LMS stands in need of a vigorous technology framework. Teachers have to be enthusiastic to tailor their syllabus from traditional lectures to online lectures. Orthopedic injuries and vision problems can stem whenever students spend too much time on computer.

3 Methodologies

This paper explores learning management systems used in some of the remarkable research works across the globe. The findings are based upon a random sample of 15 research papers.

The authors went to explore each of these research papers to determine how they found various LMS software implementing their online or web-based courses.

The statistical analysis for this study was done using an electronic spreadsheet. The observation came as in Table 1.

4 Results

This research strives to compare various well-known learning management systems which were used in various research works across the globe. To conclude the research work, we present our calculations of these LMSs on the basis of their efficiency, usability, pricing and user satisfaction in the following statistics. Much research papers have been published about the effects of online courses and the approaches of web-based LMS pedagogy. The results are depicted in the form of the pie chart below which tells the percentage of research papers which referred specific LMS or none of them in their research papers. Refer in Fig. 1.

The findings on this study indicated that the most popular LMS used at various alma maters as mentioned in the research papers was Blackboard. The second most used system was WebCT.

Table 1 Comparison of technologies and results of research articles

S. No.	Name of paper	Authors	Technology	Conclusion
1.	The use of Learning management system in USA	David A. Falvo, Ben F. Johnson	Blackboard, WebCT	The most popular LMS used in universities in the US was Blackboard followed by WebCT
2.	Learning Management Systems (LMS): Inside Matters, Information Management and Business Review	Shakeel Iqbal, Ijaz A. Qureshi	LMS Pedagogy	Six Functionalities of LMS: user-friendly, elaborated interface, course repository, course administrative tools, timely feedback
3.	Developing, Deploying, Using and Evaluating an Open Source Learning Management System	J Grob, H. L., Bensberg F, Dewanto, B. L.	Blackboard, WebCT	J2EE is an excellent tool to create a robust LMS. It contributes to the continuous improvement of the whole system
4.	Evaluating the Innovation of Online Learning Systems in Higher Education	Raj R.	Blackboard, WebCT	Students appreciate the ability of LMS to provide a central repository for information and course announcements, which allows them to meet deadlines and have more efficiency
5.	Blackboard as an Online Learning Environment: What do Teacher Education, Students and Staff think?	Heirdsfield, A., Walker S., Tambyah M., Beutel D.	Blackboard	Blackboard is identified as having potential to enhance the learning experience but features like Wikis, Blogs and AV Chats are time consuming

(continued)

Table 1 (continued)

S. No.	Name of paper	Authors	Technology	Conclusion
6.	Who Needs to do What Where?: Using Learning Management Systems on Residential Versus Computer Campuses	Lonn S., Teasley S. D., Krumm A. E.	Docebo	LC oriented tools are heavily used in residential campus and LL oriented tools are highly active in computer campus
7.	Use of CALMS to Enrich Learning in Introductory Programming Courses	Richard C., Whitfield	CALMS	Socrates and development of an API has been and will be considered for providing metadata to Moodle to the concept of a CALMS [11]
8.	Supporting Students' Self-Directed Learning in the Flipped Classrooms through the LMS TES BlendSpace	Zamzani Zainuddin, Corrine Jacqueline Perera	TES Blendspace	Flipped classrooms enable the students' full autonomy to direct their learning pace and to become familiar with video lectures [12]
9.	Socio-Demographic Differences in the Perception of Learning Management System Design	Keh Niang Chee	Learner Central Design (LCD)	Socio-demographic factors and interaction between them are proven significant and they affect how users perceive the LMS design. Not everyone has same satisfaction level of design [13]
10.	Learning Management System Acceptance Scale (LMSAS): A Validity and Reliability Study	Ramazan Yilmaz	Efront, Blackboard, Brightspace	LMSAS can be used as a tool that generates valid and reliable measurements of students' acceptance of LMS [14]

(continued)

Table 1 (continued)

S. No.	Name of paper	Authors	Technology	Conclusion
11.	The Impact of Positive And Corrective Feedback via Showbie on Saudi Students' English Writing	Najat Abdulaziz Al Saleh	Showbie	Direct corrective feedback has a positive impact on the performance of LMS while indirect corrective feedback was least prioritized [15]
12.	Identity Management and e-Learning Standards for Promoting the sharing of Contents and Services in Higher Education	Paulo Alves, James Uhomoibhi	SCORM, IMS	SSO systems provide an efficient way to manage authentication and authorization inside institutions, however, restricted to administrative domain [16]
13.	CCAMS: A Tool for Co-Curricular Activities Management	Muhammad Farhan	CCAMS	With the help of CCAMS the knowledge base and activity management could become handy as is in distributed environment [17]
14.	Implementation and Evaluation of a Multilingual Learning Management System for Sleep Medicine	Thomas Penzel	Acentia, Docebo	All ENNICS partners (Germany, Portugal, Sweden) contribute to the refinement of the system development in accordance with quality requirements defined by DISCERN, HON and GMDS [18]
15.	Using an Outcome Based Information Technology Curriculum and an E-Learning Platform to Facilitate Student Learning	Azzedine Lansari, Abdullah Tubaishat, Akram Al-Rawi	Blackboard	E-learning platform facilitates the delivery of course content and also improves discussion [19]

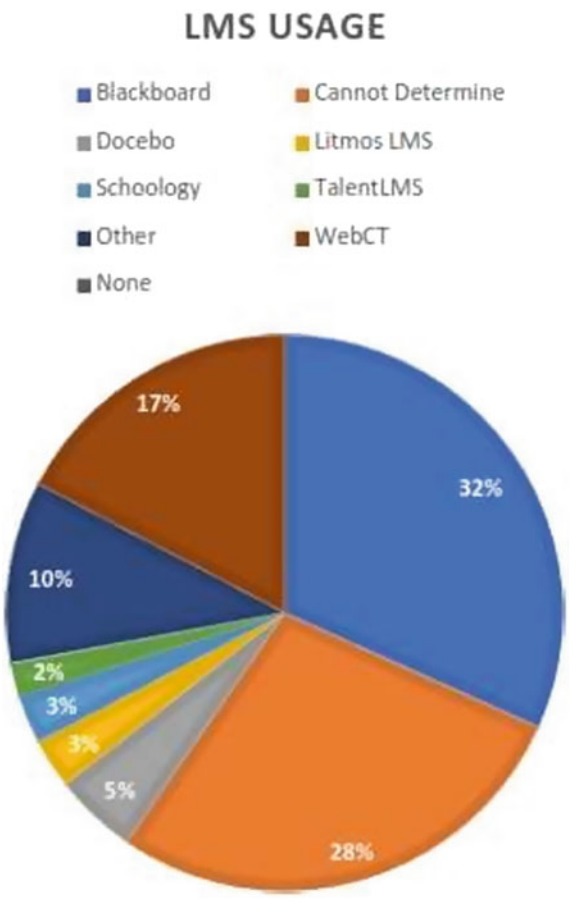


Fig. 1 Graphical representation of usage of LMS in different sectors

5 Conclusion and Future Scope

Learning management systems are a huge force in technology in higher education today. But LMS is definitely more than what meets the eye. This area of research has many opportunities for study as learning management systems continue to be adopted and used in new ways. Consideration for how to promote or redeem learning management systems that entirely converges the demands of learning, scholars and professorates stands at vanguard of research queries encompassing these systems. More research can be undertaken in the field of pure learning and how to exploit the technology in the learning management system to advance an excellent educational wisdom. "Instructor and student feedback can be further captured to develop higher quality experiences in learning management systems. New features can be adopted as they are shown to serve various needs of learners. Learning management systems are only going to become further entrenched in the education experience, so optimizing

the software to fully serve students, faculty and the institutions themselves remains a priority for future and present research" [20]. According to a topical scrutiny, by Zion Market Research, the LMS market is widening at a substantial scale and has a monetary worth of approximately USD 5.19 billion in 2016 with the purview of striking USD 19.05 billion in 2022 with a CAGR of roughly 24%. Hence, the future is bright [20].

References

1. Finances Online, Review for Business (2019) https://learning-management.financesonline.com/top-10learning-management-software-solutions-for-your-company/. 10 Best Learning Management Systems for your Company
2. eLearning Industry (2011–19) https://elearningindustry.com/directory/elearning-software/talentlms. TalentLMS
3. eLearning Industry (2011–2019) https://elearningindustry.com/directory/elearningsoftware/docebo. Docebo
4. Falvo DA, Johnson BF (2007) The use of learning management systems in the United States. TechTrends 51(2):40–45
5. Iqbal S, Qureshi IA (2011) Learning management systems (LMS): inside matters. Inf Manag Bus Rev
6. Grob HL, Bensberg F, Dewanto BL (2004) Developing, deploying, using and evaluating an open source learning management system. J Comput Inf Technol 12(2):127–134
7. Herrington J (2006) Authentic e-learning in higher education: design principles for authentic learning environments and tasks
8. Raj R (2011) Evaluating the innovation of online learning systems in higher education. Int J Manag Cases 13(4):12–23
9. Heirdsfield A, Walker S, Tambyah M, Beutel D (2011) Blackboard as an online learning environment: what do teacher education students and staff think? Aust J Teach Educ 36(7):1
10. Lonn S, Teasley SD, Krumm AE, Who needs to do what where?: Using learning management systems on residential vs. commuter campuses. Comput Educ 56:642–649. https://doi.org/10.1016/j.compedu.2010.10.006
11. eLearning Industry (2011–2019) https://elearningindustry.com/directory/elearning-software/litmos-lms. Litmos LMS
12. Whitfield RC (2009) Use of CALMS to enrich learning in introductory programming courses
13. Zainuddin Z, Perera CJ (2018) Supporting students' self directed learning in the flipped classroom through the LMS TES BlendSpace
14. Lim YM, Ayesh A, Chee KN (2013) Socio-demographic differences in the perception of learning management system design
15. Yilmaz R (2019) Learning management system acceptance scale (LMSAS): a validity and reliability study
16. Abdulaziz Al Saleh N (2018) The impact of positive and corrective feedback via Showbie on Saudi Students' English writing
17. Alves P, Uhomoibhi J (2000) Identity management and E-learning standards for promoting the sharing of contents and services in higher education
18. Farhan M (2011) CCAMS: a tool for co-curricular activities management
19. Penzel T (2006) Implementation and evaluation of a multilingual learning management system for sleep medicine
20. Nashiya S (2017) Learning management system: does it have a future?
21. Lansari A, Tubaishat A, Al-Rawi A (2007) Using an outcome based information technology curriculum and an E-learning platform to facilitate student learning

Multiple Action Detection in Videos

M. N. Renuka Devi and Gowri Srinivasa

Abstract In this work, we present the efficient detection of multiple actions occurring simultaneously in streaming video of various real-world applications using a frame differencing-based method for background detection. We compare our method with other modeling methods (such as multi-channel nonlinear SVM) for multiple action detection on various video datasets. We demonstrate through quantitative performance evaluation metrics such as performance accuracy, standard deviation and detection *F*-score, and the efficacy of the proposed method over those reported in the literature.

Keywords Background subtraction · Feature detection · Frame differencing method · Nonlinear SVM

1 Introduction

Identifying human actions in a video is widely used in several video analysis applications such as surveillance, human–computer interaction, and security [1]. Whereas the detection of simple intermittent actions involves isolating the region of movement, the study of multiple human actions profits from an understanding of fundamental relationships between people, where one person moves and the other reacts.

There are several datasets used to benchmark the performance of human action recognition in the video: KTH, Weizmann, and Hollywood (HOHA). However, these clips are limited to a very small number of activity categories and are captured in restricted settings. The KTH videos have irrelevant camera motion and are limited to detecting a few actions. The Hollywood dataset taken from movies reports the matter of unrestrained videos to some degree, but it involves actors in movies and contains some camera shift and clutter under good lighting conditions [2]. The CAVIAR

M. N. Renuka Devi (✉) · G. Srinivasa
PESIT South Campus, Electronic City, Bengaluru, Karnataka 560100, India

G. Srinivasa
e-mail: gsrinivasa@pes.edu

H. S. Saini et al. (eds.), *Innovations in Computer Science and Engineering*,
Lecture Notes in Networks and Systems 103,
https://doi.org/10.1007/978-981-15-2043-3_43

dataset includes video web activities such as three persons meeting at a place, discussing something and moving apart, fast-moving traffic, crowded video scenes, two people crossing paths at the entry of a store, a couple walking in the corridor, and two people meeting, having a fight and running away [3]. Thus, each of these datasets presents challenges that are quite different in scope. In the present work, we study the precision of detection of various methods on large datasets and propose a new framework that can address the problem of abnormal activity detection in video clips

2 Related Work

Extracting multiple features in a single video and categorizing actions have gained considerable interest in recent years. There has not been much work done on human action detection on a very large set of videos in datasets and in real-time videos by categorizing only visual features. In recent years, with rapid development in human action recognition technology, a vast variety of approaches has been tried and implemented for multiple action recognition in video clips. Template-based methods [4–6], or hidden Markov models (HMM) [7], BoF models [8, 9], and neural networks [9] are a few well-known approaches that have been resorted to solve the problem of detecting multiple actions in videos.

However, a vast majority of the foregoing techniques have been limited to small and constrained datasets. That is, the algorithms perform well in certain situations and detect only simple human actions. Most of the algorithms do not process the entire human body part motions and result in a high degree of uncertainty. We propose a system to build a robust method for detecting multiple co-occurring actions on various datasets, without being sensitive to the nature of the dataset—such as lighting conditions or a limited number of actions.

3 Proposed System

Different methods [10–12] in the literature are limited to single action detection in video sequences which are practically less applicable in real-time situations and surveillance techniques, where multiple people actions classification is required. Hence, we propose a technique based on background subtraction for multiple action detection in videos on large datasets. We also compare background subtraction method with feature detection (multi-channel nonlinear SVM) method [13, 14].

A typical human activity detection system (Fig. 1) has the following components.

Video acquiring system: Capturing the real-time video or using videos from various datasets. In our paper, we have used many videos from six various datasets for multiple instances of multiple actions.

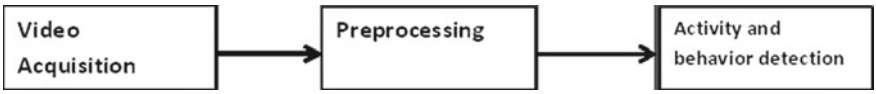


Fig. 1 General framework for human activity detection system

Preprocessing component filters the error from video frames and extracts key information using different filtering methods. We mainly emphasize on extracting the region of interest by using the background subtraction method.
The activity and behavior detection module progresses the results given by the detection and classification procedures and detects the human actions. Performance of this module extremely impacts the overall system accuracy.

In our paper, we are comparing the background subtraction method with feature detection (multi-channel nonlinear SVM) method for multiple instances of multiple action classification in videos.

Background subtraction (BS) method:

Background subtraction method used in our paper is a frame differencing method which is explained below.

Frame Differencing Method

Absolute frame difference at time $t + 1$ is explained in Eq. 1

$$D(t+1) = |V(x, y, t+1) - V(x, y, t)| \tag{1}$$

The background is expected to be a frame t. The changed frame will indicate the strength for the changed pixel. This technique will work for scenarios where all forefront pixels are in motion and all background pixels are static [6]. Next, threshold Th is applied on the difference image to progress the deduction (subtraction) as explained in Eq. 2

$$|V(x, y, t) - V(x, y, t+1)| > \text{Th} \tag{2}$$

We use frame differencing in our work, as the accuracy of this approach is higher compared to other methods. Datasets which are used in our paper include all types of actions/movements in videos.

To categorize various actions in the videos, feature detection method uses space time interest points for each frame of the video. STIP features are those with large temporal deviation and fairly strong interest points through multiple iterations of smoothing in the space domain. A cluster of STIP features is input to the classifier, viz. the multi-class SVM used for training different actions [15].

We resort to SVMs based on its ability to detect human silhouettes and perform action detection in images and videos. These are the steps for classification as follows:

- Recognize and detect spatiotemporal points.
- Identify and extract the shape features which represent the pattern based on the *k*-means algorithm.
- Classify several actions of humans by nonlinear SVM multi-class classifier.

4 Performance Evaluation

The projected system can experiment with different set of various features which can be used for performance valuation. Detection precision is a period occupied by the algorithm to perceive the multiple actions in a single video frame intended by using tic and toc functions of MATLAB. Based on detection precision, we would verify the best system performance.

5 Experimental Results

Experimental results for multiple action classification implemented using the proposed approach have been applied to large datasets of videos. Here, we are using a large set of videos from six different datasets that describe different sequences that represent distinctive situations significant for video supervision systems, movie datasets, sports videos, and video web activity datasets and showcase qualitative results obtained with the proposed method.

1. **Surveillance dataset** (Fig. 2)
2. **HOHA Hollywood movie dataset** (Fig. 3)
3. **UCF Sports Datasets** (Fig. 4)
4. **YouTube Datasets** (Fig. 5)
5. **CAVIAR Test Case Scenarios** (Fig. 6)
6. **VISOR—Video Surveillance Online Repository dataset** (Fig. 7)

In our test dataset, CAVIAR Test Case Scenarios have the highest accuracy, standard deviation (SD), and *F*-score value compared to other datasets as it involve fewer illumination changes, less occlusion, and noise ratio in videos, and VISOR dataset has the lowest accuracy and detection precision compared to other datasets as it involves videos containing the highest level of occlusion and noise ratio.

In multi-channel nonlinear SVM method, CAVIAR dataset has higher detection precision, performance, and *F*-score compared to other datasets as it involves less occlusion in videos, and VISOR dataset has a lower performance rate compared to all other datasets. But as we observe values from both Tables 1 and 2 that multiple Action detection using background subtraction method takes minimum time (in seconds) to detect multiple actions in videos of various datasets compared to multi-channel nonlinear SVM. Table 3 with Fig. 8 summarizes the performance of the system based

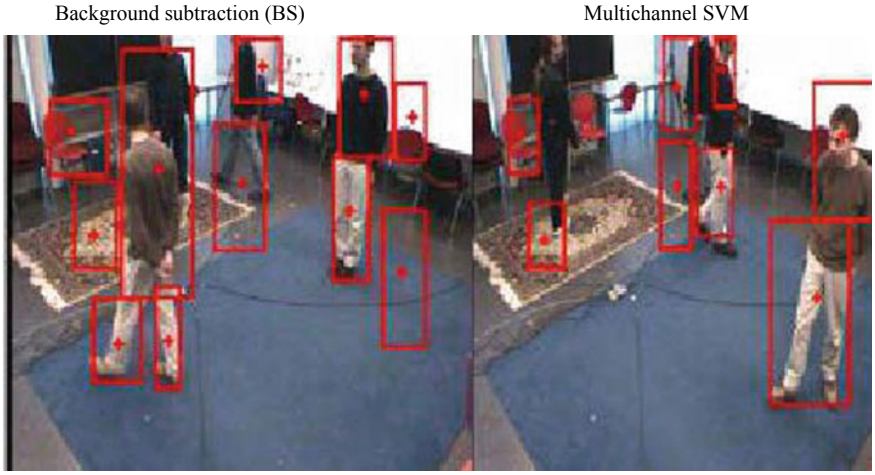


Fig. 2 Action detection with bounding box for multiple people walking

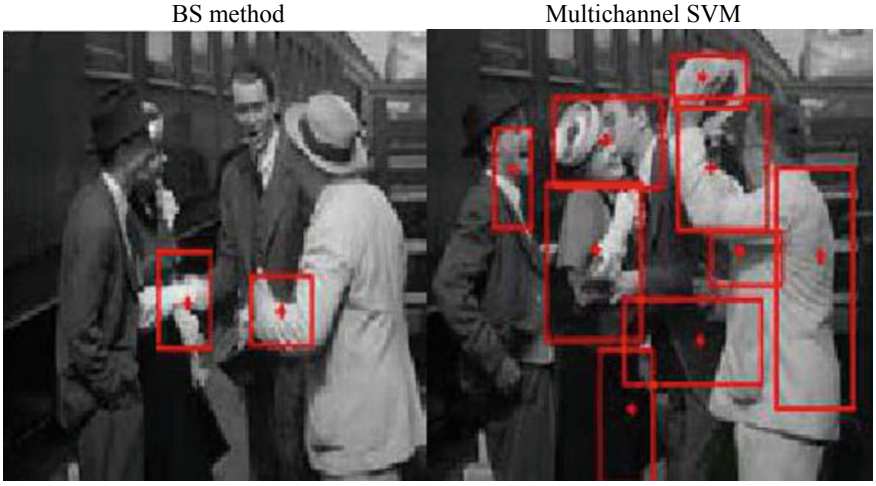


Fig. 3 Detected action as handshake, kiss and hug

on area under ROC curve. Background subtraction method shows a higher value (0.92) of AUC compared to nonlinear SVM method indicating higher accuracy of the method.

Feature detection (multi-channel nonlinear SVM) detects human activities by extracting STIP features. The foremost shortcoming of support vector machines is its greater calculation liability for the controlled optimization programming used in the learning phase.

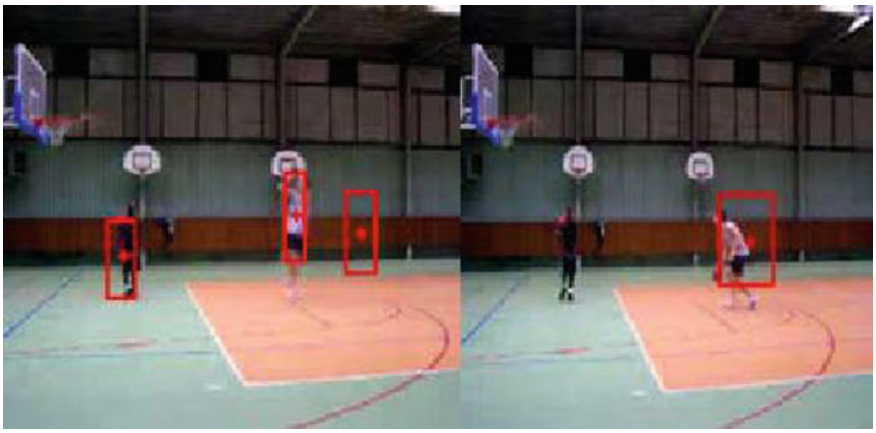


Fig. 4 Action detected as "serving" in sports video

Fig. 5 Action detected as "Three persons crossing the path at the entrance of the store"

However, compared to feature detection (multi-channel nonlinear SVM), a method background subtraction method provides high detection rates in various datasets due to its simplicity and efficiency. The background subtraction (BS) method has been comprehensively functional in different cases of datasets, with enhanced updates. It analyzes the sequential changes in the observed scene's environment in terms of the distribution of image vectors.

Fig. 6 Action detected as "Three people meet, fight and run away"

Fig. 7 Action detected as "Two persons handshake and two persons fight at the same place"

Table 1 Multiple action detection using background subtraction method

Datasets	Detection Precision	SD	Performance (%)	*F*-score
1. Surveillance	1.11	1.33	91	0.82
2. Hollywood	1.56	1.47	88	0.80
3. UCF Sports	1.79	1.60	84	0.76
4. YouTube	0.57	1.01	92	0.83
5. CAVIAR	0.21	0.36	95	0.86
6. VISOR	2.80	2.22	80	0.66

Table 2 Multiple action detection using nonlinear SVM method

Datasets	Detection Precision	SD	Performance (%)	*F*-score
1. Surveillance	2.11	2.33	81	0.60
2. Hollywood	2.56	2.47	77	0.55
3. UCF Sports	3.79	2.60	74	0.50
4. YouTube	1.57	1.01	82	0.63
5. CAVIAR	1.21	1.36	85	0.66
6. VISOR	4.9	3.99	69	0.48

Table 3 Comparison of AUC values for multiple action detection

Methods	AUC values
1. Background subtraction	0.92
2. Nonlinear SVM	0.74

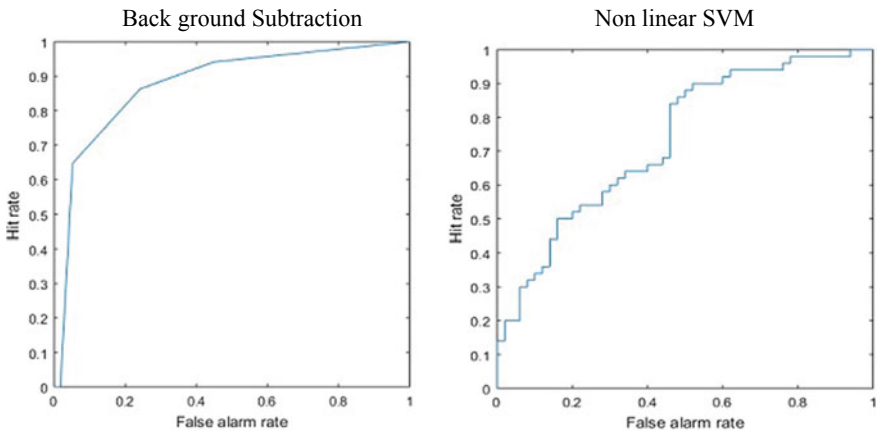


Fig. 8 Area under (ROC) curve for multiple action detection

6 Conclusion

In our work, the proposed system is made to be adaptable to detect multiple human actions on different datasets. We implemented a technique based on background subtraction for multiple action detection in videos on six different datasets. We also compare background subtraction method with feature detection (multi-channel nonlinear SVM) method. Both methods can be implemented across a variety of circumstances and situations from normal surveillance to security-related monitoring, and we have also performed tests on both indoor and outdoor video sequences to cover

all demanding cases. The assessment consequences were associated based on detection precision, standard deviation, *F*-score, and performance. Comparatively, the background subtraction method gives a higher performance on videos from various datasets compared to feature detection methods which are having static backgrounds.

References

1. Escorcia V, Dao CD, Jain M, Ghanem B, Snoek C (2018) Guess where? Actor-supervision for spatiotemporal action localization. arXiv preprint arXiv:1804.01824
2. Zhang M et al (2018) Recurrent attention network using spatial-temporal relations for action recognition. Signal Process 145:137–145
3. CAVIAR: "Context aware vision using image-based active recognition" funded by the EC's Information Society Technology's programmed project IST 2001 37540
4. Weinland D, Ronfard R, Boyer E (2011) A survey of vision-based methods for action representation, segmentation, and recognition. Comput Vis Image Underst 115(2):224–241
5. Pecka P et al (2018) Solving large markov models described with standard programming language. In: International symposium on computer and information sciences. Springer, Cham
6. Xiao C, Yu M (2018) Model-based quantitative distributed fault diagnosis using system decomposition. In: 2018 prognostics and system health management conference (PHM-Chongqing). IEEE
7. Asghari P, Soelimani E, Nazerfard E (2019) Online human activity recognition employing hierarchical hidden Markov models. arXiv preprint arXiv:1903.04820
8. Tu NA et al (2019) ML-HDP: a hierarchical bayesian nonparametric model for recognizing human actions in video. IEEE Trans Circuits Syst Video Technol 29(3):800–814
9. Wang H et al (2011) Action recognition by dense trajectories. 2011 IEEE conference on computer vision and pattern recognition (CVPR). IEEE
10. Aggarwal JK, Ryoo MS (2011) Human activity analysis: a review. ACM Comput Surv 43(3):1–43
11. Wu D et al (2016) Deep dynamic neural networks for multimodal gesture segmentation and recognition. IEEE Trans Pattern Anal Mach Intell 38(8):1583–1597
12. Laptev I et al (2008) Learning realistic human actions from movies. IEEE conference on computer vision and pattern recognition, CVPR 2008. IEEE
13. Devi R, Srinivasa A, Srinivasa G (2016) Detection of multiple, co-occurring actions in video frames. In: International conference on wireless communications, signal processing and networking (WiSPNET). IEEE
14. Zhang B et al (2017) Action recognition using 3D histograms of texture and a multi-class boosting classifier. IEEE Trans Image Process
15. Geertsema EE et al (2019) Automated remote fall detection using impact features from video and audio. J Biomech
16. Zhou W et al (2018) Foreground detection based on co-occurrence background model with hypothesis on degradation modification in background changes. In: 2018 12th France-Japan and 10th Europe-Asia congress on mechatronics. IEEE

AI-Assisted Diagnosis of Cerebral Oedema Using Convolutional Neural Networks

B. Sri Gurubaran, Takamichi Hirata, A. Umamakeswari, E. R. S. Subramanian and A. S. Sayee Shruthi

Abstract With the current advances in medical sciences, it is easy to observe the changes happening in the brain in real-time. But the procedure involved is costly and invasive in nature. So, the commonly used procedure is to obtain computed tomography (CT) scans of the brain, which provides static greyscale images. The biggest drawback of a CT scan is that the images are in greyscale; therefore, it is difficult for the naked eye to distinguish the subtle changes in the brain tissues. A wrong prognosis, in this case, could lead to the death of a patient. In this paper, we propose an AI-assisted diagnosis method where a predictive model is deployed, which can discern even the subtlest of the differences in the brain tissues and can help determine any anomalies. The model was trained and tested using CT scans of a rat's brain, which is affected by Cerebral Oedema (a certain type of disease which leads to accumulation of fluid in the intracellular or the extracellular spaces of the brain). To improve the accuracy of the model, a colour gamut transformation is also proposed. The results after testing the model, with and without the transformation, are tabulated.

Keywords Convolutional neural network · Colour gamut · Cerebral Oedema · CT scan · Greyscale images · Tensor flow

1 Introduction

The recent advancements in medical sciences enable us to view the internal organs of the human body in real-time at a microscopic level. With augmented reality, surgeons could view and modify the internal organs at the tissue level. These methods, when practically applied, have greatly improved the success rate of surgeries involving critical organs. Since organs like brain, lungs, and heart are critical for normal bodily functioning, even the slightest slip up while operating them will have catastrophic

B. Sri Gurubaran (✉) · A. Umamakeswari · E. R. S. Subramanian · A. S. Sayee Shruthi
CSE, SOC, SASTRA University, Thanjavur 613401, India

T. Hirata
Department of Biomedical Engineering, Tokyo City University, Tokyo 158-8557, Japan

H. S. Saini et al. (eds.), *Innovations in Computer Science and Engineering*,
Lecture Notes in Networks and Systems 103,
https://doi.org/10.1007/978-981-15-2043-3_44

consequences and often lead to the death of the individual. Even with these advances, the death rate due to the wrong prognosis is still high. Researchers are now proposing AI-assisted diagnosis of diseases [1], which gives better insights into the doctor to treat the patient appropriately.

Even with these technological advancements, most of them are not adopted for common use, mostly because they are too costly to perform and the lack of adequate resources at the hospitals. So generally, they resort to using regular conventional methods, where a doctor manually looks over the scans and tries to discern the ailment, where there is a high chance of human error. In these types of cases, AI-assisted diagnosis may provide a middle ground to provide an affordable yet, a less error-prone method to diagnose diseases. In this paper, we took the specific case of Cerebral Oedema, which is the accumulation of fluid in the brain of humans and animals alike. And currently, the commonly prevalent method to identify it is through CT scan images of the brain.

To tackle this problem, we proposed training a convolutional neural network with the scan images, to determine whether the subject is affected with Oedema or not. But even when using the help of neural networks, there arises the problem of False Positives (Normal brains being diagnosed with Oedema) and False Negatives (Oedema-affected brains being classified as normal), either of them proving to be fatal for the subject. Therefore, the accuracy of the neural network should be maximised. One of the key problems affecting accuracy is that CT scan images are in greyscale. Therefore, the subtle changes in the pixels cannot be distinguished properly, which might lead to discrepancy while training the neural network and thereby affecting the accuracy of the model. The simplest method to rectify this problem is to map the original greyscale colour gamut of the image onto an RGB colour gamut, which may provide better clarity and might improve the accuracy of the model.

Due to the lack of data and other ethical reasons, the entire experiment was carried out using the scan images of a rat's brain rather than that of a human. But the same principle can be extended onto human subjects, provided there is an availability of an extensive amount of data, which can be used to train and test the neural network.

2 Related Works

Machine learning for medical diagnosis: History, state of the art and perspective [1] provide a futuristic view of integrating medicine and machine learning for intelligent data analysis and to verify abnormal phenomena in the field of medicine. It explains the importance of several state-of-the-art representatives from the field of machine learning, such as neural networks and decision trees, to assist and develop the diagnosis of various diseases.

A hybrid approach for automatic classification of brain MRI using genetic algorithm and support vector machine [2] proposes a hybrid approach for classifying brain tissues using support vector machine and genetic algorithm. A set containing wavelet-based texture features is formed by spatial grey level dependence method,

and a genetic algorithm was used to converge on the essential features. This classifies the brain as normal or affected with benign or malignant tumour.

Extreme learning machine-based classification of ADHD using brain structural MRI data [3] proposes an algorithm to diagnose the attention deficit hyperactivity disorder (ADHD) patients using extreme learning machine (ELM) for efficient and clean diagnosis. *F*-score and SFS methods are applied to select the optimal features for the classification. The performance of the ELM is compared with that of a traditional support vector machine (SVM).

Machine learning on brain MRI data for differential diagnosis of Parkinson's disease and progressive supranuclear palsy [4] proposes the use of supervised machine learning to pave the way for automatic diagnosis of patients and by identifying sensitive medical image biomarkers. The patients' magnetic resonance imaging (MRI) images were provided as inputs to a supervised machine learning. Principal components analysis and SVM were used for feature extraction and classification, respectively.

Classification of brain tumour type and grade using MRI texture and shape in a machine learning scheme by Zacharaki et al. [5] proposes an automated computer analysis tool for differential diagnosis. The tool provides a means of extracting features by classification that can be included to differentiate tumours based on tumour shape, intensity, and many more. SVMs coupled with recursive feature elimination, are used to attain feature subset classification.

Investigating machine learning techniques for MRI-based classification of brain neoplasms [6] discusses how machine learning algorithms can be applied to identify relevant attributes for optimal brain tumour differentiation. The brain tumours are differentiated based on attributes such as shape and intensity that are calculated with the help of different machine learning techniques. Best first, greedy stepwise and scatter search algorithms are used for attribute subset selection.

3 Convolutional Neural Networks

Neural networks (a.k.a. artificial neural networks or ANN) are a system of interconnected nodes inspired by the constitution of the human brain, mimicking their ability to "learn" and provide a solution to a problem based on the data from the previous results of the same problem. They automatically create and learn the characteristics of the previous examples and use that knowledge to process the current given scenario.

As discussed before, ANN is a collection of interconnected nodes which are loosely modelled based on neurons of humans. Like the real brain, each connection between the nodes is similar to synapses that process the incoming signal and transmit to the other nodes if necessary. And the connections in an ANN have a weight parameter that adjusted during the learning process to suit the current given scenario.

Convolutional neural network (CNN) is one type of neural network which is commonly utilised for analysing visual imagery. Its design pattern was inspired by

the organisation of the visual cortex in our brains. This is primarily adapted for analysing images because it requires little to no preprocessing compared to other image analysis methods commonly implemented. This reduces the human effort and prior knowledge required to implement the aforementioned methods.

CNN consists of multiple layers arranged in an orderly fashion between the input and the output layer. The different types of layers that comprise a CNN are as follows:

- **Convolutional layer**: As the name itself suggests, convolutional layers make use of convolution operation on the input to that layer and pass the output to the next layer. Convolution is simply an operation on two functions or processes that determines the effect that one function has on the other. On applying convolution on two functions, a third function is obtained that describes the aforementioned effect. It has various applications such as in the fields of signal processing, probability, neural networks, and many more. Below is the mathematical formula for convolution:

$$C(u) = (f * g)(x) = \int_{\infty}^{-\infty} f(x)g(x-u)\mathrm{d}u \tag{1}$$

$$= \int_{\infty}^{-\infty} f(x-u)g(x)\mathrm{d}u \tag{2}$$

  The convolution of f and g is expressed as $f * g$. The result obtained is described by the function $C(u)$.
- **Pooling layer**: This performs the task of nonlinear down-sampling, which reduces the size of the data. The most commonly used method is maximum pooling, where the image is partitioned into a set of non-overlapping rectangles and from each rectangle, and the maximum value is taken to form a new image with these output values. This reduces the number of parameters as well as control overfitting. And the output is given to the rectified linear units (ReLUs) to apply the activation function to the resultant, which is used to train the neural network. Generally, it is performed along with the convolution process in a single step.
- **Fully Connected layer**: This is the point where the classification part takes place; they have connections to all activation of the previous layers and are generally performed by a matrix multiplication with a bias parameter. This a cheap way to learn nonlinear combinations of various features obtained after the convolution and pooling layers.
- **Flattening layer**: It is a step that reduces the dimensionality of the output obtained after convolution and pooling and is necessary in order to use the fully connected layers. It basically flattens all the structure of the output to create a single long feature vector which is used for classification.

4 Colour Gamut Transformation

The main drawback of conventional CT scans is the inability to identify the dark spots clearly in the greyscale images. Hence, the greyscale image is converted to a colour image based on a reference colour model to reduce the errors in the identification of dark spots. This is achieved with the help of a colour gamut transformation. A colour space and a reference colour model are required to perform the gamut transformation. Colour space refers to the set of colours that might be present in the grey image. The colours in the colour space can be organised based on any property that clearly distinguishes the colours from each other in the colour space. The reference model contains colour mappings based on the properties by which the colours are organised in the colour space. For example, the reference model can dictate that a colour with property X is to be transformed into the colour, say A and a colour with property Y is to be transformed into the colour, say B. Hence, on applying the reference colour model to the input colour space, colour gamut transformation is performed on the CT-scanned greyscale image to produce colour images of the same.

5 Proposed Framework

The proposed framework consists of a convolutional neural network (CNN) [7] with 15 layers, as listed in Table 1. The images are preprocessed using a colour gamut transformation [8]. Figure 1 represents a sample of the proposed colour gamut transformation, which provided a clear contrast in the images and led to a considerable increase in the accuracy of the model.

- *Training Phase*

  Step 1: The training images are obtained, and a percentage of them is set aside for validation (in our case, we used 20% of available data for validation [9]).
  Step 2: All images are then preprocessed to be of the same size and focused only on the skull and removing any other parts from the scan image.
  Step 3: The proposed transformation is carried out on all the training data.
  Step 4: The training data is now fed on to the neural network for training, and the training takes place in batches of 32 images at a time.
  Step 5: The validation data is randomly chosen from the training set, and that data is used to verify that the model is not overfitted.
  Step 6: The model is saved and is used on the testing images to obtain the results.

- *Testing Phase*

  Step 1: The testing images are obtained and are preprocessed, the same way as the training data.
  Step 2: Then, the proposed transformation is performed on the data.

Table 1 Structure of the CNN used

Layers	Type	No. of neurons (output layer)	Kernel size for each output feature map	Stride
0–1	Convolution	4092 × 4	6	1
1–2	Max pooling	2046 × 4	2	2
2–3	Convolution	2042 × 4	5	1
3–4	Max pooling	1021 × 4	2	2
4–5	Convolution	1018 × 10	4	1
5–6	Max pooling	509 × 10	2	2
6–7	Convolution	506 × 10	4	1
7–8	Max pooling	253 × 10	2	2
8–9	Convolution	250 × 15	4	1
9–10	Max pooling	125 × 15	2	2
10–11	Flattening	625	–	–
11–12	Fully connected	50	–	–
12–13	Fully connected	25	–	–
13–14	Fully connected	12	–	–
14–15	Fully connected	2	–	–

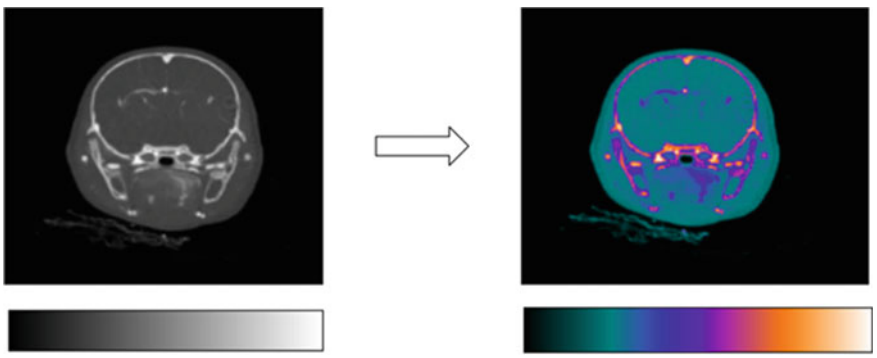


Fig. 1 Proposed colour gamut transformation

Step 3: The trained model is retrieved, and the data is fed into the model.

Step 4: The model analyses the images in batches of 32 and provides result probabilities in the format.

$$[[(\text{probability of Oedema}), (\text{probability of normal})]] \tag{3}$$

Step 5: Finally, the below metrics of the model are calculated to prove the efficacy of the proposed method.

Accuracy: Probability that a patient will be correctly diagnosed.
Positive predictive value: Probability that the disease is present when the diagnosis produces a positive result.
Sensitivity: Probability that the diagnosis will produce a positive result when the disease is present.
Specificity: Probability that the diagnosis will produce a negative result when the disease is not present.

Consider, True Positives $= a$, False Negatives $= b$, False Positives $= c$ and True Negatives $= d$

$$\text{Accuracy} = \frac{a+d}{a+b+c+d} \tag{4}$$

$$\text{Positive Predictive Value (PPV)} = \frac{a}{a+c} \tag{5}$$

$$\text{Sensitivity} = \frac{a}{a+b} \tag{6}$$

$$\text{Specificity} = \frac{d}{c+d} \tag{7}$$

6 Experimental Results

The CNN was deployed using tensor flow [10] on an Ubuntu machine. The training data set included 4500 images of a normal rat's brain and 2600 images of brains affected by Oedema, and 20% of this data was used for validation during the training phase. For testing, two data sets were used, the first data set consists of 100 images of normal and 150 images of Oedema-affected brains. The second data set consists of 350 images of Oedema-affected brains and 150 images of normal brains. Table 2 shows the number of True Positives, True Negatives, False Positives, and False Negatives obtained and the accuracy, PPV, sensitivity, and specificity of the model when no colour transformation is performed. Table 3 shows the same metrics as Table 2 after a colour gamut transformation has been performed on the images.

Table 2 Results after testing without the colour gamut transformation

Testing set	tp	tn	fp	fn	Accuracy (%)	PPV (%)	Sensitivity (%)	Specificity (%)
Testing set 1	96	69	54	31	66	64	75.59	56.1
Testing set 2	276	105	74	45	76.2	78.86	85.98	58.66

Table 3 Results after testing with the colour gamut transformation

Testing set	tp	tn	fp	fn	Accuracy (%)	PPV (%)	Sensitivity (%)	Specificity (%)
Testing set 1	146	68	4	32	71.2	97.33	68.22	88.89
Testing set 2	342	104	8	46	77.6	97.71	76.68	85.19

tp—true positives, tn—true negatives, fp—false positives, fn—false negatives

On observation of the tables, we can see that there is not much of an increase in accuracy. But the specificity and PPV are greatly improved after applying the transformation. This implies that the chance for the model to classify any healthy individuals as sick is pretty low, which ideally excludes all healthy samples.

7 Future Work

On applying the colour gamut transformation, though a significant increase in specificity and PPV, the sensitivity underwent a gradual decrease, which means the chance for classifying a sick person as healthy is a bit higher when compared to that of prior transformation. Hence, future research work is to be concentrated on perfecting the colour gamut transformation to increase the sensitivity.

Furthermore, with the ongoing development of new imaging technologies, the current model can be enhanced further to support such live feed of the scans and can provide assistance on a near real-time basis.

8 Conclusion

This paper proposes an artificial intelligence (AI)-assisted diagnosis of Cerebral Oedema in a rat's brain. A CNN was deployed to determine whether the brain is affected by Oedema or not. A colour gamut transformation was used to improve the accuracy of the obtained results. From the experimental results, it can be deduced that the Cerebral Oedema can be detected at a very early stage from the scan images with a decent accuracy, which was further increased after training the CNN using the transformed images. On closer inspection of the metrics, it was inferred that the transformation greatly assists in reducing the False Positives and thereby enabling the model to rule out all the healthy samples effectively. This will allow the doctors to start the diagnosis and treat before the Oedema inflicts any corporeal damage to the brain. This approach can be extended onto other medical conditions that can be detected using scan images.

Acknowledgements We are grateful to the Institute of Development, Ageing and Cancer, of Tohoku University for providing access to their Rat Brain Image Database, which greatly helped us with our research and improved the results obtained in this manuscript.

References

1. Kononenko I, Kukar M (1995) Machine learning for medical diagnosis. In: Proceedings of the CADAM
2. Kharrat A, Gasmi K, Messaoud MB, Benamrane N, Abid M (2010) A hybrid approach for automatic classification of brain MRI using genetic algorithm and support vector machine. Leonardo J Sci 17(1):71–82
3. Peng X, Lin P, Zhang T, Wang J (2013) Extreme learning machine-based classification of ADHD using brain structural MRI data. PLoS ONE 8(11):e79476
4. Salvatore C et al (2014) Machine learning on brain MRI data for differential diagnosis of Parkinson's disease and Progressive Supranuclear Palsy. J Neurosci Methods 222:230–237
5. Zacharaki EI, Wang S, Chawla S, Soo Yoo D, Wolf R, Melhem ER, Davatzikos C (2009) Classification of brain tumor type and grade using MRI texture and shape in a machine learning scheme. Magn Reson Med 62(6):1609–1618
6. Zacharaki EI, Kanas VG, Davatzikos C (2011) Investigating machine learning techniques for MRI-based classification of brain neoplasms. Int J Comput Assist Radiol Surg 6(6):821–828
7. Krizhevsky A, Sutskever I, Hinton GE (2012) Imagenet classification with deep convolutional neural networks. In: Advances in neural information processing systems, pp 1097–1105
8. Smith AR (1978) Color gamut transform pairs. ACM Siggraph Comput Graph 12(3):12–19
9. Guyon I (1997) A scaling law for the validation-set training-set size ratio. AT&T Bell Lab 1–11
10. Abadi M et al (2016) TensorFlow: a system for large-scale machine learning. OSDI 16:265–283

Steganalysis of Very Low Embedded JPEG Image in Spatial and Transform Domain Steganographic Scheme Using SVM

Deepa D. Shankar and Prabhat Kumar Upadhyay

Abstract Steganalysis recognizes the manifestation of a hidden message in an artefact. In this paper, the analysis is done statistically, by extracting features that shows a change during an embedding. Machine-learning approach is employed here by using a classifier to identify the stego image and cover image. SVM is used as a classifier and a comparative study is done by using steganographic schemes from spatial plus transform domain. The two steganographic schemes are LSB matching and F5 Six unlike kernel functions, four diverse samplings are used for classification. In this paper, the percentage embedding is kept as low as 10%.

Keywords Steganalysis · LSB matching · F5 · SVM · Kernel · Sampling

1 Introduction

The data in today's world is diverse which comprises of banking transactions, military, hospital records, employee details and so on. Hence, protecting this data is of prime importance since a major data leak can cause a lot of implications. Steganography is considered to be a superior technique because it helps message to remain undetectable so that the hidden message cannot be identified by the user [1]. Steganography which is concerned with "secret writing" uses certain algorithms and procedures to hide information into another medium in order to deny access to unauthorized users [2]. Steganography can work in two scenarios to protect against detecting data and protect against removing data. The embedding can be done in text, audio and video. The ability of identification is known as steganalysis. There are two types of steganographic detectors—targeted and blind. The former has an idea of the steganographic scheme used, whereas the latter does not. Steganalysis procedures generally calculate the features of the images, which are not "normal" in assumed candidate images. If the practice of steganalysis is capable of finding the presence of secret message with

D. D. Shankar (✉)
Abu Dhabi University, Abu Dhabi, UAE

P. K. Upadhyay
Department of Electrical and Electronics, Birla Institute of Technology, Mesra, India

H. S. Saini et al. (eds.), *Innovations in Computer Science and Engineering*,
Lecture Notes in Networks and Systems 103,
https://doi.org/10.1007/978-981-15-2043-3_45

a higher rate of success in comparison with that of random guess, then the related system is said to be broken [3]. In this paper, low embedding of 10% is used with JPEG images. The novel idea behind the research is to consider six different kernels and four type of sampling for feature-based steganalysis. The comparative study of classification is done using LSB matching which is a targeted steganographic scheme, and F5 which is a blind steganographic scheme. The classification is done using SVM.

2 Related Work

The efficacy of steganalysis lies in the classification of stego and cover images. In the initial step of classification, the relevant features are extracted [4]. The embedded data in JPEG images can be modeled with high accuracy with the help of statistical model having an optimum number of discrete cosine transform (DCT) coefficients. The methodology of using transform domain can be incorporated to obtain better result with nominal changes in the cover image [5]. Steganalysis is implemented in spatial domain as well, where the embedding is done directly into the pixel intensity of the image [6]. Among the different steganographic schemes, LSB matching and F5 are considered in this paper. The operation ± 1 is performed to change a bit in case of LSB matching. The addition and subtraction do not influence the hidden message. A learning-dependent LSB matching steganalysis is suggested by Xia et al. [7] with SVM classifiers. Three significant histogram features of the images are used to train the classifier. F5 algorithm makes use of matrix decoding to avoid the statistical attacks. Malathi and Gireeshkumar [8] carried out research to incorporate a large payload with various techniques related to LSB and F5. When statistical steganalysis is being considered, the analysis of features is very important. The analysis has two parts—feature extraction and classification. Liu et al. [9] have done work on different feature sets.

3 Methodology

Previous literature has opened a venue for exploration of machine learning in statistical steganalysis. Hence, the proposed work in the paper would help bridge the gap found in the previous literature. The subsequent sections of this paper will throw light to the methodology and experimental results. As mentioned before, the work is done on JPEG images. This particular format is easy to store and distribute [10]. A small-scale embedding of 10% is considered for analysis. The raw images are transformed and relevant features are mined. These output, thus, received is then served into the SVM. The image segmentation remains through 8×8 blocks, which is followed by feature extraction. The image values are normalized to advance the efficacy of the algorithm. The block diagram of the flow of data is given in Fig. 1.

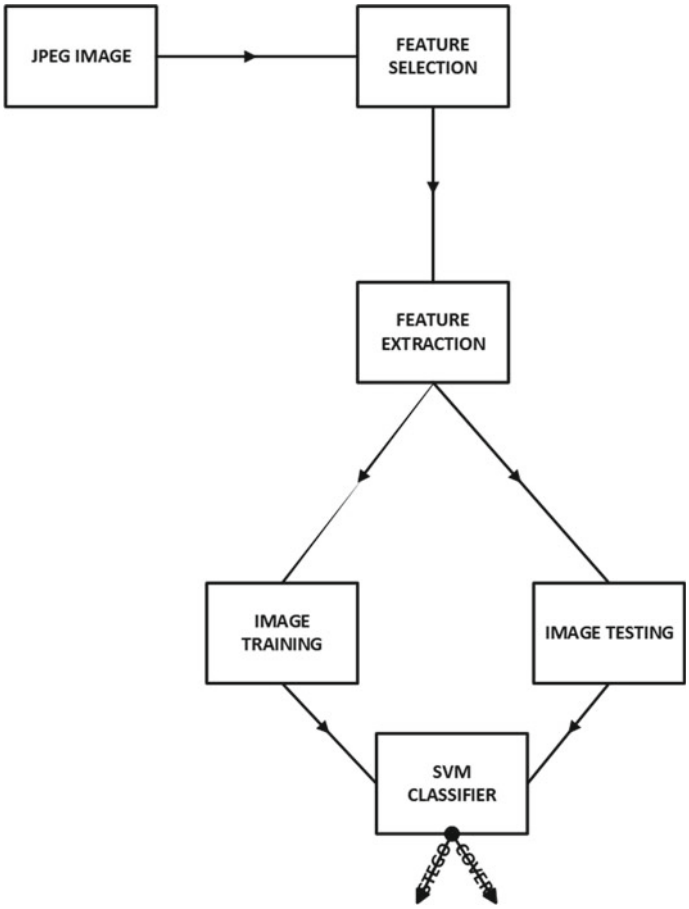


Fig. 1 System architecture of blind steganalysis with SVM

4 Extraction of Features

4.1 Dataset

In this paper, two different databases—INRIA holiday dataset and UCID image dataset—are considered. 1500 images from INRIA dataset are used as training images in this paper. The next set of data used for analysis is uncompressed color image database (UCID). The dataset used in the research contains 800 images which are being converted to JPEG without any compression. After conversion, each image is labeled from 1. The conversion helps to generate a different secret message, by using their label to be the key of a pseudo-random number generator. The image size is

Table 1 Table of extracted features

Type of feature	Method	Total extracted features
First order	Individual histogram	55
	Global histogram	11
	Dual histogram	99
Second order	Variance	01
	Blockiness	02
	Co-occurrence	25
Markovian	–	81
Total extracted features		274

restricted to 256 × 256. INRIA Holidays image dataset is used as training dataset and UCID image dataset is used as test dataset.

4.2 Extraction of Features

The features to be extracted should be selected so that it should not delete any important details pertaining to the image. Hence, a set of features are selected which would add up to 274. The individual histogram is created from DCT modes. The second-order features are inter-block dependent ones [11]. Co-occurrence, blockiness and variance are the second-order features [12]. These calculations are caused by the dissimilarities in the position of coefficients—both row and column. The co-occurrence is calculated through the likelihood distribution of nearby JPEG constants.

Total number of distinct features to be extracted is shown in Table 1.

4.3 Classification

If a machine-learning model has to be designed with a set of data, it needs to be split into training dataset and test dataset. The model is trained through the training set. This would help authenticate the test data [13]. 80% of data is generally taken as training set and the other 20% is used as test data. Classification is the process after the features are extracted. According to the features, the images are classified into different classes.

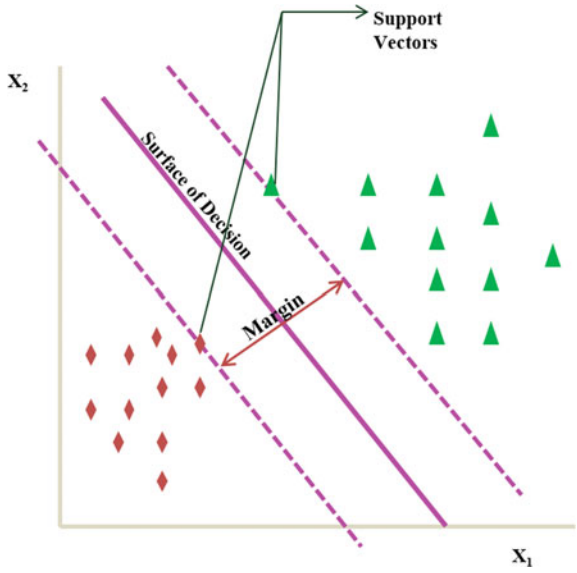


Fig. 2 SVM classification

4.4 SVM Classification

SVM determines a hyperplane of the decision in a space with N-dimensions [14]. The adjoining data points, i.e., data points lying nearest to the decision surface are known as support vectors. The space/distance between the surface of decision and the contiguous data point is referred to as margin. The SVM classifier performs with clarity with respect to the margin of separation, well suited to spaces of high dimensions, memory proficient and can be applied to binary as well as multi classifiers. Many kernels can be opted with these classifiers. Hence, in most literature, the SVM classifier is suggested to be used as one of the best classifiers in steganalysis domain [15, 16] (Fig. 2).

4.5 Kernels

Kernels are used to calculate feature mapping of large dimensions. The paper uses six types of kernels—linear, polynomial, multiquadratic, Epanechnikov, radial and ANOVA. The radial basis function kernel is represented as

$$k(x, y) = \exp\left(-g||x - y||^2\right). \tag{1}$$

where g is the gamma. If g has greater value, it introduces large variance, whilst the lower value makes smoother boundary with minimum variance.

The polynomial kernel function is denoted mathematically by,

$$k(x, y) = (x * y + 1)^p. \tag{2}$$

Here, p is the polynomial degree.
The dot function is described as

$$k(x, y) = x * y. \tag{3}$$

The dot kernel is the multiplication of x and y
The multiquadratic function is

$$K(x, y) = \left(||x - y||^2 + c^2\right)0.5 \tag{4}$$

where c is a constant.

The ANOVA kernel, whose performance is prominent in multidimensional problems, is defined as

$$k(x, y) = \sum_{k=1}^{n} \exp\left(-\sigma\left(x^k - y^k\right)^2\right) \tag{5}$$

where σ can be derived from gamma, g; $g = \frac{1}{2\sigma^2}$.

The parabolic Epanechnikov kernel is expressed as the following equation,

$$k(u) = \frac{3}{4}(1 - u^2) \text{ for } |u| \leq 1. \tag{6}$$

5 Experimental Results

LSB matching in spatial domain and F5 in transform domain are used for a comparison of classification results.

The details in Table 2 are extracted with six kernels and four sampling. Generally, the dot kernel proved to give good results for LSB matching algorithm.

The details in Table 3 are extracted with the same kernels and samples as Table 2. The best results are obtained for stratified and automatic sampling for ANOVA.

6 Conclusion

Statistical steganalysis in JPEG images is employed in this paper. Different features which are fragile to embedding are used for the analysis. First order, extended DCT,

Table 2 LSB matching details with SVM

	Linear	Shuffle	Stratified	Automatic
Dot	14.89	54.73	51.93	51.93
Radial	14.89	24.87	25.3	25.3
Polynomial	14.89	53.69	51.93	51.93
Multiquadratic	14.89	48.62	50	50
Epanechnikov	14.89	25.84	26.19	26.19
ANOVA	14.89	54.65	50.67	50.67

Table 3 F5 details with SVM

	Linear	Shuffle	Stratified	Automatic
Dot	80.34	91.73	92.63	92.63
Radial	14.89	49.07	50.37	50.37
Polynomial	32.54	75.06	75	75
Multiquadratic	14.89	48.62	50	50
Epanechnikov	14.89	49.07	50.37	50.37
ANOVA	66.05	90.39	90.92	90.92

second order and Markov features are employed for analysis. The spatial domain with LSB matching and transform domain with F5 are the steganographic schemes used. SVM is employed to classify the image to be a cover or a stego. The training images used are 1500 images from INRIA holiday dataset and testing images of 800 are taken from UCID image dataset. Six various kernels and four kinds of samplings are employed. The results project the statement that the transform domain gives a better classification rate than a spatial domain. As far as the kernels are concerned, the dot kernel provides a good output with shuffle sampling for LSB matching. The dot kernel contributes the better rate in terms of results with stratified and automatic sampling with F5. Further research can be done with different algorithms on spatial and transform domain and a comparative study can be initiated.

References

1. Kumar BR, Murti PR (2011) Data security and authentication using steganography. Int J Comput Sci Inf Technol 2(4):1453–1456
2. Nagaraj V, Zayaraz G, Vijayalakshmi V (2011) Modulo based image steganography technique against statistical and histogram analysis. Netw Secur Cryptogr 34–39
3. Christaline JA, Ramesh R, Vaishali D (2014) Steganalysis with classifier combinations
4. Guttikonda JB, Sridevi R (2019) A new steganalysis approach with an efficient feature selection and classification algorithms for identifying the stego images. Multimed Tools Appl 1–19
5. Attaby AA, Alsammak AK, Mursi Ahmed MFM (2018) Data hiding inside JPEG images with high resistance to steganalysis using a novel technique: DCT-M3. Ain Shams Eng J 9(4)

6. Kalita M, Tuithung T (2015) A comparative study of steganography algorithms of spatial and transform domain. IJCA Proc Natl Conf Recent Trends Inf Technol 9–14
7. Xia Z, Yang L, Xingming S, Sun D, Ruan Z, Liang W (2011) A learning-based steganalytic method against LSB matching steganography. Radioengineering 20
8. Malathi P, Gireeshkumar T (2016) Relating the embedding efficiency of LSB steganography techniques in spatial and transform domains. Procedia Comput Sci 93:878–885
9. Liu P, Yang C, Liu F, Song X (2015) Improving steganalysis by fusing SVM classifiers for JPEG images. In: International conference on computer science and mechanical automation (CSMA), pp 185–190
10. Bhasin V, Bedi P (2013) Steganalysis for JPEG images using extreme learning machine. In: Proceedings IEEE international conference on systems, man, and cybernetics, SMC, pp 1361–1366
11. Ashu A, Chhikara R (2014) Performance evaluation of first and second order features for steganalysis. Int J Comput Appl 92:17–22
12. Wang L, Xu Y, Du B, Zhai L, Ren Y (2019) A posterior evaluation algorithm of steganalysis accuracy inspired by residual co-occurrence probability. Pattern Recognit 87:106–117
13. Hou X, Zhang T, Wu Y, Ji L (2017) Combating highly imbalanced steganalysis with small training samples using feature selection. J Vis Commun Image Represent 49:243–256
14. Barkana BD, Yildirim B, Saricicek I (2017) Performance analysis of descriptive statistical features in retinal vessel segmentation via fuzzy logic, ANN, SVM, and classifier fusion. Knowl-Based Syst 118:165–176
15. Castelli M, Vanneschi L, Largo ÁR (2019) Supervised learning: classification. In: Encyclopedia of bioinformatics and computational biology. Elsevier, pp 342–349
16. Shankar D, Shukla V (2019) Effect of principal component analysis in feature based uncalibrated steganalysis using block dependency. SSRN online

Stealth Firewall: Invisible Wall for Network Security

Praveen Likhar and Ravi Shankar Yadav

Abstract Firewall is one of the crucial pillars of network security. Conventional network firewalls are IP visible and hence vulnerable to network-based attack. IP visible firewalls are IP reachable by attackers from untrusted external network as well as from trusted internal network. A grave situation would result if an attacker managed to break into the firewall and reconfigure it. In this case, attacker can reconfigure the firewall to allow either some specific network service access or in worst case make entire private network reachable by anyone. The risks are Brobdingnagian, once the firewall is compromised, leads to fall the whole network within the mercy of the attacker. To address the security concern due to IP visibility, we designed a stealth packet filtering firewall leveraging the bridging and Netfilter framework of Linux kernel. This paper describes our approach of stealth firewall to overcome limitations of conventional gateway firewall.

Keywords Network security · Stealth firewall · Packet filtering · Netfilter · Iptables · Ebtables

1 Introduction

With the fast-changing technology, it is an aeonian challenge faced by most of the organization to connect to the outside world and exchanging information without compromising its critical resources. When networks are connected together, the different sides of the connection often exist different levels of trust. Networks expose computers to the problem of transitive trust [1]. Firewall is a frontline defense mechanism of network security [2]. Firewall provides security to the networks against

P. Likhar (✉) · R. Shankar Yadav
Centre for Artificial Intelligence and Robotics (CAIR), Defence Research and Development Organisation (DRDO), Bangalore 560093, India
e-mail: praveen.likhar@cair.drdo.in

R. Shankar Yadav
e-mail: ravi.yadav@cair.drdo.in

H. S. Saini et al. (eds.), *Innovations in Computer Science and Engineering*,
Lecture Notes in Networks and Systems 103,
https://doi.org/10.1007/978-981-15-2043-3_46

attacks and unauthorized access by filtering out unwanted network traffic coming into or going from the network [3]. Firewall demarcates these networks with differing levels of trust and mediates the traffic between networks with policy enforcement.

There are different types of firewall that can be implemented, with the choice of firewall being dependent upon the security policy and the level of deployment in the system. Packet filtering firewall [1] is delineated as one of the eminent firewall systems which work at the transport layer of the OSI model. Packet filtering for network security began with Mogul's paper about screend [4]. The packet filtering firewall acts as a checkpoint between the internal network and the external network, for example, between Intranet and Internet. The packet filtering firewall is generally implemented in gateway or router. In this firewall, each IP datagram that arrives at firewall filtered accordant with specified rules based on the fields of the TCP/IP packet header [1, 5]. In contriving this mechanism, firewall system must have at least two IP addresses. Also, the firewall system should configure as gateway for all the users of internal network. This makes it IP visible from both internal and external networks. The IP visibility in the network makes the packet filtering firewall system susceptible to network-based attacks. Firewall can be compromised in many ways, and quantifying the consequent damage is extremely difficult [6, 7]. One way to defeat a firewall is to target it directly. As packet filtering firewall is IP reachable, an attacker can probe, scan and enumerate all of the network's visible resources to extract useful information. And, this gathered information will be exploited by attacker to launch the network attacks on firewall system and network. Hence, firewall not only needs to protect network but also itself.

One of the approaches to address this security vulnerability due to IP visibility is to conceive packet filtering firewall without IP visibility in the network. This can be achieved if packet filter firewall is implemented without assigning the IP addresses. In our approach, we exploited bridging instead of IP gateway to connect the internal and external networks. The firewall system built as bridge [8] works on the data link layer of the OSI model and hence does not require IP addresses. This firewall is IP invisible in the network and hence considered as stealth firewall. The Linux kernel provides a powerful packet filtering framework called Netfilter [9]. The Netfilter framework provides hook handling for intercepting and manipulating network packets to implement a packet filter firewall system. We devise a firewall exploiting the bridge-nf infrastructure [10] with all packet filtering capabilities of Netfilter. Our approach to firewall has ability to be stealthy along with additional benefits of ease of deployment and better filtering capabilities. Following this introductory section, the rest of this paper is organized as follows: Sect. 2 discusses related work, Sect. 3 details about Linux as firewall platform, Sect. 4 explicates our approach and implementation, Sect. 5 presents experimentation and results and Sect. 6 concludes the paper.

2 Related Work

Firewalls have existed since about 1987, and several approaches have been explored. Kahn et al. in 1997 introduced firewalls in bridge mode and developed firewalls for computers running DOS [7]. Jianbing Liu and Yan Ma in 1999 also explore this approach in their paper [11]. Keromytis and Wright discuss using IPsec on a bridging firewall to set up secure, virtual LANs [12]. Other related works are available in the form of implementation guide for setting up Linux machine as network bridge. However, not much work has been carried out in the area of stealth firewalling.

3 Linux as Firewall Platform

The Linux comprises a powerful Netfilter/ IPtables-based packet filter and gained a reputation as an excellent firewall platform. The Netfilter framework was started in 1998 by Rusty Russell as an improvement over previous instantiations of IP filtering used in older versions of Linux [9]. These include ipfwadm in Linux 2.0 and IPChains in Linux 2.2. Prior to introduction of the Netfilter, the Linux kernel lacked a general packets control framework. The significant constituents of Linux Netfilter hook system are `ip_tables, ip6_tables, arp_tables`, and ebtables kernel modules [13]. For defining a firewall policy, Netfilter framework provides a table-based system, based on which the packet is filtered or transformed. The userspace tools iptables, ip6tables, arptables and ebtables facilitate configuration and administration of these tables. Even though both the kernel modules and userspace utilities have similar names, each of them is a different entity with different functionality.

Netfilter defines five hooks points in kernel's packet processing pathways [13] defined in the kernel header file `/usr/include/linux/netfilter_ipv4.h`. The packets traversing through the IP stack are intercepted by these hooks and pass through packet processing rules. Netfilter organizes these packet processing rules into tables and each of these tables serves a specific purpose. The tables are grouped based on processing function on packets, i.e., nat, mangle, filter, etc. Filter, mangle, nat, raw and security are the five built-in tables of Netfilter framework [5, 9]. While these tables are defined by the packet processing functions, the built-in chains represent the Netfilter hooks which trigger them. Each table has its own set of built-in chains [5, 9]. The traversing of network packet through Netfilter is shown in Fig. 1. Chains basically determine when packet processing rules will be evaluated. These chains are triggered by the associated Netfilter hooks and mirror their names. The Netfilter framework comes with five built-in chains as depicted in Fig. 1 [5, 9]. Netfilter also provides support for load balancing, masquerading, port forwarding, connection tracking, accounting along with mentioned packet processing functions [14]. Netfilter is also extensible with provision to register the custom hooks [13].

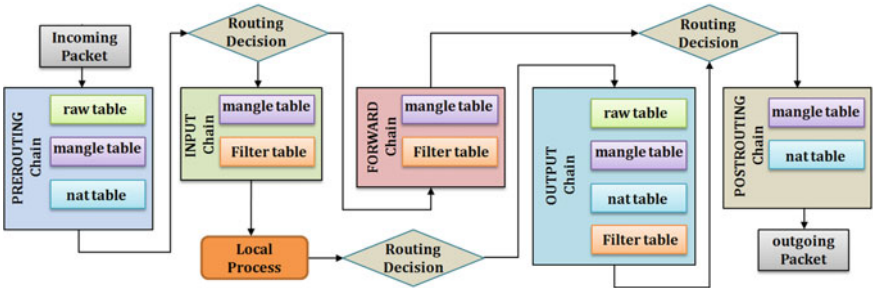


Fig. 1 Network packet traversing through Netfilter

4 Approach and Implementation

A conventional packet filtering firewall acts like a Layer 3 node in a network and inspects the IP traffic between the internal network and the external network. This packet filtering firewall is a routed hop and configured as a default gateway for all internal network hosts. This class of packet filtering firewall is IP visible from both internal and external networks. The first step of any attack is to *know your enemy* [15]. An attacker first probes, scans and enumerates all of the network's visible resources. The IP visibility makes this packet filtering firewall vulnerable to network-based attacks. In addition to this vulnerability, deploying Layer-3 packet filtering firewall in an existing network requires the network reconfiguration, which is time and resource-intensive and also it may lead to several configuration problems [11, 12].

To address this security vulnerability due to IP visibility, the firewall should be designed in such a way that it does not need IP addresses assignment. Our approach to overcome this security vulnerability is to conceive firewall by stepping down a layer, i.e, Layer-2 in the OSI model. We designed our firewall as network bridge device [16, 17] which operates on the Layer-2, forwarding packets based on the MAC address of Layer-2 header and hence does not require IP addresses. This bridge firewall acts like a bump in the wire and is not seen as a router hop to connected devices. As this bridge firewall is IP invisible in the network, hence termed as stealth firewall.

All the major Linux distributions support bridging. Till kernel 2.4, the Netfilter does not have capability to access bridged IPv4 packets. The ebtables-Patch [18] which implements ebtables, a new packet filter specifically designed for ethernet bridges to filter network traffic based on Layer-2 header fields. Ebtables [10] enables transparent filtering of network traffic passing through a Linux bridge. Later on the ebtables, kernel module became a constituent element of the Netfilter framework. Emplacing a Netfilter framework on bridge interface makes bridge an efficacious packet filtering firewall. Compare to iptables, ebtables filtering possibilities are limited to link layer filtering and some basic filtering on higher network layers. To incorporate advanced filtering capabilities based on higher layers in the bridge firewall system, the iptables Linux filtering tool is required [10]. To make the bridge as a powerful packet filtering system with all the capabilities of iptables, we leverage the

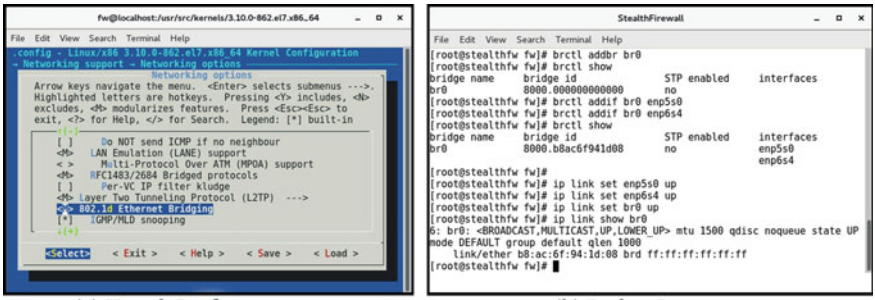


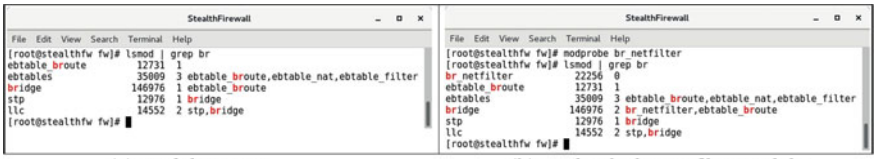
Fig. 2 Enabling bridging support

bridge-nf infrastructure [10]. The bridge-nf infrastructure extends the already built-in bridging functionality of the Linux kernel. The bridge-nf infrastructure makes bridged IPv4 packets go through the iptables chains and enables iptables to approach and access bridged IPv4 packets for filtering. In our stealth firewall implementation, we exploited the bridge-nf infrastructure along with iptables and ebtables to build a packet filtering system possessing all the capabilities of the conventional packet filtering. The bridging firewall is plugged in-line with the network it is protecting.

To build our stealth firewall, we have used CentOS Linux release 7.5.1804 with 3.10.0-862 kernel version. The main processes in implementing our stealth firewall are to set up a network bridge and to enable Netfilter framework for packet filtering. The bridging is supported in the Linux kernel 2.4 and later versions from all the major distributions. Bridging can also be enabled in kernel configuration by setting "Networking support -> Networking options -> 802.1d Ethernet Bridging" to either yes or module (as depicted in Fig. 2a). The bridge-utils [19] package is required to configure the bridge. Modern distributions typically install this package by default.

4.1 Building the Bridge

The bridge configuration is the foundation in order to create an ethernet bridge interface; it is required to add a bridge layer between the IP layer and the ethernet (MAC) layer. To create the bridge use the command brctl addbr br0 as depicted in Fig. 2b. This command creates the bridge br0. Now, those network interfaces, which should become part of the bridge, have to be added to this bridge. Once added to the bridge, these network interfaces become the ports of the bridge, and subsequently, the bridge has to be enabled. It is important to note that the enslaved interfaces of the bridge eth0 and eth1 must not have an IP address! The virtual bridge interface br0 may use an IP address. This is only needed if the machine is to be administered remotely. In our implementation, we have not assigned IP address to the bridge interface to make our firewall stealthy in the real sense, and the information about the created bridge is shown in Fig. 2b.



(a) Module Listing (b) Modprobe br_netfilter module

Fig. 3 Enabling br_netfilter module

4.2 Enablement of Netfilter for Bridge

In bridge mode, only ebtables capability can be used on bridged packets because bridged packets do not pass through iptables chains [10]. To use the iptables capability on bridged packets, these packets should pass through iptables chains, to build this capability `br_netfilter` module needs to be exploited. Latest kernel versions by default do not load the `br_netfilter` module automatically at boot time. As shown in Fig. 3a when lsmod is run on fresh installation of centos-7.5, the `br_netfilter` is not loaded automatically. To load the `br_netfilter` module in to the kernel it is required to run `modprobe br_netfilter` as shown in Fig. 3b. Modprobe command loads the module but will not persist in next boot and require manual loading at every boot. The systemd-modules-load.service daemon facilitates automatic loading of modules at boot time [20]. For automatic loading of `br_netfilter` module, a `br_nf.conf` file has to be created in the `/etc/modules-load.d/` directory with the name of module as content of file, i.e., `"br_netfilter"`.

Once the bridge has been configured, Netfilter is enabled and `br_netfilter` module loaded to kernel the system is ready to operate as a stealth firewall. Just like Layer-3 packet filtering firewall, this stealth firewall can use iptables rule set to implement filtering policy. This stealth firewall can also filter Layer-2 traffic using ebtables, which is an additional capability when compared to conventional gateway firewall.

5 Experimentation and Result

We carried out the experiments to measure the throughput and latency in gateway (no filtering), gateway firewall and stealth firewall modes. The experimentation apparatus is composed of SPT-2000A Spirent TestCenter and a host machine with an Intel i7 CPU cadenced at 2.93 GHZ with 8 GB of RAM and two-gigabit ethernet adapters. The experiment setups are shown in Fig. 4.

In gateway mode (no filtering), the host is configured to just forward the IP traffic. In gateway firewall mode, the host is configured to filter IP traffic based on protocol,

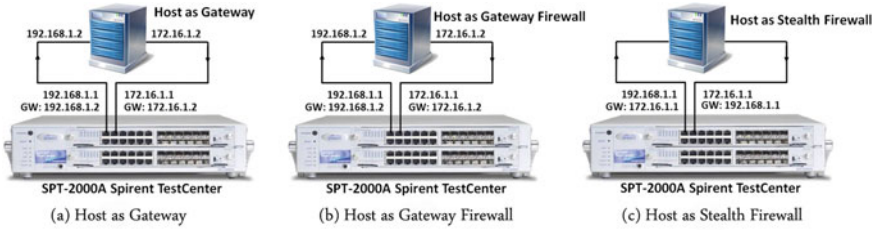


Fig. 4 Experiment setup

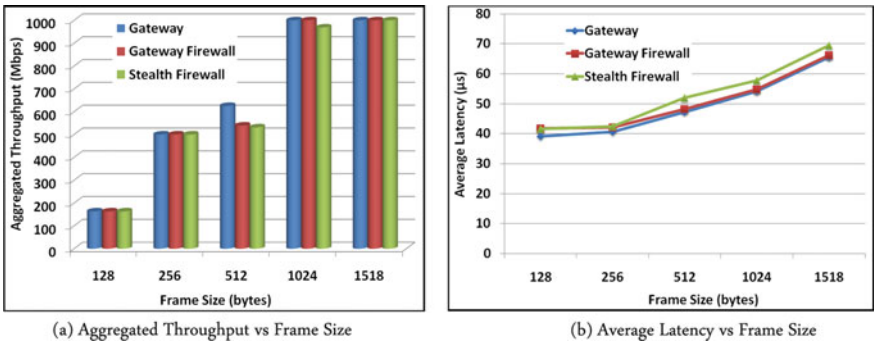


Fig. 5 Experiment results: throughput and latency

source IP, source port, destination IP and destination port. In stealth firewall mode, the host is configured as bridge and the same filtering rules are configured for this mode.

The throughput and latency are measured for different frame sizes varying from 128 to 1518 bytes as per the standards mentioned in RFC 2544 [21] and RFC 2679 [22]. The experimentation results are depicted in Fig. 5. The aggregated throughput for stealth firewall mode is slightly less and average latency is marginally more as compared to gateway mode (no filtering) but they are almost same as conventional gateway firewall mode.

6 Conclusion

In network security, firewall has become central fixtures and is relied upon to enforce the entire security policy for that network. Firewall is the first line of defense, deployed along with complementary network security solutions to protect the network. Firewall becomes the foundation for enterprise network security by constituting a strong perimeter defense between trusted and untrusted networks. One way to defeat a firewall is to target it directly. The conventional Layer-3 packet filtering firewall usually implemented as gateway or router and has IP addresses. This IP visibility

characteristic of conventional packet filter firewall makes them vulnerable to network attacks. To overcome this vulnerability, we explicate an approach to conceive a firewall by stepping down a layer, i.e, Layer-2 in the OSI model. This approach makes firewall stealthy by making it invisible from both internal and external networks. This stealth firewall does not need its own IP address and hence immune to any attack which makes use of IP. In implementing the stealth firewall, we leveraged the Netfilter framework, bridging, iptables and ebtables capabilities of Linux. The combination of iptables and ebtables makes this stealth firewall a powerful filtering system. This firewall is having all the capabilities of conventional Layer-3 Linux packet filtering firewall with additional capability of filtering traffic at Layer-2. The stealthy firewall also has advantage of seamless deployment into any existing network and alleviates the network administrator of the pain of network redesign and IP configuration changes. The stealthiness, zero network changes and rapid deployment make stealth firewall worthful alternatives to conventional Layer-3 Linux packet filtering firewalls.

References

1. Cheswick WR, Bellovin S, Rubin A (2003) Firewalls and internet security, 2nd edn. Addison-Wesley
2. Ranum MJ (1992) A network firewall. In: World conference on system administration and security, Washington. DC, pp 153–163
3. Chapman D, Zwicky E, Cooper S (2000) Building internet firewalls, 2nd edn. O'Reilly
4. Mogul J, Rashid R, Accetta M (1987) The packet filter: an efficient mechanism for user-level network code. In: Eleventh ACM symposium on operating systems principles, pp 39–51
5. Andreasson O (2006) IPtables tutorial 1.2.2
6. Chen S, Iyer R, Whisnant K (2002) Evaluating the security threat of firewall data corruption caused by instruction transient errors. In: International conference on dependable systems & network, Washington, DC, pp 495–504. 10.1109/DSN.2002.1028938
7. Ingham K, Forrest S (2002) A history and survey of network firewalls. ACM J 1–42
8. Benvenuti C (2009) Understanding linux network internals. O'Reilly Media
9. Russell R, Welte H (2002) Linux Netfilter Hacking HOWTO. Revesion 1:14
10. Ebtables and bridge. http://ebtables.netfilter.org. Last accessed 21 Apr 2019
11. Jianbing L, Yan M (1999) Packet filtering in bridge. In: Internet workshop. IEEE-communications society, Piscataway, NJ, pp 94–98
12. Keromytis AD, Wright JL (2000) Transparent network security policy enforcement. In: USENIX technical conference, San Diego, CA, pp 215–226
13. Rosen R (2013) Linux Kernel networking: implementation and theory. Apress
14. Gregor NP (2004) Linux Iptables pocket reference. O'Reilly Media
15. Tzu S (2019) The art of war. http://www.ccs.neu.edu/home/thigpen/html/art_of_war.html. Last accessed 21 Apr 2019
16. Ethernet Bridging. https://www.kernel.org/doc/html/latest/networking/bridge.html. Last accessed 21 Apr 2019
17. 802.1D MAC bridges IEEE standard. http://www.ieee802.org/1/pages/802.1D.html. Last accessed 21 Apr 2019
18. Ebtables patch download. ftp://ftp.netfilter.org/pub/ebtables/old/ebtables-brnf-13_vs_2.4.37.9.diff.gz. Last accessed 21 Apr 2019

19. Bridge-utils-1.6. http://www.linuxfromscratch.org/blfs/view/svn/basicnet/bridge-utils.html.Last accessed 21 Apr 2019
20. RHEL 7, Kernel Administration Guide. https://access.redhat.com/documentation/en-us/red_hat_enterprise_linux/7/html/kernel_administration_guide/index, 2018. Last accessed 21 Apr 2019
21. Bradner S, McQuaid J (2005) Benchmarking methodology for network interconnect devices. In: RFC 2544
22. Almes G, Kalidindi S, Zekauskas M (1999) A one-way delay metric for IPPM. In: RFC 2679

Approaches for Efficient Query Optimization Using Semantic Web Technologies

Rambabu Mukkamala and V. Purna Chandra Rao

Abstract Query optimization system proposes an answer-driven approach to information access. Most of the query optimization system aims for information retrieval required by natural language queries. Queries are generally asked within a context, and answers are provided within that specific context. RDF is a general proposition language for the Web, joining data from diverse resources. SPARQL, a query language for RDF, can join data from different databanks, as well as papers, inference engines, or anything else that may reveal its expertise as a guided classified chart. Because of lack of proper architectural circulation, the existing SPARQL-to-SQL translation techniques have actually trimmed a lot of restrictions that decrease their toughness, effectiveness, and reliability. These constraints include the generation of ineffective or perhaps incorrect SQL inquiries, lack of official history, and bad applications. This paper recommended a structure which made use of by an ontology-based moderator system to provide the well-defined semantical design, which (i) supplies a distinct SPARQL semantics used to rewrite the question in SQL; (ii) ontology-based expertise is created for rapid accessibility as well as equate question revising SPARQL to SQL for reliable information retrieval in semantic Internet data of big dataset; (iii) hybrid query optimization framework is proposed for query handling technique for the effective access of customized details on the semantic Internet making use of bundled ontology expertise and also inference engine.

Keywords Query optimization system · RDF · SPARQL · Hybrid · Ontology · Query processing

1 Introduction

The rise of the semantic Internet has awakened a few entrances among RDF and normal social stores. Structures like superstar, D2RQ, and squirreled revamp SPARQL

R. Mukkamala (✉)
Research Scholar, Dravidian University, Asst. Professor, NICMAR, Hyderabad, India

V. Purna Chandra Rao
Professor, MLRIT, Hyderabad, India

H. S. Saini et al. (eds.), *Innovations in Computer Science and Engineering*,
Lecture Notes in Networks and Systems 103,
https://doi.org/10.1007/978-981-15-2043-3_47

questions to SQL. Oracle's and the MySQL SPASQL module order SPARQL concerns especially right into an assessment framework to be executed by the social electric motor. Including regional SPARQL assistance to the database permits an equivalent execution from quite custom fitted SQL inquiries.

i. **Data integration of large data**:

Organizations of all types have information scattered around in a variety of media, varying from level data as well as email archives to relational as well as object-oriented databases to spatial and also text systems. As numerous markets experience durations of debt consolidation, the companies in those markets locate themselves bought by, merged with, or acquiring various other organization, which just magnifies the issue of dispersed data.

ii. **Semantic Web**:

Among the most worrying problems in working with information from dissimilar resources, regardless of whether they are all SQL data sources oversaw by DBMSs from the same implementer, is finding strategies to collaborate details in one data source to information having a comparable semantics in another data source.

SPARQL is an RDF language to query, that is, a query language for RDF databases, which is able to fetch and manipulate data kept in source description structure layout such as getting nodes from RDF charts. Given that the entire database is a set of 'subject-predicate-object' triples, SPARQL permits users to compose queries against information that complies with the RDF specs of the W3C.

iii. **Query rewriting techniques**:

A query is rewritten just when a certain variety of problems are satisfied:

- Session-based query answering needs to be enabled.
- An appeared sight needs to be enabled for inquiry rewrite.
- The revise dependency degree needs to allow the usage of the emerged sight. For instance, if an appeared view is not fresh and also query reword honesty is readied to implement; after that, the appeared view is not utilized.
- Either all or part of the outcomes requested by the query must be available from the recomputed outcome kept in the materialized view or sights.
- Query rewrite must be enabled for the session.
- A materialized view must be enabled for query rewrite.
- The rewrite integrity level should allow the use of the materialized view. For example, if a materialized view is not fresh and query rewrite integrity is set to enforce, then the materialized view is not used.
- Either all or part of the results requested by the query must be obtainable from the recomputed result stored in the materialized view or views.

2 Related Works

In the study of semantic Web intends to develop an usual framework that enables information to be shared and also reused across applications, enterprises, and also community borders [1]. It recommends to use RDF as an adaptable data design as well as usage ontology to represent information semiotics. Currently, relational versions and also XML tree versions are extensively used to represent structured as well as semi-structured information. But they offer limited means to catch the semantics of information. An XML schema defines a syntax-valid XML document and has no formal semantics, and an ER version can capture data semantics well, but it is tough for end users to use them when the ER design is transformed into a physical database design on which customer inquiries are assessed.

Bensilimane et al. [2] supported the compositional semantics of SPARQL which has some submissions with respect to the last SPARQL release [3]. In the context of optional chart patterns, the major benefit of the compositional semantics is that it permits easier SPARQL-to-SQL translation for optional patterns and makes it possible for much better optimization.

In the study of Bikakis et al. [4], quizzing and also thinking over RDF streams are two increasingly relevant locations in the wider extent of handling structured data online. While RDF Stream Processing (RSP) has focused up until now on expanding SPARQL for continuous inquiry as well as event processing, stream thinking has actually focused on ontology development as well as incremental materialization. In this paper, we suggest a different strategy for inquiring RDF streams.

Rozeva et al. [5–9] have actually studied on Web mining-based sagacious Internet seek device. At present, the global Internet has made to a distributed data room with essentially 100 million workstations and also varied billion Web pages, which shares the problems for individuals venturing to find essential data among the goliath level of information available. The web look is an unprecedented level of a critical mechanical celebration for people to find data on the Web, yet low-accuracy as well as low-review victories typically in existing Internet appearance devices.

In the paper of Harmelen et al. [10], they offer a unique information access method that makes use of expertise defined by the semantic Internet ontology and regulation languages OWL and SWRL. We examine our method making use of an autism ontology that has 156 SWRL regulations defining 145 autism phenotypes. Our method makes use of a vector area model to correlate just how well these phenotypes associate with the publications utilized to define them.

In the paper of Calvanese et al. [11], different systems and also search engines are available for simple access and also access of appropriate multimedia content. Most of them depend on textual information connected with the visual contents. So this paper provides a technique that will certainly create the search engine result by taking into consideration the details of the pictures on Web sites.

In the paper of Rongxio and also Chebotko et al. [12], question rewriting and also semantic matching are two crucial strategies to bridge the semantic void between them to enhance significance. Lately, deep neural networks have actually been efficiently applied to the two tasks and also improved the significance performance.

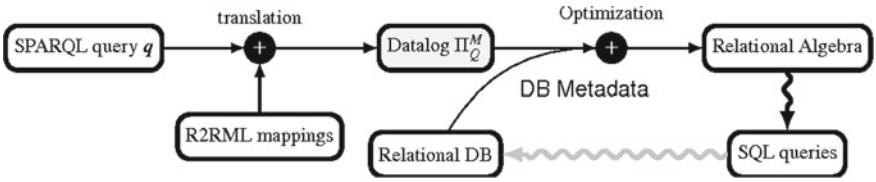


Fig. 1 SPARQL translation techniques

Nevertheless, such approaches deal with the sparseness of training information in E-commerce situation.

3 Proposed Methods

This research work proposes various efficient approaches for query optimization and translation of SPARQL to relational SQL queries.

The proposed work is implemented in different phases.

1. ***Mapping Between the RDF and Relational Models***

The power of SPARQL to perform data integration tasks by carrying out single inquiries that extend multiple data sources does not require that information be kept natively as RDF. Rather, there need to only be some collection of policies that describe exactly how information living according to a legacy relational schema can be designed as an RDF chart. We refer to such a collection of regulations as a mapping. In this research, we will certainly carry out mapping of RDF and SPARQL-to-SQL allows communication in between SQL engine as well as without non SQL engine for inquiry access techniques which is discussed in Fig. 1.

4 SQL Query Rewriting Algorithms

Comparable to various other strategies adhered to in the past, we use graph pattern rewriting in order to convert SPARQL queries, and then, we extended this strategy for dealing with information adjustment. In particular, we made use of the positioning between triples frameworks over to revise a question in order to have the ability to run it on various information collections (named as target datasets) that employ various ontology possessions [13].

i. **Graph Pattern Rewriting Algorithm**

The graph pattern rephrasing process is utilized for changing the RDF graph within a SPARQL query in order to run the very same question over different information collections. During the rewriting process, the formula matches the head of a revising guideline and also rewords its body taking into consideration the eventual variables

binding as well as functional dependencies connected to the policy. In order to revise a SPARQL question, according to an ontology alignment, the required formulas are required to be done.

Algorithm: BGP Query Rewriting

```
1.  function rewrite(align,bgp)
2.  for all t ∈ bgp do
3.  match ← align.match(t)
        a.  match 6= null then
4.  for all triple ∈ match.getRHS() do
5.  target ← instFunction(triple,match,align)
6.  target ← instPattern(triple,match)
7.  result ← result ∪ target
8.  end for
9.  else
10. result = result ∪ t
11. end if
12. end for
13. return
    result
14. end
    function
```

Algorithm-2: Functional Dependencies between Variables

```
 1: function instFunction(triple,match,a)
 2: binding ← match.getBinding()
 3: vars← {v ∈triple ∧v ∈Vars} .retrieve all the variables in a
    triple
 4: for all var∈vars do
 5: fd← match.getFD(var). retrieve the functional dependency for
    the variable
 6: param ← ∅
 7:         if fd6= null then
 8:         for all param∈fd.getParameters() do
 9:                 if param ∈ Vars ∧ binding[param] ≠ ∅
    then
10:     value ← binding[param]
11:                 else
12:                     value ← param
13:                 end if
14:             end for
15:     result ← fd.getFunc().exec(params)
16:     binding[var] = result                    . binding is modified
17:         end if
18:     end for
19:     return triple
20: end function
```

ii. **Ontology-based query optimization**:

The system will identify the different patterns of queries based on the user given query. The listed queries and its answers are stored in database for future reference.

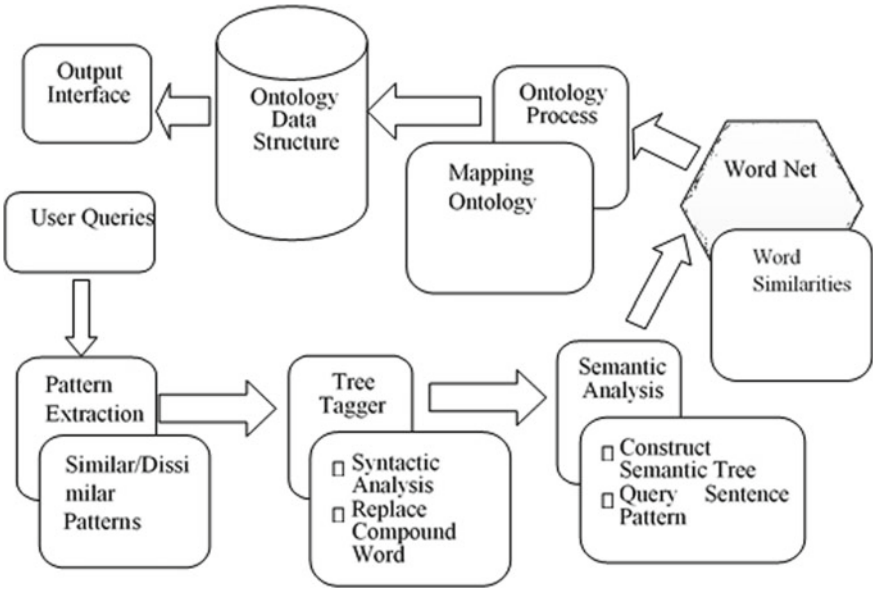


Fig. 2 Proposed system design using ontologies

If another user inputs the same query in different type, the proposed system identifies the query as well as the answer from the database depicted in Fig. 2.

(a) ***Query Pattern***

According to the levels of queries proposed by various authors definition levels of queries are considered as the major work for answer extraction.

(b) **Identification of Query Patterns**

The query patterns are generated for all the type of queries by a parser. The parser gives the result of noun and verb term of a query which is the essential source for finding the answers to the queries given in Table 1. Table 2 describes the lexical constraint of the sample queries.

(c) **Ontology Construction**

Sample ontology is constructed to implement the query optimization on a data structure domain. A collection of dataset queries are considered to experiment the process using Protégé 4.0 tool. The above ontology file is considered for the query optimization system. The process checks each node for extracting the exact answers.

(d) **Answer Extraction**

Each node represented in the classes and attributes in the ontology may contain the concept word or instance word. The answers are extracted from the ontology, if there exists an element that matches with the concept word of the node and the

Table 1 Output of the parser

Query	Query parser output							
	VV	NN	VBZ	WN	IN	DT	JJ	WP
What is meant by Queue?		Queue	Is	Meant	By			What
Define Stack?	Define	Stack						
Give the definition of stack?	Give	Stack, Definition			Of	The		
State queue?	State	Queue						
What is the biggest city of USA?		City, USA	Is		of	The	Biggest	What

Table 2 Identification of query patterns

Lexical constraint	Answer type
What (wp)	{head of NN}
Define (vv)	{head of NN}
Give (vv)	{head of NN}

instance word of the node. The instance or concept word gives the results for the query phrases. The phrases are also matched if the nodes contain the synonyms of the query phrases. If the result could not be matched, the proposed model provides an empty result.

III. ***Hybrid query optimization framework***:

The proposed '**Hybrid Query Processing (HQP) Framework**' functions in three phases as shown in Fig. 3. In the first phase, it performs the **Domain Ontology Construction (DOC),** and in the second phase, it implements **Hybrid Classification Approach (HCA)** using proposed enhanced Naïve Bayes algorithm. Finally, in the last phase, a reasoner or an inference engine is attached to schedule the query optimization activities based on the domain knowledge.

i. **Domain Ontology Construction**

This section of the work demonstrates a conceptual model for constructing domain ontologies using Web services.

A. ***Service Information Extraction***

To construct organized service ontology, we need to know service knowledgebase. It detects the required subject and topic information to build a knowledge structure. HCA collects few known Web services, documents, and extracts the available metadata information. The obtained metadata undergoes a preprocessing to remove the generic and non-relevant terms to generate service-related terms (SRTs). These

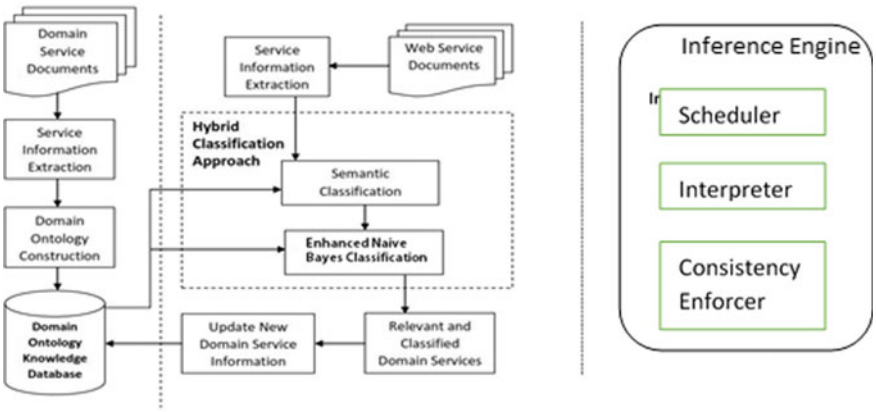


Fig. 3 Proposed hybrid query processing (HQP) framework

terms refer two or more domain service subjects which are similar to each other in an ontology hierarchy.

B. ***Domain Ontology Model***

Domain ontology model is constructed by using the SRTs generated from the Web service documents. Initially, Service Top Edge Terms (STETs) to be identified. STETs are the main subjects of the ontology under which Service Apply Terms (SATs) are linked in top-down model. The model maps SATs and SRTs to build ontology model and will be used as a knowledgebase to classify the domain services.

Mapped terms which are common in between ontology and Web services are shown in Fig. 4.

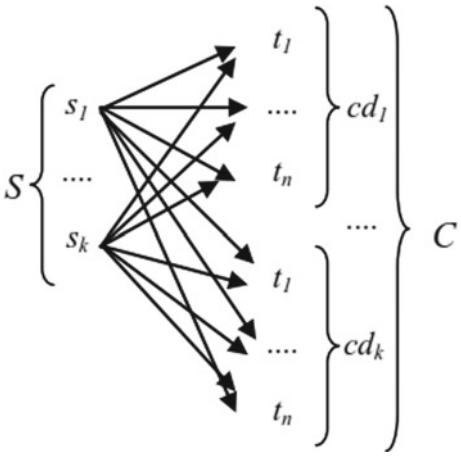


Fig. 4 Matching ontology and web services for classification

Here, '*S*' represents the defines ontology service, '*t*' represents terms in Web service documents, '*cd*' represents the initial classified label, and '*C*' represents the final classified label for the Web service document.

C. **Inference Engine**

Inference engine is a 'computer program that tries to derive answers from a knowledgebase and automates the predefined functionalities in a structured manner.'

5 Experimental Results

The examination dataset is a synthesized dataset which has been made by the collection of Web documents collected from various famous domains like food, education and learning, information and also health care from Open Directory site Job (http://www.dmoz.org/). Next, a total amount of 10 queries from 4 domains of the experimental data were fed right into the semantic-based to execute semantic query expansion as given in Table 4. The searching is executed with the semantic query as well as the semantic material. The outcomes are compared to the keyword-based to evaluate the distinction in between them.

Initially, a simple SPARQL query is expressed by using a form resembling a standard query language (SQL) SELECT statement applied on collected Web pages.

SELECT B FROM u WHERE P

where 'u' is the URL of an RDF graph G to be queried, whereas 'P' is a SPARQL graph pattern (i.e., a pattern constructed over RDF graphs with variables), and 'B' is a tuple of variables that appear in 'P' [14]. The SPARQL-to-SQL translation is represented in Fig. 5.

PREFIX books: http://example.org/books#
PREFIX rdf: http://www.w3.org/1999/02/22-rdf-syntax-ns#
SELECT? essay, ?author, ?authorName, ?translator
FROM http://example.org/books
WHERE (?essaybooks:author ?author), (?author books:authorName ?author-Name)
OPTIONAL (?essaybooks:translator ?translator)

The similar query conversion is explained with the help of RKB explorer as shown in Fig. 5.

Semantic similarities between different queries have been computed as shown in Table 3 and Fig. 6.

The precision and recall scores are considered for the accuracy of the methods using F-measure. The average of all precision of the keyword-based optimization is 0.49, and the mean of the proposed system is 0.87 as shown in Fig. 7 (Table 4).

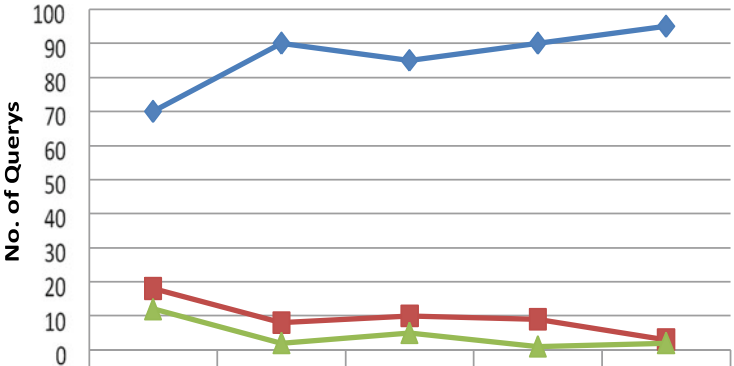
The above computed values are represented graphically as shown in Fig. 8.

Fig. 5 SPARQL-to-SQL query translation RKB explorer

Table 3 Semantic similarity calculations of different queries

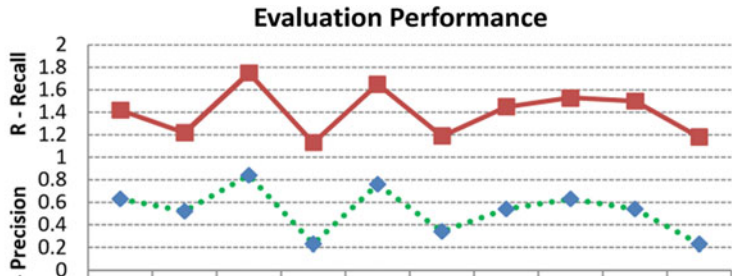
Dataset	Queries/answers	Semantic similarity
Q1 A1	What is the biggest city in USA? Atlanta is the biggest city in USA by area	0.42
Q1 A2	What is the biggest city in USA? Chicago is the biggest city in USA by area	0.44
Q1 A3	What is the biggest city in USA? New York is the biggest city in USA	1.0
Q1 A4	What is the biggest city in USA? The biggest population in USA is New York	0.57
Q1 A5	What is the biggest city in USA? Los Angles is the biggest city in USA by population	0.34

The computed *F*-measure values from Table 5 are shown graphically in Fig. 9.



	User1	User2	User3	User4	User5
Correct Answer	70	90	85	90	95
Incorrect Answer	18	8	10	9	3
No Response	12	2	5	1	2

Fig. 6 Query similarity compositions



	P	R	P	R	P	R	P	R	P	R
	Dataset 1		Dataset 2		Dataset 3		Dataset 4		Dataset 5	
Ontology based answering	0.79	0.7	0.91	0.9	0.89	0.85	0.909	0.9	0.96	0.95
Keyword based answering	0.63	0.52	0.84	0.23	0.76	0.34	0.54	0.63	0.54	0.23

Fig. 7 Performance evaluation of the proposed approaches

6 Conclusion

The language picked for the inquiry is SPARQL, and the rewriting phase impacts the RDF graph pattern that is the almost all of a question interpretation. Extra challenging study scenario would certainly be the one that examines just how to conquer

Table 4 Precision and recall values of the proposed approaches

Queries	Knowledge-based		Semantic-based	
	Precision	Recall	Precision	Recall
1	1	0.5	0.93	0.6
2	0.33	0.5	0.83	0.75
3	0.48	0.67	1	0.75
4	0.5	0.58	0.87	0.67
5	0.37	0.63	1	0.63
6	0.27	0.5	1	0.67
7	0.44	0.63	0.92	0.67
8	0.44	0.67	1	0.67
9	0.44	0.63	1	0.5
10	0.23	0.6	1	0.63

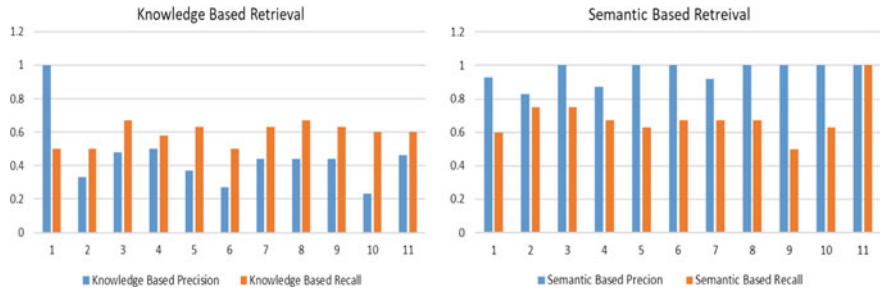


Fig. 8 Precision and recall performance of knowledge- and ontology-based approaches

Table 5 *F*-Measure values of proposed approaches

Queries	Knowledge-based	Semantic-based
	F-Measure	F-Measure
1	0.67	0.73
2	0.40	0.79
3	0.56	0.86
4	0.54	0.76
5	0.47	0.77
6	0.35	0.80
7	0.52	0.78
8	0.53	0.80
9	0.52	0.67
10	0.33	0.77

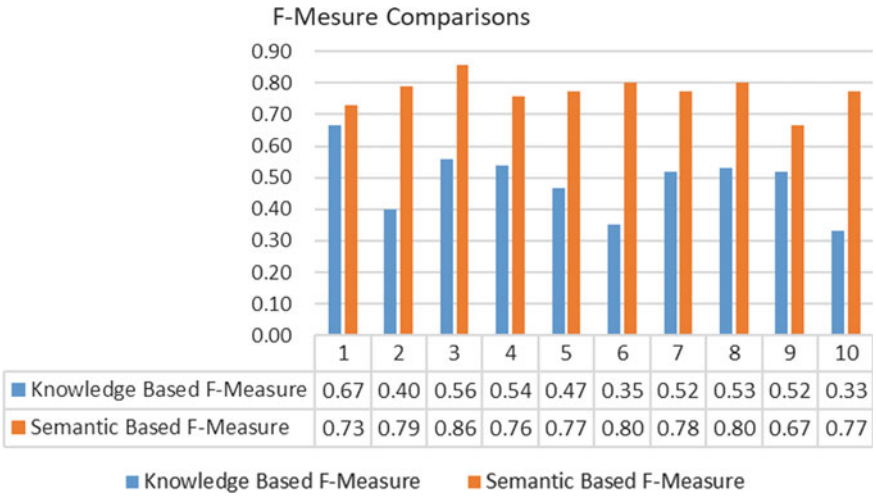


Fig. 9 F-Measure computations of the proposed approaches

the architectural disputes in between information sets. In fact, SPARQL as a basic language for inquiring RDF information is still under support for this purpose, concentrating a lot more on how to choose and recreate RDF charts than manipulating non-URI information. The proposed ontology-based approaches enable e-learning users to supply changes to the inquiry optimization system. This ingenious strategy identifies the different patterns of the inquiries that have actually attained a time efficiency of 0.87% which is significantly better compared to the comparable kind of inquiry patterns. This suggested work is concentrated to work on any kind of domain detail ontology that can be included for improvement of e-learning applications. To attain far better precision, the semantic similarity measure is utilized. The future researches focus on domain name-associated questions for boosting the study.

References

1. Akahani J, Hiramatsu K, Satoh T (2003) Approximate query reformulation for multiple ontologies in the semantic web. NTT Tech Rev 1(2):83–87
2. Benslimane SM, Merazi A, Malki M, Bensaber DA (2008) Ontology mapping for querying heterogeneous information sources. INFOCOMP (J Comput Sci)
3. Imprialou M, Stoilos G, Grau BC (2012) Benchmarking ontology-based query rewriting systems. In: Twenty-sixth AAAI conference artificial intelligence, pp 779–785
4. Bikakis N, Gioldasis N, Tsinaraki C, Christodoulakis S (2009) Querying XML data with SPARQL. In: Proceedings of the 20th international conference on database and expert systems applications, pp 372–381
5. Cyganiak R (2005) A relational algebra for SPARQL. Technical Report http://www.hpl.hp.com/techreports/2005/HPL-2005-170.html, HP Laboratories Bristol; Calvanese D, De Giacomo G, Lenzerini M, Vardi MY (2000) What is query rewriting?

6. Chandrasekaran B, Josephson JR, Benjamins VR (1999)What are ontologies, and why do we need them ?
7. Khattak M, Batool R, Pervez Z, Khan AM, Lee S (2013) Ontology evolution and challenges. J Inf Sci Eng 29(5):851–871
8. Belhajjame K, Embury SM, Paton NW (2014) Verification of semantic web service annotations using ontology-based partitioning. IEEE Trans Serv Comput 7(3):515–528
9. Rozeva A (2012) Classification of text documents supervised by domain ontologies. Appl Technol Innov 8(3):1–12
10. Bouquet P, Giunchiglia F, van Harmelen F, Serafini L, Stuckenschmidt H (2003) C-OWL: contextualizing ontologies. The SemanticWeb—ISWC 2003:164–179
11. Calvanese D, De Giacomo G, Lenzerini M, Vardi MY (2000) What is query rewriting? In: Proceedings of the 7th international workshop on knowledge representation meets databases, pp 17–27
12. Chebotko A, Lu S, Jamil HM, Fotouhi F (2007) Semantics preserving SPARQL-to-SQL query translation for optional graph patterns. Technical report, Wayne State University, Department of Computer Science
13. Gruber BT (1993) What is an ontology ?, pp 1–11
14. Chen H (2005) Rewriting queries using view for RDF/RDFS-based relational data integration. Distrib Comput Internet Technol 3816:243–254

A Novel Hypergraph-Based Leader Election Algorithm for Distributed Systems

E. R. S. Subramanian, B. Sri Gurubaran, A. S. Sayee Shruthi, V. Aishwarya, N. Balaji and A. Umamakeswari

Abstract In distributed networks, a single process is selected as the coordinator for each task to be performed. This coordinator process acts as the leader and synchronizes all the processes to execute a particular task. Hence, the leader is first elected before initiating the execution of the task. Two standard algorithms used for leader election are bully and ring election algorithms. But both these algorithms have their respective pitfalls. This paper focuses on combining these two algorithms with the help of hypergraphs to overcome these drawbacks. Initially, the two algorithms are discussed in detail, and their drawbacks are discussed. Further, the concept of hypergraphs is discussed to understand how the two algorithms can be combined, thus introducing a more efficient leader election algorithm.

Keywords Distributed systems · Fault-intolerant · Leader election · Hypergraphs

1 Introduction

Distributed systems have inhibited a crucial part in today's computing world. It is not economically feasible to store every single piece of information that every system in the network might use in the future. Thus, the information is distributed across different systems in the network and accessed accordingly. A system initially checks its local file system for the information required, and if not available, retrieves the information from other systems. The information is accessed in such a way that multiple systems do not access the same resource simultaneously, which otherwise might lead to data inconsistency. But such sophisticated resource management is not possible on their own. And that is why leaders are elected to manage the resources in a distributed system. Before the actual resource is accessed, a leader is elected to organize the task execution. A layman might remark that the user himself can

E. R. S. Subramanian (✉) · B. Sri Gurubaran · A. S. Sayee Shruthi · V. Aishwarya · A. Umamakeswari
CSE, SOC, SASTRA University, Thanjavur 613401, India

N. Balaji
SOCE, University of Missouri-Kansas City, Kansas City, MO 64110, USA

H. S. Saini et al. (eds.), *Innovations in Computer Science and Engineering*,
Lecture Notes in Networks and Systems 103,
https://doi.org/10.1007/978-981-15-2043-3_48

select the leader before to execution. Initially, a process can be selected by the user as the leader to coordinate resource access. But whenever the selected leader crashes or departs the system, it is not possible to continually request the user to elect a new leader. It is not possible to predict when the crash happens beforehand, either. Existing algorithms for leader election are highly fault-intolerant, thereby bringing down network efficiency [1]. Hence, we need an efficient leader election algorithm to maintain smooth processing in distributed systems. In this paper, a hypergraph-based leader election algorithm for distributed systems is proposed that is designed by combining the ideas of the famous bully and ring leader election algorithms with the help of hypergraphs. For better understanding, the two famous algorithms for leader election and the concept of hypergraphs are initially discussed in the sections below. The proposed algorithm is then discussed in detail in the later sections.

2 Related Works

Design and analysis of a leader election algorithm for mobile ad hoc networks [2] proposed an adaptive leader election algorithm with the aim of handling the frequent topology changes in mobile ad hoc networks. The algorithm deployed diffusing computations to find an extremum. The algorithm was analyzed and simulated in a mobile ad hoc setting. With the help of the simulation, the algorithm was proven to be effective in a variety of operating conditions.

An asynchronous leader election algorithm for dynamic networks [3] proposed a leader election algorithm to handle the problems caused by dynamic topological changes in an asynchronous environment. The proposed algorithm is framed by combining ideas from the temporally ordered routing algorithm (TORA) with a wave algorithm. It is also proved that in certain situations, leaders are not elected unnecessarily.

A self-stabilizing leader election algorithm in highly dynamic ad hoc mobile networks [4] proposed a self-stabilizing leader election algorithm by introducing a time interval-based concept so that multiple concurrent topological changes can be handled efficiently. The algorithm is simulated and thus ensuring that each node in the network has a leader over 99 percent of the time.

An efficient algorithm for leader election in synchronous distributed systems [5] indicated the problems with the classic bully algorithm for leader election developed by H. Garcia-Molina in the year 1982. The paper also makes changes to the bully algorithm by introducing a failure detector instead of relying on explicit time-outs as used in the original bully algorithm. This algorithm is shown to be more efficient than the classic bully algorithm in terms of processing time.

A leader election algorithm in a distributed computing system [6] proposed a leader election framework based on the operation and the performance of the nodes in the distributed network. The paper also discusses the pre-election algorithm to elect a provisional leader, while the actual leader is performing some execution.

3 Existing Algorithms

3.1 Bully Algorithm

Whenever a process detects the failure of the coordinator, it checks:

(i) If the process knows that its id is the highest, it elects itself to be the coordinator and broadcasts the coordinator message to all other processes
(ii) Else the process starts an election
(iii) All the other processes with a higher id are sent a claim message, and a timer is started

   a. If it receives no stop message until the timeout, then it wins the elections, and a coordinator message is sent to all the other processes
   b. If it receives a stop message with higher Id, then it stops sending messages, thereby giving up the election and waits for the coordinator message

(iv) Whenever a process receives a claim message from a process of lower id,

   a. It sends back a stop message to the process from which the claim was received
   b. It initiates an election of its own

(v) Whenever a process receives a coordinator message, the sender is marked as the coordinator.

Bully algorithm is a dynamic leader election algorithm used for electing a coordinator among a group of distributed processes. It is aptly named so because the currently running process with the highest id wins the election and becomes the coordinator. That is, at some point all lower id processes give up the election leaving behind the one with the highest process Id, which eventually becomes the coordinator.

The execution time and the number of messages transmitted in a network based on bully algorithm to elect the leader are very high, even when the size of the network is substantially small. Also, it takes a longer time to elect the election leader in large networks.

3.2 Ring-Based Leader Election Algorithm

(i) When a failure has been detected by a process, an election is initiated by sending a claim message containing its id to its immediate successor in the ring.
(ii) Whenever a process receives a claim message,

   a. If the received id is greater than its id, the process forwards the claim message to its successor.

b. If the received id is smaller than its id and if the process has not sent a claim message earlier to its successor, it replaces the id in the received claim message with its id and forwards it.
c. If the received id is smaller than its id and if the process has already sent a claim message to its successor, the received claim message is discarded.
d. If the received id is equal to its own id, a coordinator message is sent to its successor announcing itself to be the leader.

This algorithm arranges the process in a logical ring and establishes a unidirectional communication along the clockwise direction in the ring. Thus, the successor of each node is its clockwise neighbor in the ring.

A significant flaw with ring election algorithms is the multiple election messages that get transmitted when more than one node detects the failure of the leader elected. Consider a system with n nodes, wherein the elected leader process has failed due to unforeseen reasons, and the failure has been detected by two nodes, say n_a and n_b. Though both n_a and n_b initiate elections of their own, they will also participate in each other's elections. Thus, the number of messages transmitted doubles in number. If more nodes detect the failure of the leader, the number of messages transmitted will increase by a great amount and will lead to heavy traffic and possible congestion in the network. Also, the overhead of each node in the network will increase due to the creation and servicing of a large number of election messages [7].

4 Proposed Algorithm

4.1 What Is a Hypergraph?

It is always easy to study different objects by the relationships via which they are connected to one another. These relationships are easier to observe when the entire system is represented in the form of graphs. But in many real-world scenarios, the relationships are more complex to be implemented using standard graphs. Thus, hypergraphs are used to study such objects with complex relationships. Each edge in a graph is connected by exactly two vertices. But in a hypergraph, each edge is connected by any number of vertices. Each edge in a hypergraph is called a hyperedge. Each hyperedge is a set of nodes. Hypergraphs are characterized based on their cardinality, which is the size of all the hyperedges in the hypergraph. In an n-uniform hypergraph, all hyperedges are of size n. In the following section, we will see how hypergraphs can be used in the leader election process.

4.2 Framework

In the previous sections, bully and ring leader election was illustrated with examples. But, as stated earlier, both these algorithms are inadequate in cases of large networks. Bully election algorithms involve a large number of messages being sent, thereby increasing network traffic. Bully algorithm becomes highly inefficient in the case a leader crashes, and the election needs to be held again. The number of messages to be transmitted increases rapidly in widely distributed networks. The worst-case message complexity for a system with n processes is $O(n^2)$. Though ring election algorithms are simpler and easier to implement than bully algorithms, a lot of time is consumed in message passing. The message containing the process identification numbers needs to be passed around the entire ring until it is received by the process that initiated the election. In this paper, we combine bully and ring election algorithms so that both the time spent and the number of messages transmitted in message-passing are reduced.

In Fig. 1a, the set of processing nodes that need to be executed is represented as a hypergraph. The major difference between the conventional bully and ring leader election algorithms and the proposed method is the clustering of processes. Neighboring processing nodes form a cluster. Neighboring clusters communicate to cooperate with each other through the processes common to both the clusters. Each cluster is represented as a hyperedge in the hypergraph. Hypergraph's property of being an arbitrary set of nodes allows for any number of nodes within each cluster. In the figure, there are four clusters, namely C1, C2, C3, and C4. In the upcoming sections, the terms cluster and hyperedges are used interchangeably, meaning one and the same.

In our proposed method, instead of implementing either bully or ring election algorithm, both the methods are implemented with the help of hypergraphs. Each cluster elects its own leader to contest with the processes of other clusters. Since the number of nodes within each hyperedge is lower when compared to that of the entire system, we implement bully election within each hyperedge to select the leader for that cluster. The elected leaders from each cluster initiate ring election among themselves to choose the coordinator of the network. For better understanding, the proposed framework is implemented for the configuration of nodes present in Fig. 1a–c, as follows.

Bully election is implemented within each cluster, and the leaders for each cluster are determined as depicted in Fig. 1b. The processes with id 206 and 250 are elected as the leaders of the clusters C1 and C2, respectively. The process with id 242 is elected as the leader of both clusters C3 and C4. As a final step, the nodes with unique process id contest in a ring election, and the node with the highest process id 242 becomes the leader of the network, as shown in Fig. 1c. The leaders of the cluster transmit the message containing the elected leader's process id within their respective clusters.

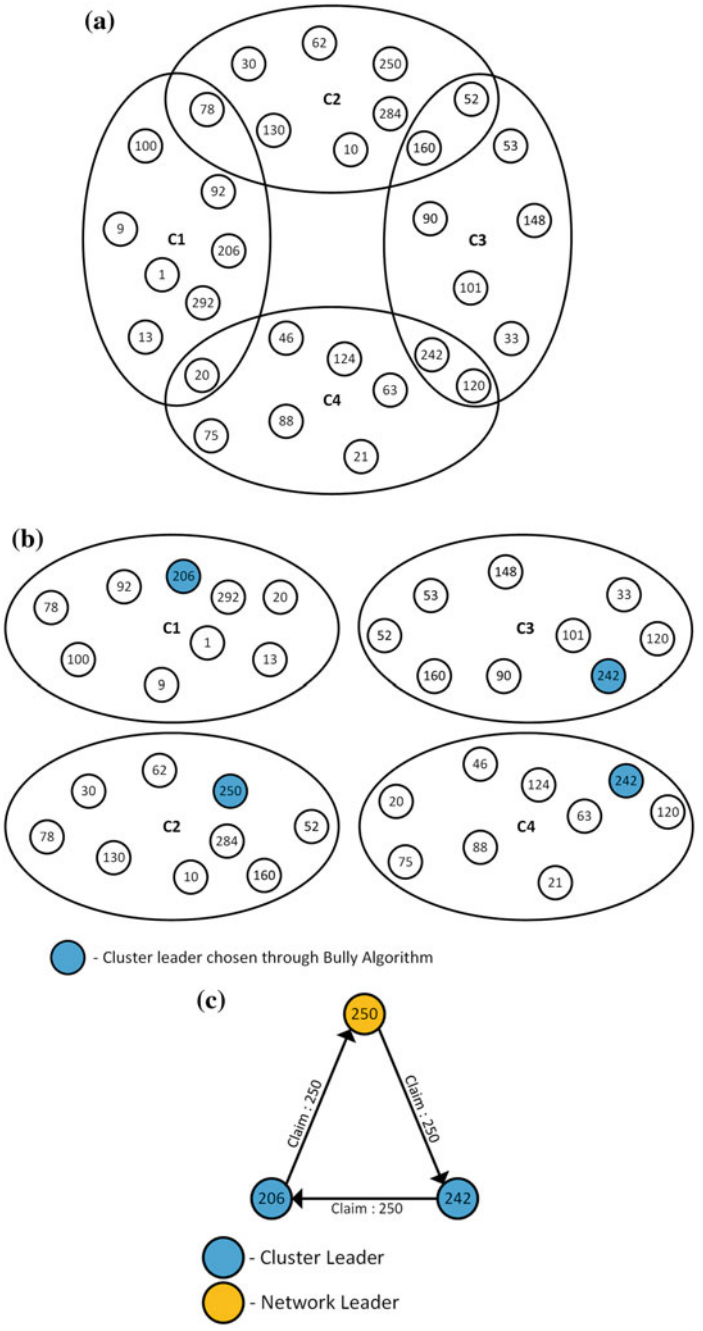


Fig. 1 **a**–**c** A typical example showcasing how the proposed algorithm works

5 Experimental Results

5.1 Complexity Analysis

On using the proposed algorithm, the number of messages transmitted during the leader election process is substantially reduced as opposed to when using the traditional bully and ring leader election algorithms. This can be proved by examining the worst-case message complexities of the different algorithms discussed in this paper.

The worst-case message complexity refers to the complexity of the algorithm when all the nodes in the algorithm initiate the leader election process.

In bully and ring leader election algorithms, the worst-case message complexity is $O(n^2)$, where n is the number of nodes in the network. The worst-case message complexity for the proposed algorithm is derived below.

Let the entire network be divided into m clusters, thus forming m hyperedges in the hypergraph representing the network, and assume that the entire set of nodes is divided almost equally into m clusters. Since bully election algorithm is executed within each hyperedge, the worst-case message complexity for electing leader within each cluster is $O((n/m)^2)$. Since there are m hyperedges, the total worst-case message complexity for executing bully election in all clusters is,

$$m \times O\left((n/m)^2\right) \tag{1}$$

The above expression can be simplified to $O(n^2/m)$. Now since there are m clusters, a set of m nodes comprising of one node from each cluster takes part in ring leader election algorithm to send the message containing the unique process identification number of the elected leader from their respective clusters. The worst-case message complexity for ring leader election algorithm is $O(m^2)$. Thus, the worst-case message complexity for the proposed algorithm is,

$$O\left(n^2/m + m^2\right) \tag{2}$$

It is also imperative to note that as the values of n and m increase, the difference in the number of messages transmitted between the proposed and standard algorithms also increases. As the network size increases, the proposed algorithm becomes more efficient than the standard bully and ring election leader algorithms. Table 1 compares the worst-case message complexity of the different election algorithms.

5.2 Performance Analysis

To illustrate the differences in the execution time of the proposed framework in contrast with the existing bully and ring election algorithms, three networks consisting of 50, 100, and 150 nodes, respectively, are considered. The proposed algorithm's

Table 1 Worst-case message complexities of the different leader election algorithms

Algorithm used	Worst-case message complexity
Bully algorithm	$O(n^2)$
Ring-based leader election algorithm	$O(n^2)$
Hypergraph-based leader election algorithm	$O(n^2/m + m^2)$

Table 2 Execution time of the different leader election algorithms

Total no. of nodes	Bully election execution time (in ns)	Ring election execution time (in ns)	Proposed algorithm's execution time		
			With 5 clusters (in ns)	With 10 clusters (in ns)	With 25 clusters (in ns)
50	692,734	10,792	2309	2049	1881
100	117,243,087	11,712	2973	2640	2280
150	120,721,912,862	15,714	3331	2951	2658

execution time is analyzed by considering each network with three scenarios containing 5, 10, and 25 clusters, respectively. The nodes in the network are distributed evenly among the total number of clusters in the scenario considered.

It is evident from Table 2 that the hypergraph-based proposed framework fares better in terms of execution time when compared to bully and ring election algorithms. This is so because, unlike in the traditional election algorithms, the election result within a cluster is independent of the election results of the other clusters. Thus, the bully election within each cluster can be executed in parallel. The proposed algorithm also scales well when the number of nodes increases from 50 to 100, and then 150, as the execution time was found to be lower than that of the traditional leader election algorithms.

6 Conclusion

Though the two standard leader election algorithms are prevalent, they are inefficient in the case of large networks or when the leader crashes frequently. A new framework is proposed, which makes use of both the bully and ring leader election algorithms. The entire system of processes is divided into different clusters, where each cluster represents a hyperedge in a hypergraph, thereby reducing the number of messages transmitted and the message passing time significantly. Experimental results were derived and compared with the existing algorithms to prove that the proposed algorithm fares better. More research work needs to be done on how to effectively group the different processes together to form clusters to increase the efficiency of the proposed framework.

References

1. Garavel H, Mounier L, Spectre P (1996) Specification and verification of various distributed leader election algorithm for unidirectional ring networks. Sci Comput Program 29
2. Vasudevan S, Kurose J, Towsley D (2004) Design and analysis of a leader election algorithm for mobile ad hoc networks. In: Proceedings of the 12th IEEE international conference on network protocols, pp 350–360
3. Ingram R et al (2009) An asynchronous leader election algorithm for dynamic networks. In: IEEE international symposium on parallel & distributed processing, pp 1–12
4. Derhab A, Badache N (2008) A self-stabilizing leader election algorithm in highly dynamic ad hoc mobile networks. IEEE Trans Parallel Distrib Syst 19(7):926–939
5. Park S, Kim Y, Hwang JS (1999) An efficient algorithm for leader-election in synchronous distributed systems. In: Proceedings of the IEEE region 10 conference, vol 2, pp 1091–1094
6. Kim TW, Kim EH, Kim JK, Kim TY (1994) A leader election algorithm in a distributed computing system. In: Proceedings of the fifth IEEE computer society workshop on future trends of distributed computing systems
7. Soundarabai P et al (2013) Message efficient ring leader election in distributed systems. In: Computer networks & communications: proceedings of the fourth international conference on networks & communications, pp 835–843

A Method to Estimate Perceived Quality and Perceived Value of Brands to Make Purchase Decision Using Aspect-Based Sentiment Analysis

Satanik Mitra and Mamata Jenamani

Abstract Perceived quality and value are very essential attributes in the context of brand management. These attributes are traditionally measured using primary surveys. In this work, we propose a methodology to estimate perceived quality and value from online consumer reviews using aspect-based sentiment analysis. We crawled reviews of five popular mobile brands from a reputed e-commerce website. We have applied state-of-the-art text pre-processing techniques to clean the text and to extract the aspects using a semi-automatic approach using dependency parser. The aspects are categorized into five clusters in relevance with benefits consumers get from the brand. Lastly, we have applied TOPSIS, a multi-criterion decision-making algorithm, to rank the brands based on perceived quality scores.

Keywords Aspect-based sentiment analysis · Dependency parser · Perceived quality · Perceived value · Purchase decision-making · TOPSIS

1 Introduction

European Consumer Satisfaction Index (ECSI) model considered the perceived quality and perceived value of a brand as one of the key factors of consumer satisfaction. Perceived quality evaluates the degree of reliability of the firm's offerings and the degree to which the brand meets up the consumers' need. Perceived value is the rating between quality and price paid [1]. Keller suggested three benefits consumer can get from a brand are functional benefits, experiential benefit and symbolic benefits [2]. Among these benefits, the functional benefit is closely related to the perceived quality of a brand [3]. A brand with high quality creates purchase intention in the consumers and allows the brand to be more visible with respect to its competitors [4].

S. Mitra (✉) · M. Jenamani
Indian Institute of Technology, Kharagpur, India
e-mail: satanikmitra@iitgp.ac.in

M. Jenamani
e-mail: mj@iem.iitkgp.ac.in

H. S. Saini et al. (eds.), *Innovations in Computer Science and Engineering*,
Lecture Notes in Networks and Systems 103,
https://doi.org/10.1007/978-981-15-2043-3_49

In the literature, perceived quality and values are measured with traditional data collection and survey-based methods [1, 5]. These methods are long and costlier in terms of time involved in them [6, 7]. On the other hand, consumer reviews are truly imperative and valuable for both the firms and customers [8]. These reviews can help in reducing the risk of shopping online before consumers make a purchase decision. Besides that, as brands are created upon products [6], it reveals consumers' overall perception of quality and satisfaction towards a brand. This information gives a chance to the brand managers to compare the quality of the product and create basic business values [9].

In this work, we propose a novel method to measure the perceived quality and perceived value of brand which has been used to give consumers an opportunity to choose the brand, best in quality. Aspect-based sentiment analysis is used to extract consumers' sentiments towards each aspect of the product. Aspects are extracted using dependency parser. This technique is motivated by double propagation method [10]. To the best of our knowledge, aspect-based sentiment scores have been used for the first time to represent perceived quality and perceived value. These aspects are manually clustered into functional, experiential and symbolic categories with the help of annotators [10]. The sentiment scores of individual clusters have been used in measuring perceived quality and perceived value as per American Consumer Satisfaction Index [5]. Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) has been applied to choose the best alternatives from competing brands. Figure 1 shows our proposed model. The paper is arranged in the following order—Sect. 2 presents the related works. Section 3 and Sect. 4 cover methodology, and experiment and results, respectively. Section 5 is conclusion.

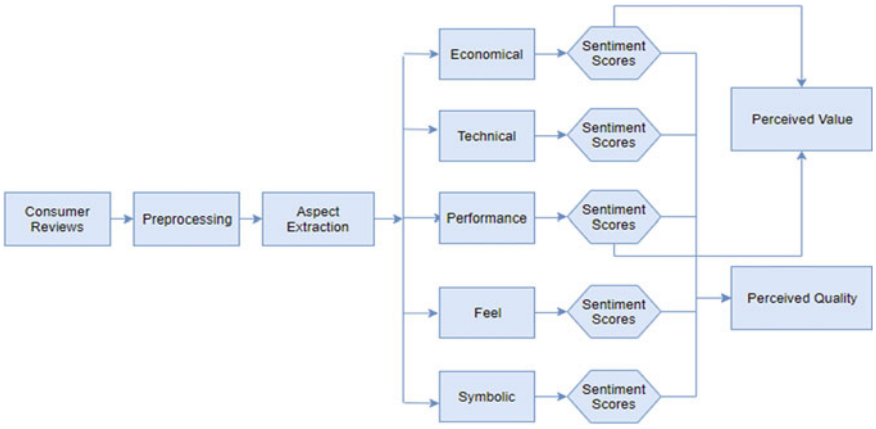


Fig. 1 Perceived quality and perceived value measuring model

2 Related Works

2.1 Perceived Quality and Perceived Value

Perceived quality is reflected by the degree of reliability of the firm's offerings to meet consumers' expectations [1]. It has an impact on purchase intentions when a purchaser is not able to do a direct and detailed analysis of the product or brand quality [4]. Keller suggests that product quality does not rely only upon the functional benefits associated with it but the experiential benefits such as the feel of the product, performance of the product and also symbolic benefits such as social status and self-esteem [2]. In the American Consumer Satisfaction Index (ACSI), perceived quality and perceived value of a brand are important antecedents and reflect consumer satisfaction [5]. Moreover, overall quality, product quality related to technical aspect, is taken as governing items of perceived quality [1]. Perceived value reveals brands' goodness with respect to its price, and it also conveys the reason to choose the brand over other competitive brands [11]. Perceived value is also a critical factor in purchase decisions. It is subsequently taken by many managers to create a value-based pricing strategy to sell a product at the right price [12]. It can be evaluated by price per performance perceived by the consumers [1].

2.2 Aspect-Based Sentiment Analysis

Aspect-based sentiment analysis focuses upon extraction of aspects (or product features) from the opinionated content. The main motivation is the sentiment of the entire text content which does not reflect the authors' exact opinion about any aspect. This idea is useful in terms of extracting consumer perception and their conviction about the product quality [1]. In double propagation approach, syntactical structure of the sentence has been exploited by the use of dependency parser [10]. The relation among the words generated by the dependency parser is the key to be extracted [10].

3 Methodology

3.1 Aspect Extraction

Pre-processing has been done on the text scrapped from online shopping sites, and Stanford dependency parser has been used to extract the dependency relations from the text. A dependency parser establishes the connection between headword and the words which modify the headword.

Table 1 Aspect extraction from dependency parser

Sentence	Dependency parser output	Rules applied	Aspects
Phone is awesome	[(u'phone', u'NN'), u'amod', (u'awesome', u'JJ')]	If opinion word is "JJ" → "NN", then "NN" is an aspect	Phone
I was a little doubtful about its low specifications	[(u'doubtful', u'JJ'), u'nmod', (u'specifications', u'NNS')]	If opinion word is "JJ" → "NNS", then "NNS" is an aspect	Specifications

A list of English opinion words has been used to extract aspects. Each sentence of the corpus is fed into the Stanford dependency parser. We have considered the noun terms as aspects which are dependent on the opinion words through adjective modifier (amod), noun modifier (nmod). See Table 1 for the demo output of the dependency parser. This process is applied to all five datasets we have collected from Amazon.

3.2 Clustering of Aspects

The aspects are clustered into five subgroups. This clustering has been done manually with the help of four annotators. Aspects are clustered broadly into functional, experiential and symbolic categories [2]. Functional category stores the words related to the visible features of the product. We have categorized functional aspects into two subgroups—Economical and Technical. The experiential category is further subgrouped into Performance category and Feel category. The detailed list of aspects is shown in Table 2.

Table 2 List of few aspects clustered into five clusters based upon benefits

Functional		Experiential		Symbolic
Economical	Technical	Performance	Feel	
Product	Phone	Perfected	Worry	Huawei
Price	Display	Performance	Life	Amazon
Replacement	Camera	Delivery	Good	Honor
Return	Light	Quality	Low	Galaxy

3.3 Sentiment Analysis

Once our aspects are extracted and clustered, we have applied lexicon-based sentiment analysis. VaderSentiment [13] lexicons have been used in this work to do sentiment analysis. The sentiment attached to each aspect in each category has been analysed. The arithmetic mean of the sentiment of each category is considered as the sentiment of the cluster. The sentiment of the entire review is calculated separately using the unsupervised method. Sentiment score of each category shows that consumer perception about the certain quality of the product which has been captured from the sentiment consumers showed upon a particular aspect of the product.

3.4 Perceived Quality and Perceived Value

We have applied arithmetic average on the sentiment score we got with respect to each aspect from individual reviews. This actually gives sentiment corresponding to individual aspect in the whole corpus. To get the sentiment score of each broader cluster of aspects, we applied weighted average of the sentiment scores corresponding to each aspect present in that particular cluster. Finally, the geometric mean of the score of each category with respect to each brand has been taken to get the perceived quality for that particular brand.

4 Experiment and Results

We have extracted consumer review data of Coolpad, Samsung, Honor, Lenovo and Motorola from Amazon. These are well-known mobile phone brands. We keep our choice of mobiles within the same price range. We have extracted 500 reviews per brand and overall 2500 reviews for 5 brands. Around 590 aspects are extracted. Manual clustering of these aspects into five clusters and sentiment analysis of aspects inside each cluster have been done. These sentiment values typically form a decision matrix having benefits as row and brands as column. Perceived quality is calculated by taking geometric mean of all the attribute values in the decision matrix for an individual brand. Perceived value is calculated by using price/performance and performance/price method. We have considered the “Economical” cluster as a representative of price, and “Performance” is represented as the performance of the brand. TOPSIS has been applied to the resultant decision matrix to choose the best alternative brand. TOPSIS works upon the concept of geometric distances and is considered the best alternative [14]. The decision matrix is shown in Table 3. The brand with highest perceived quality is shown in bold. Mobile 1 is selected by TOPSIS as the best alternative. Figures 2 and 3 show the radar chart plot of economical cluster and performance cluster sentiment of brand Mobile 5. Perceived value is shown in

Table 3 Decision matrix from aspect sentiment scores

Mobile brands	Economical	Technical	Performance	Feel	Symbolic	Perceived quality
Mobile 1	0.31	0.21	0.31	0.31	0.31	**0.29**
Mobile 2	0.02	0.34	0.34	0.40	0.40	0.22
Mobile 3	0.41	0.32	0.37	0.51	0.01	0.19
Mobile 4	0.20	0.46	0.17	0.28	0.10	0.22
Mobile 5	0.19	0.35	0.11	0.10	0.01	0.10

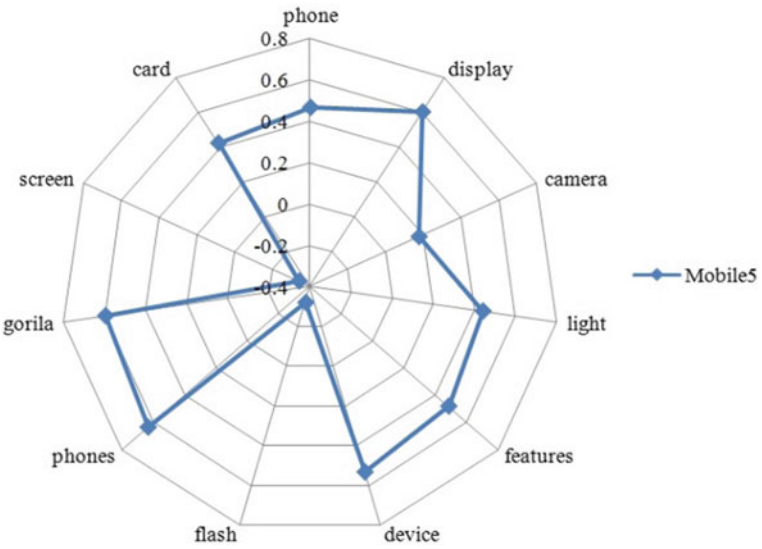


Fig. 2 Sentiment score plot of performance aspects of Mobile 5

Table 4. Table 5 shows the TOPSIS report of the brands. The brand with maximum TOPSIS score is shown in bold.

5 Conclusion

In this work, we propose a method to measure two brand related attributes, perceived quality and perceived value. Perceived quality is an attribute of brand equity models and consumer satisfaction indices. Perceived value is representing the ratio between quality and investment. Our method measures perceived quality by consumers' unbiased responses which unveils their perception by their sentiment towards functional (Economical, Technical), experiential (Performance, Feel) and symbolic aspects, and the scores corresponded to these aspects contribute perceive quality. We also applied

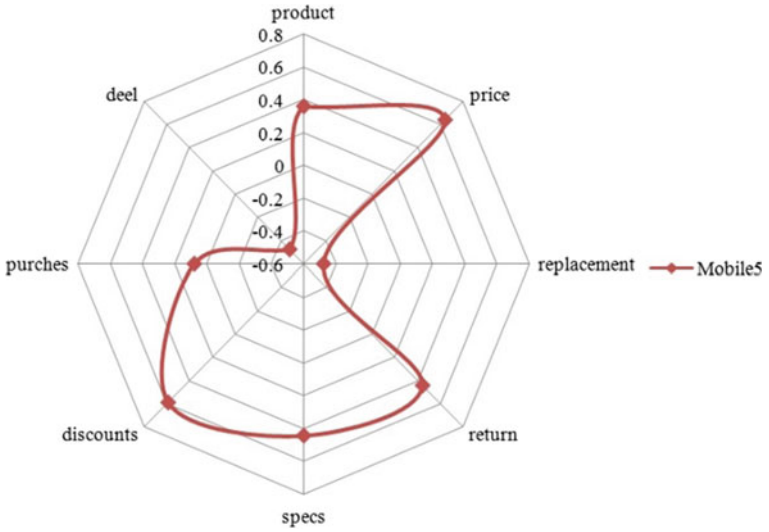


Fig. 3 Sentiment score plot of economical aspects of Mobile 5

Table 4 Perceived value from aspect sentiment score

Brands	Price/performance	Performance/price
Mobile 1	1.07	0.92
Mobile 2	0.79	12.6
Mobile 3	0.79	0.91
Mobile 4	1.19	8.39
Mobile 5	1.72	0.57

Table 5 TOPSIS report of brands based on perceived quality

Brands	TOPSIS report
Mobile 1	**0.64**
Mobile 2	0.57
Mobile 3	0.55
Mobile 4	0.40
Mobile 5	0.24

TOPSIS on the final decision matrix to get the best choice of brand. Here, reviews of five well-known mobile brands are used. Our work has certain limitations; we have not applied any machine learning-based semantic word clustering to cluster words relevant to a particular benefit (such as Economical). A fully automated technique can be used for this purpose. Perceived quality also leads to consumers' loyalty towards the brand. In this work, we do not consider the loyalty attribute of a brand. Here, we use aspect-based sentiment analysis and we do not perform any comparison of

our techniques with machine learning-based or lexicon-based techniques. We would like to do these analyses in future.

References

1. Bayraktar E, Tatoglu E, Turkyilmaz A, Delen D, Zaim S (2012) Measuring the efficiency of customer satisfaction and loyalty for mobile phone brands with DEA. Expert Syst Appl 39:99–106
2. Kevin Keller L (1993) Conceptualizing, measuring, and managing customer-based brand equity. J Mark 57:1–22
3. Aaker DA (1996) Building strong brands, New York, NY
4. Smith DC, Aaker DA (1992) Managing brand equity: capitalizing on the value of a brand name. J Mark 56:125
5. Fornell C, Johnson MD, Anderson EW, Cha J, Bryant BE (2006) The American customer satisfaction index: nature, purpose, and findings. J Mark 60:7
6. Gensler S, Völckner F, Egger M, Fischbach K, Schoder D (2015) Listen to your customers: Insights into brand image using online consumer-generated product reviews. Int J Electron Commer 20:112–141
7. Culotta A, Cutler J (2016) Mining brand perceptions from twitter social networks. Mark Sci 35:343–362
8. Lee AJT, Yang FC, Chen CH, Wang CS, Sun CY (2016) Mining perceptual maps from consumer reviews. Decis Support Syst 82:12–25
9. Xu X, Wang X, Li Y, Haghighi M (2017) Business intelligence in online customer textual reviews: Understanding consumer perceptions and influential factors. Int J Inf Manage 37:673–683
10. Qiu G, Liu B, Bu J, Chen C (2011) Opinion word expansion and target extraction through double propagation. Comput Linguist 37:9–27
11. Aaker DA (2012) Measuring brand equity across products and markets. Calif Manage Rev 38:102–120
12. Zimmer MR, Kapferer JN (1994) Strategic brand management: new approaches to creating and evaluating brand equity
13. Wilson J, Hernández-Hall C (2014) VADER: a parsimonious rule-based model for sentiment analysis of social media text. In: Eighth international AAAI conference on weblogs and social media
14. Opricovic S, Tzeng GH (2004) Compromise solution by MCDM methods: a comparative analysis of VIKOR and TOPSIS. Eur J Oper Res 156:445–455

IoT-Based Multifunctional Smart Toy Car

Aarti Chugh, Charu Jain and Ved P. Mishra

Abstract IoT technology has not only revolutionized almost every industry but also it has created a huge impact on our day-to-day lives. The toy industry has also got influenced from this current technology. This paper aims at the development of IoT-based smart toy car which has certain unique features like Peltier AC, Bluetooth audio speaker, obstacle detection, turning-on of indicators on turns, etc. The toy car stops automatically whenever any obstacle is found. Mini AC turns on automatically when the temperature goes above 20°. It has also Bluetooth controlled audio player which can be paired with the Bluetooth of the car on your phone for playing songs or controlling volume. Basically, the proposed system contains different car functions which can be controlled with Internet from anywhere in the world. The system is cost-effective as it uses low power sensors.

Keywords Internet of Things · Smart toy car · Mini AC · Bluetooth audio device · Object detection

1 Introduction

Smart technology has become part of our everyday life. Usage of smart phones is increasing exponentially by providing facilities not only for phone calls and messaging but also for automating various day-to-day activities. Discovery of Internet of Things has given a new horizon in development of smart phone-based technologies. It is possible to control functioning of TV, sound systems, AC, etc. through smart phone apps [1].

A. Chugh · C. Jain (✉)
Amity University Haryana, Gurgaon, India
e-mail: cjain@ggn.amity.edu

A. Chugh
e-mail: achugh@ggn.amity.edu

V. P. Mishra
Amity University Dubai, Dubai, United Arab Emirates

H. S. Saini et al. (eds.), *Innovations in Computer Science and Engineering*,
Lecture Notes in Networks and Systems 103,
https://doi.org/10.1007/978-981-15-2043-3_50

With new innovations and combinations of multiple technologies, IoT has impacted many areas like healthcare, business, telecommunication, transportation, etc. [1]. One of the major contributions of IoT is in designing smart toys. Smart toy concept refers to integration of technologies to develop physical toys which serve as a medium for cognitive development and entertainment tool for kids. This paper discusses development of a smart toy car which can be controlled through desktop commands or by smart phone. The prototype portrays smart toy car which plays with the child and also packs some additional features like mini AC, audio speaker and obstacle detection. Various components are used like Peltier AC, Bluetooth audio speaker, IR, HC-SR04, etc. The smart car works on the microcontroller board, i.e., Arduino Uno. The language used to code the system is "C," Arduino functions and methods as well.

There are many different types of car based on Arduino board already available in the market but the unique thing in this project is that it has some more additional features like mini AC which control the temperature for around 3°–4° also turn on automatically when the temperature goes above 20°. The second additional feature is that it has a Bluetooth controlled audio player in which you can connect Bluetooth of the car on your phone and play songs and control volume easily. Also, this toy smart car stops automatically when there is any object or wall comes in the range sensor, and then you can give command like left or right to move the car.

2 Technology Used

2.1 Arduino Uno

The Arduino Uno is a microcontroller board based on the ATmega328 [2, 3]. Arduino Uno has good capabilities supportive for connection with microcontroller. Its multiple pins comprise digital input/output pins, analog inputs, a crystal oscillator, a USB connection, a power jack, an ICSP header and a reset button. To use it, one can either connect it with computer through USB or use AC-to-DC adaptor for power supply. While using Arduino, the power source is selected automatically.

If a person uses battery as an external power source, then two main pin headers named Gnd and Vin are used. Arduino Uno board requires a power of 6–20 V. It is necessary to keep a check on current flowing in device. This task is performed by internal pull-up.

2.2 DHT11 Sensor

DHT11 refers to digital temperature and humidity sensor [4]. This is one of the famous sensors due to its best performance in measuring even small changes in temperature as well as humidity. The sensor digitally outputs readings for both quantities continuously. It has three main components negative temperature coefficient (NTC) thermistor, humidity sensor and an IC.

2.3 L293d Motor Driver Board

L293d motor driver IC allows motion in either direction board and can work with two DC motors [5]. It supports currents of up to 600 mA at voltages from 4.5 to 36 V. It is compact in size [3] due to which it is mostly used with terminal blocks for connecting motors and power supply and berg sticks for control signals from microcontroller.

2.4 IR Sensors

These sensors are used for color as well as object detection and are capable to emit or receive infrared waves in the form of heat [6, 7]. An infrared light-emitting diode emits light between range 700 nm to 1 mm. It generates both digital and analog output. The digital output can be forwarded to an Arduino, Raspberry Pi or any other microcontroller for further use. There are two main parts which work together during proximity calculation. A photodiode detects light falling on it and generates a response in term of change in resistance. This is measured in terms of voltage [8]. An IR LED is a source of IR light which is reflected by the object and received by an IR receiver (photodiode). Any difference between reflection and reception makes changes in input voltage. This variation is used for proximity detection.

2.5 HC-SR04 Module

These are a type of ultrasonic sensors and provide many benefits for various applications. The HC-SR04 module [9] accuracy ranges to 3 mm in 2–400 cm non-contact measurement function. There are three important components: ultrasonic control circuit, transmitters and receiver. Its working depends on trigger pulse. Once its Trig pin receives trigger pulse, it produces sound wave which is finally transmitted and received back by Echo pin. The time difference between wave reflection and receiving is termed as speed of sound. This value is used to find distance to an object.

2.6 Peltier AC Module

Peltier AC module is used to prepare mini AC. This module works on Peltier effect which creates a temperature difference by transferring heat between two electrical junctions [11]. This is constructed using two external ceramic plates separated by arrays of semiconductors. When a current is passed over semiconductor pellets [11], one plate will absorb heat (becomes cooler) and the other plate dissipates heat (becomes hotter).

2.7 PAM8403 Module for Sound

This is the most power-efficient class-D stereo amplifier. It provides high-quality sound reproduction because of low total harmonic distortion plus noise (THD + N). Its new filterless design enables the device to drive the speaker directly.

2.8 BT Receiver Module (Bluetooth)

This Bluetooth audio receiver module includes a USB port and TF card slot. This is used to connect the Bluetooth-enabled mobile phone (or computer) and play music in toy car speaker.

Further, basic components used are geared motors (for controlling car movement), LEDs (for headlight and indicators), jumper wires (to connect two points to each other without soldering), metal chassis (used for Robots to support two wheels and motors) and an electronics breadboard (for solderless temporary circuits and prototyping).

3 Design and Implementation

3.1 Mini AC (Air Conditioner)

This is just like the everyday air conditioner. Its unique feature is the cooling unit that has no moving parts. The only moving parts here are the PC fans [12]. Figure 1 shows steps of working of mini AC.

3.2 BT Audio Player

Figure 2 shows working of BT audio player.

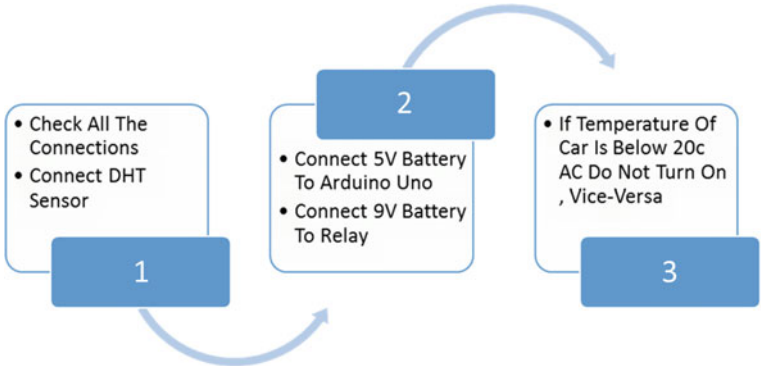


Fig. 1 Steps to use mini AC

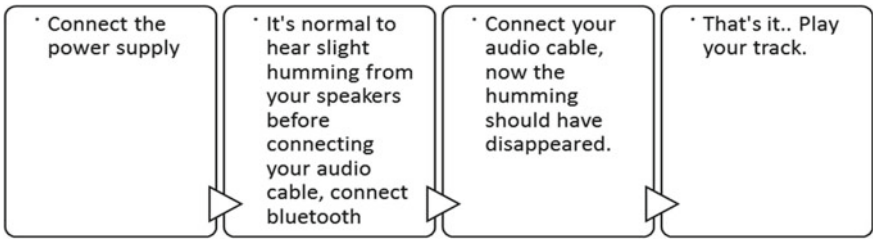


Fig. 2 Steps to use BT audio player

3.3 Smart Car

Following steps show the working of a smart toy car.

Step 1: Connect 9 V battery to Arduino UNO and Motor IC.
Step 2: Connect Arduino wire to device with Arduino IDE/HC-05 Module with Android device.
Step 3: Open Arduino IDE/Amr_Voice Control Application and select the option "Connect Robot."
Step 4: Turn on Wi-Fi.
Step 5: Give commands on serial monitor or voice command through "AMR_VOICE CONTROL." It follows certain set of commands like moving forward, backward, right, left direction. It stops whenever any object is detected. To start, again commands are to be given. Figure 3 shows working model of mini AC.

For starting car, initialize Bluetooth and ultrasonic sensor. Coding has been done for various functions: playing audio through Bluetooth, starting and stopping AC and object detection on way. Figure 4 shows working model of BT audio player.

Smart toy car works in three modes: Bluetooth, child and attract mode. In Bluetooth mode, Bluetooth (BT module) is connected to phone or laptop for listening

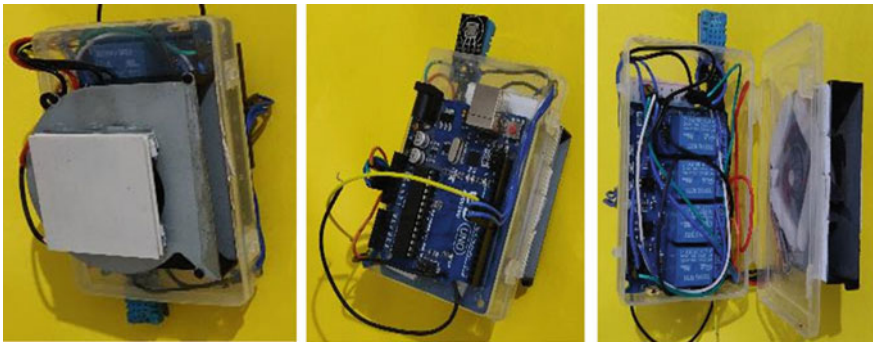


Fig. 3 Working model of smart AC

Fig. 4 Working model of BT audio player

songs, etc. In child mode, sensors are used to detect obstacle. If any object is found within a range of 4–8 cm, the car will stop automatically. In attract mode, indicators are turned on accordingly when car takes right or left turn.

4 Conclusion

Multifunctional IoT-based smart toy car has been implemented with unique features like Bluetooth, mini AC, obstacle detection, indicators while taking turns. AC turns on automatically when temperature is above 20° and also has Bluetooth audio player feature by which one can connect Bluetooth with smart phone and play songs easily. The proposed toy car can be controlled from anywhere as it is controlled by Internet either by giving commands (serial or voice) from application. This smart car is cost-effective and can be further extended to have teaching features for students.

References

1. Bahga A, Madisetti V (2015) Internet of Things-a hands on approach. Orient Black Swan
2. Ardiuno UNO. https://www.farnell.com/datasheets/1682209.pdf
3. Ardiuno UNO. https://datasheet.octopart.com/A000066-Arduino-datasheet-38879526.pdf
4. DHT11 Temperature and Humidity Sensor. https://www.robot-r-us.com/vmchk/sensor-temp/humid/dht11-temperature-and-humidity-sensor.html
5. DC Motor/Stepper Motor Driver Board with L293D IC. https://www.elementzonline.com/dc-motor-stepper-motor-driver-board-with-l293d-ic-84
6. IR LED (infrared light-emitting diode). https://whatis.techtarget.com/definition/IR-LED-infrared-light-emitting-diode
7. Infrared IR Sensor Circuit Diagram and Working Principle. https://www.elprocus.com/infrared-ir-sensor-circuit-and-working/
8. NodeMCU—Digital and Analog Infrared Sensor. https://roboindia.com/tutorials/digital-analog-ir-pair-nodemcu
9. HC-SR04 Ultrasonic Sensor Distance Measuring Module. http://www.mgsuperlabs.co.in/EFL/HC-SR04
10. Complete Guide for Ultrasonic Sensor HC-SR04 with Arduino. https://randomnerdtutorials.com/complete-guide-for-ultrasonic-sensor-hc-sr04/
11. Smout J, Choosing and using advanced peltier modules for thermoelectric cooling. https://www.digikey.in/en/articles/techzone/2018/feb/choosing-using-advanced-peltier-modules-thermoelectric-cooling
12. Mini Peltier Air Conditioner (Plans). https://www.instructables.com/id/Thermoelectric-Peltier-Air-Conditioner/

IoT-Based Data Logger for Environmental Monitoring

Ved P. Mishra, Charu Jain and Aarti Chugh

Abstract IoT has revolutionized the whole world by having mechanism to not only monitor but also control vital statistical information in our environment with the help of variety of sensors. The collected data is transmitted wirelessly to cloud which further processes, stores, transforms and analyzes the data in some usable form (Bahga and Madisetti in Internet of things—a hands on approach. Orient Black Swan, 2015 [1]). The collected information can be accessed through mobile or web applications. IoT-based logger can achieve online real-time monitoring of equipment working status and environmental condition as well as controlling. It can make sure that the equipment works in its security zone and under environment protection state as well as in energy-saving mode. It can not only monitor but one can also analyze the causes of the fault and identify faulty components from the log file created by it on data base server. Using the log file, one can also predict when the environment condition and equipment working status reach at an unacceptable level, and the working of that equipment should be shut down or bypass for maintenance. Thus, the IoT-based data logger (IoTDL) ensures the reliable operation of equipment, personal security and suitable environmental condition. It can also extend equipment life and also reduce equipment failure rate.

Keywords IoT · Data logger · Sensors · Weather monitoring · EAGLE · Arduino-Uno · Wi-Fi

V. P. Mishra
Amity University Dubai, Dubai, United Arab Emirates

C. Jain (✉) · A. Chugh
Amity University Haryana, Gurgaon, India
e-mail: cjain@ggn.amity.edu

A. Chugh
e-mail: achugh@ggn.amity.edu

H. S. Saini et al. (eds.), *Innovations in Computer Science and Engineering*,
Lecture Notes in Networks and Systems 103,
https://doi.org/10.1007/978-981-15-2043-3_51

1 Introduction

The weather conditions need continuous monitoring to know the vital statistics of environment. This monitoring can lead to better harvesting of crops, etc. The information can be collected by different types of sensors, devices which measure the physical and environmental features. This collected information can be stored and analyzed. Such analysis can boost the entire system. The system proposed basically works on three types of sensor modules: temperature, soil moisture and humidity. The environmental condition and equipment working status as well as human safety have a great influence on resources, daily production and environment in industry. Because of improper environment condition and improper working status of equipment in industry, majority of accidents were caused. Similarly, the environmental condition monitoring is also important in home for energy consumption monitoring, switching on and off remotely appliances to avoid accidents, detection of window and door openings. Usually, human inside their home interacts with the environment setting like temperature, light, etc. and regulates accordingly. If the environment setting can be made to respond human behavior automatically, then there are advantages.

Internet of things-based data logger (IOTDL) [2] can serve a solution for the problems addressed above. Utilizing the facility of IoT can achieve online real-time monitoring of equipment working status and environmental condition as well as controlling. It can make sure that the equipment works in its security zone and under environment protection state as well as in energy-saving mode. It can not only monitor but one can also analyze the causes of the fault and identify faulty components from the log file created by it on data base server. Using the log file, one can also predict when the environment condition and equipment working status reach at an unacceptable level, and the working of that equipment should be shut down or bypass for maintenance. Thus, the IOTDL ensures the reliable operation of equipment, personal security and suitable environmental condition. It can also extend equipment life and also reduce equipment failure rate.

Though several data loggers are available in market, the proposed system is cost-effective. It is using low power sensors and includes low power Wi-Fi module. So, the system can be considered low power solution to establish a successful IoT-based weather station.

2 Design and Implementation

Figure 1 shows the block diagram of our system. Sensor devices will capture the temperature, light intensity and soil moisture, respectively, and send to front-end interface through microcontroller. AT328 microcontroller acts as the brain for the entire system as all devices and sensors are connected with it. The sensors are managed by the microcontroller to fetch the information from them and update it to internet through Wi-Fi connectivity.

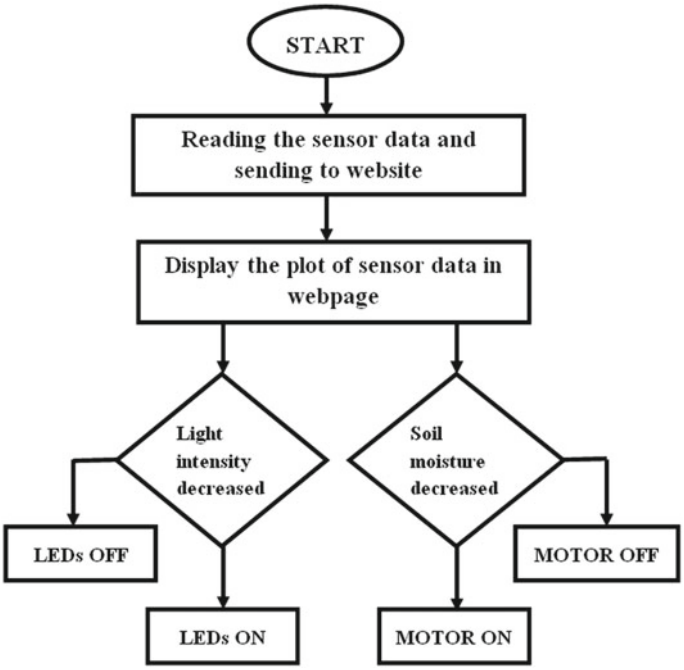


Fig. 1 Block diagram for IoT-based data logger

The data can be accessed through any web or mobile application. Lights will turn on automatically if light intensity value goes below to set threshold value and vice versa. Similarly, motor will be turned on for water supply if soil moisture is decreased by set threshold value and vice versa.

2.1 Hardware Design

Table 1 shows the hardware and software requirements for the system.

Figure 2 shows the hardware design of the proposed system. It basically works with three sensors: DHT11 sensor [3] for reading the temperature and humidity

Table 1 Hardware and software requirements

Hardware specifications	Software specifications
Wi-Fi module (ESP8266) Microcontroller (ATmega328) Voltage regulator (LM1117 & LM7805) Temperature and other sensors	Sublime (Text Editor) Eagle (Program) Arduino IDE Mosquitto MQTT Broker PhP

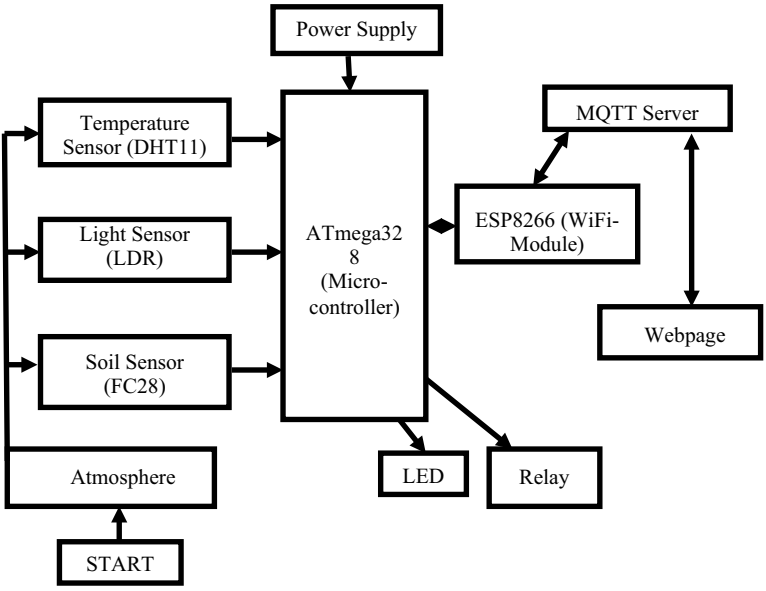


Fig. 2 Hardware design for IoT-based data logger

value from the environment. Light-dependent resistor (LDR) and soil sensors are used to read the light intensity from the environment. Both LDR and soil sensors are connected to the analog pins of the ATmega328 microcontroller [4, 5] and LED and relay are also connected to the digital pins of the microcontroller. These sensors will collect data from environment and microcontroller compares collected data with the LED and relay function. If the light intensity is less than 30, lights turn on automatically and if it is greater than 30, lights will turn off. Similarly, if value of soil moisture is less than 20, relay switch will be turned on and vice versa. Data collected is sent to the front-end interfaces through MQTT server. Wi-Fi module (ESP8266) is used for Wi-Fi set up. Collected data can be seen and processed through web page or mobile application. Relays are required to perform the switching operation of AC/DC devices. In our system, they are required to turn motor on whenever the moisture in soil is less than the set range.

Data collected is sent to the front-end interfaces through MQTT server. Wi-Fi module (ESP8266) [6] is used for Wi-Fi set up. Collected data can be seen and processed through web page or mobile application. Relays are required to perform the switching operation of AC/DC devices. In our system, they are required to turn motor on whenever the moisture in soil is less than the set range.

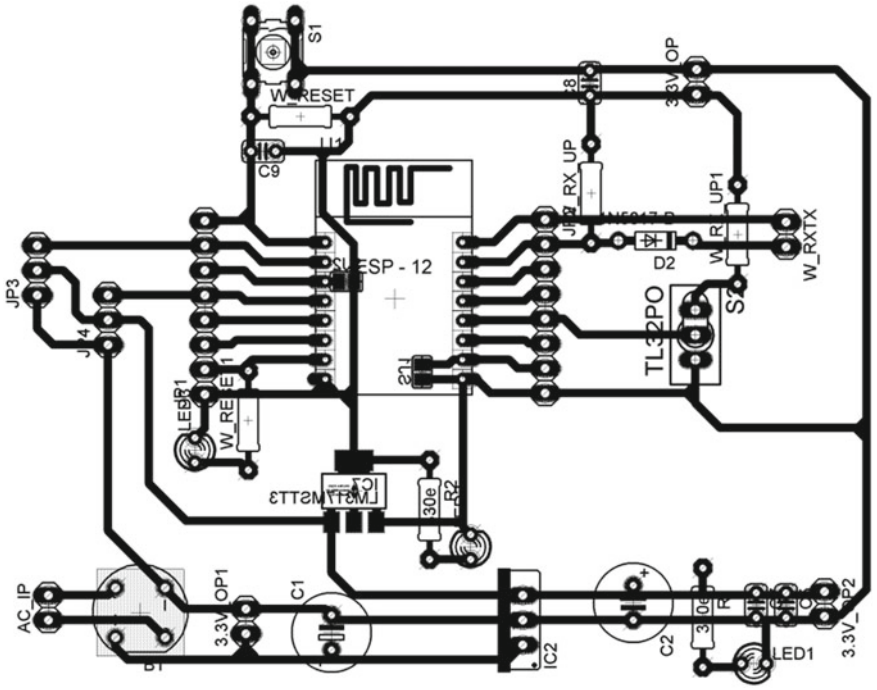


Fig. 3 Layout of board-2 (with Wi-Fi)

3 PCB Layouts

A PCB layout is a physical implementation drawing of a net list taking into account the physical footprints of the components, make a functional circuit board [7]. The drawing is used to "print" metallic conductor traces onto a carrier substrate that can be assembled into a working board. Figure 3 shows the layout diagram [8] with microcontroller and relay, respectively.

4 Results

Figure 4 shows the dashboard on a web page where the live values from the different sensors are shown. It also plots the graph for them for analytical purpose. Figure 5 shows the data collected by different sensors with vital information. Figure 6 shows the working set up of a system. Figure 7 shows the lights turned on automatically in darkness.

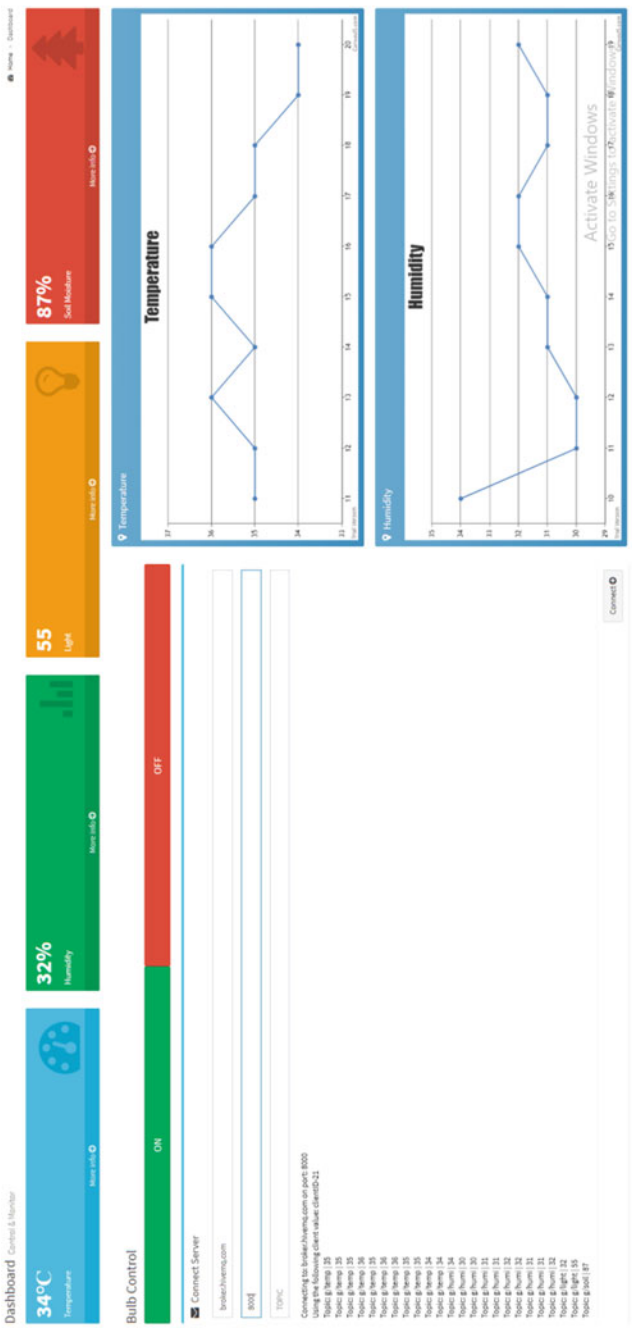


Fig. 4 Dashboard of web page

Data Table

Show 10 entries Search:

S.NO	Date & Time	Temperature	Humidity	Light	Soil
614	20/05/2019 09:41:18pm	34°C	32%	55	87%
613	20/05/2019 09:40:58pm	34°C	32%	55	0
612	20/05/2019 09:40:52pm	34°C	32%	32	0
611	20/05/2019 09:39:40pm	34°C	32%	0	0
610	20/05/2019 09:39:35pm	34°C	31%	0	0
609	20/05/2019 09:39:35pm	34°C	31%	0	0
608	20/05/2019 09:39:30pm	34°C	32%	0	0
607	20/05/2019 09:39:30pm	34°C	32%	0	0
606	20/05/2019 09:39:26pm	34°C	31%	0	0
605	20/05/2019 09:39:26pm	34°C	31%	0	0

Showing 1 to 10 of 614 entries Previous 1 2 3 4 5 ... 62 Next

Fig. 5 Data collected from sensors

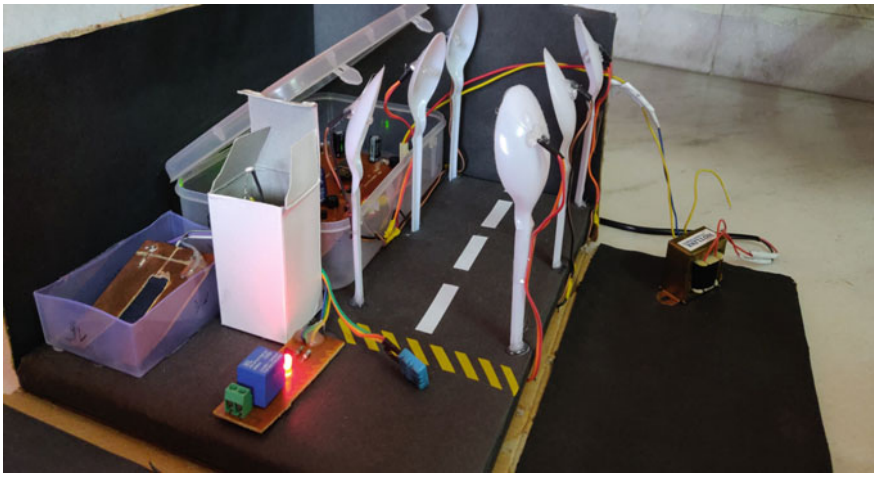


Fig. 6 Working set up of project

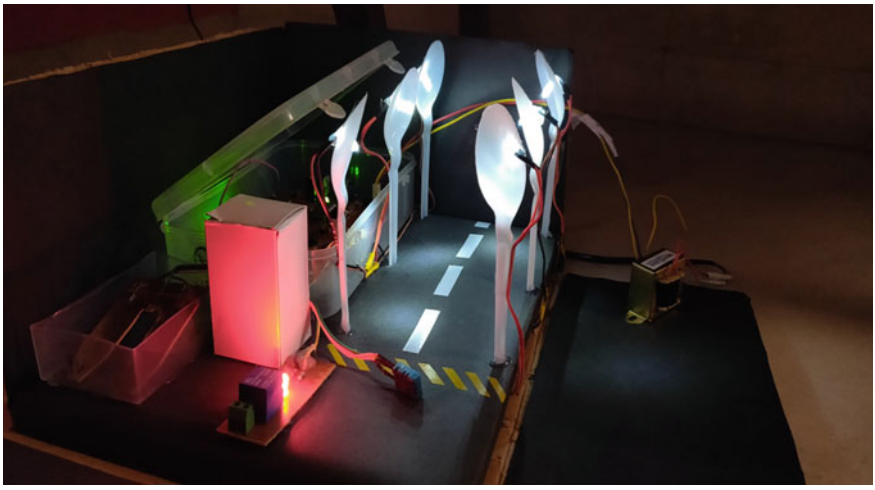


Fig. 7 Lights on (in darkness)

5 Conclusion

The project entitled IoT-based data logger for monitoring the environmental parameters using IoT scenario was completed successfully. The system provides a low power solution for establishing a weather station. The system is tested in an indoor environment, and it is successfully updated the weather conditions from sensor data. It is also a less expensive solution due to usage of low power wireless sensors and contains a low-cost Wi-Fi module. The temperature and humidity sensors are giving

close to the real values. The street lights are also functioning in the way they are supposed to be. The LDR is working properly and turns the lights on and off according to the need and the values taken from the environment. The water motor switch turns off as soon as the soil moisture increases above 40 and again turns the motor on when the moistures go below 40. To conclude, cost-effective model was presented to monitor and control the experimental conditions and equipment's working status in order to collect and analyze the data.

References

1. Bahga A, Madisetti V (2015) Internet of things—a hands on approach. Orient Black Swan (2015)
2. Patel KK, Patel S (2016) IOT based data logger for monitoring and controlling equipment working status and environmental conditions. Int J Innov Res Comput Commun Eng 4(4):5103–5112
3. DHT11 temperature and humidity sensor. https://www.robot-r-us.com/vmchk/sensor-temp/humid/dht11-temperature-and-humidity-sensor.html
4. Ardiuno UNO. https://www.farnell.com/datasheets/1682209.pdf
5. Bell DA (2008) Electronics devices and circuits, 5th edn. Oxford
6. Minoli D, Sohraby K (2010) Wireless sensor networks. Wiley, Hoboken
7. How to design a PCB layout. http://www.circuitbasics.com/make-custom-pcb/
8. Tutorial 1 for Eagle schematic design. https://www.youtube.com/watch?v=1AXwjZoyNno

A Hybrid Approach for Protecting Mobile Agents Against Malicious Hosts

Kanduru Phani Kumar and V. Purna Chandra Rao

Abstract The mobile agent devices must be part of any static or dynamic network structure for making the complete network and application functioning. In case of the static networks, the application host distributes specific security protocols for securing the mobile nodes. However, in case of the dynamic networks, the client nodes are directed to select the host nodes for making the application operational. During this process, the host can determine the connectivity of the mobile client nodes based on various authentication schemes. Nevertheless, the mobile nodes cannot justify the authenticity of the hosts. Hence, a good amount of changes persists to get connected to a malicious host node for any client nodes. During this kind of situations, the malicious host node can not only tamper the data, but also de-structure the complete network. Henceforth, this work proposes a novel throughput securing and optimization strategy to protect the network throughput during malicious host connections. This work also proposes malicious host connection fault detection in mobile agents using 2ACK plan. In this paper, we have implanted some security concerns with 2ACK to verify secrecy of the message by confirming first hash code with the objective hash code created. Nevertheless, due to the nature of battery power devices in the network for mobility device agents and WSN, the power consumption of the routing protocols also to be considered for the betterment of the routing algorithms. Henceforth, the energy efficiency became the most important criteria for performance evaluation to be considered. Thus, this work evaluates the performance of routing algorithms for highly dense mobility device agent's architecture. The major outcome of this work is to propose a novel safe host-based algorithm with lesser energy consumption and evaluates improvements over the existing systems.

Keywords Mobility agent security · Routing security · Communication security · Energy efficiency · Reduced complexity

K. P. Kumar (✉)
Research Scholar, Department of Computer Science, Dravidian University, Kuppam, Andhra Pradesh, India

V. Purna Chandra Rao
CSE, MLR Institute of Technology, Hyderabad, India

H. S. Saini et al. (eds.), *Innovations in Computer Science and Engineering*,
Lecture Notes in Networks and Systems 103,
https://doi.org/10.1007/978-981-15-2043-3_52

1 Introduction

With the growing nature, the architecture also demands the improvement in terms of infrastructure, architecture, and parameters to make the algorithms suiting better [1]. The lack of improvement guidelines like Shannon theorem applicable to MANET is the major bottleneck to develop the improvised guidelines for designing and developing the MANETs. The recent researches have demonstrated the demand of such a model and also predicted that the mathematical formulation of such a model to calculate the throughput for each node can accelerate the improvement of MANET alongside with the optimization theories. This will also become a baseline for the improvement of strategy design during the manufacturing and implementation of MANETs [2].

The recent researches have demonstrated the effort to create a higher level of knowledge regarding throughput capacity of a MANET. We define throughput capacity as most extreme attainable info rate that can be bolstered by a spatial and transient devising calculation.

In order to achieve the efficient balance factor between the throughput and delay in the network performance, the recent works have demonstrated a good number of assumptions and results [3]. The recent works have also considered the effect of the works carried out on independently identically distributed mobility models. With the static delay of "d," it is possible to achieve throughput of the network with the order of $\Theta\left(n^{\frac{-1}{3}}\right)$, where the throughput can be maximized up to $d^{\frac{2}{3}}$. This is a considerably major improvement of the study. It is also demonstrated in the previous works that in the independently identically distributed, the throughput can be achieved by the order of $O\left(\frac{1}{\sqrt{n}}\right)$ considering the network delay at $O\left(\sqrt{n}\right)$, if and only if the no. of redundant packets in a network are $\sqrt{n}$ for each data packets. The results of the previous works are also considered in this work.

Moreover, the recent works also consider the networks with Brownian motion traffics with the randomness parameter value of σ_n^2. In such networks, the throughput of the network can be extended up to with the assumption that the data packet delay cannot exceed $\Omega\left(\log \frac{n}{\sigma_n^2}\right)$.

The recent research outcomes also demonstrate the framework for improving the throughput capacity for the network [4].

Hence this framework is proposed to maximizing the throughput capacity for the network, by analyzing the network structure and improving the network throughput, rather understanding the mathematical model to realize the per node throughput capacity and apply optimization techniques for maximizing the total throughput.

There are two kinds of mobile agents: Closed_MA and Open_MA [5]. In a closed mobile agent network, all mobile nodes coordinated with each other to obtain a common objective, such law enforcement and as emergency search/rescue or military operations. Wireless transmission is identified as one of the major sources of energy consumption in the mobile nodes of mobile agents. A node is said to be selfish node,

i.e., conserve its own energy, only if it may refuse to forward data packets for other nodes to avoid energy conservation [6–8].

The challenge in the mobile ad hoc networks is to propose an efficient routing algorithm [9, 10]. The efficiency of mobility device agents depends not only on the packet delivery but also on the power awareness of the algorithm [11]. A number of studies are being carried out in the space of mobility device agents routing algorithms [12]. The existing space of routing algorithms is being classified into three categories [13]. As and when the routing needs or the network topologies changes, the information is being propagated to all the nodes and the routing information table is being updated subsequently [6, 7]. The details of the few of the existing algorithms are studies in this research in the forthcoming sections.

2 Understanding and Optimization of Networks for Mobile Agents Under Malicious Hosts Introduction

Primarily, we consider a network, where with a "significantly sustainable transmission range of '*v*,' each node can reach to maximum throughput capacity with any possible value of '*f*.'"

The sustainable distance v for transmission to each node, we denote the maximum or optimized throughput as $\mu*$. Hence, $\mu*$ can be formulated as the following mathematical model:

$$\mu = \max\{\mu(v, f)\} = \text{maxmin}\left\{\frac{1}{E\{S_S(S)\}}, \frac{1}{E\{S_D(f+1)\}}\right\} \tag{1}$$

where $1 = f = n - 2$, $1 = v = \left\lfloor \frac{\sqrt{n}+1}{2} \right\rfloor$.

As the $E\{S_S(1)\}$ and $E\{S_D(f+1)\}$ are demonstrated previously.

Concerning the resolution of this improvement issue, it is important to consider the succeeding results:

For each v, $|v| \in \left[1_2 \frac{\sqrt{n}+1}{2}\right]$

we have,

$$u = \max\left\{\frac{1}{E\{S_D(f+1)\}|f - f_0}, \frac{1}{E\{S_S(1)\}|f - f_1}\right\}$$

where,

$$\begin{aligned} f_0 &= \max\{f|E\{S_S(1)\} \le E\{S_D(f+1)\}\} \\ f_1 &= \min\{f|E\{S_D(f+1)\} \le E\{S_S(1)\}\} \end{aligned} \tag{2}$$

The above outcomes specify that for a MANET with a static υ, there is an optimal situation of f (f_0 and f_1) to realize the optimum every node throughput $\boldsymbol{u}*$

To demonstrate optimum throughput $\boldsymbol{u}^*$, for $\upsilon = \{1, 2, 3\}$, how $\mathbf{u}^*$ and the equivalent optimal situation of f vary with network size n. These demonstrations evidently that for every situation listed above for υ, though the corresponding u^* decreases rapidly as the size of the network grows in terms of area and transmission range. For example, when $n \leq 143$, the $\boldsymbol{u}^*$ where $\upsilon = 3$ is always the highest considering all the situations, while the u^* of the instance $\upsilon = 1$ becomes the utmost one once n is greater than 270. Thus, it can be naturally understood as follows:

Any specified network, if a greater υ (and therefore a greater transmission distance) is presumed, any node should have more likelihood to connect with its endpoint or relay and hence should transport packets more profligate, subsequent in a lesser number of replicas for every packet before it reaches at the endpoint.

3 A Method for Detection of Malicious Host Connection in Mobile Agent Network by 2ACK

The proposed structure is utilized to determine the defect guiding utilizing 2ACK and furthermore examine the secrecy of the information message in mobile drivers' condition. Below, we made use of a strategy called 2ACK strategy, where the goal of the adhering to bounce link will certainly send back a 2-jump affirmation called 2ACK to show that the details' bundle has actually been obtained effectively. The proposed job (2ACK with category) is according to the following:

- "Let we consider, 2ACK time is not specifically the hold-up time and also the very first message material is not customized at the in-between interfere hub at that point, a message is offered to the sender that the link is functioning appropriately."
- "Suppose, 2ACK time is more than the hold-up time and the initial message substance is not changed at the center of the roadway center, then a message is offered to the sender that the link is leaving hand."
- "If the 2ACK time is greater than the hold-up time and also the very first message compound is changed at the middle of the roadway hub, the message is given to sender that the connection is getting out of hand, and secrecy is shed."
- Finally, "2ACK time is not exactly the hold-up time and also the initial message compound is adjusted at the middle of the roadway center at that point; a message is given to sender that the connection is working appropriately, as well as a category is lost." At goal, a hash code will be created and also contrasted with the sender's hash code with checking of the personal privacy of the message. Therefore, if the link is breaking down, sender to transfer messages will not utilize it in future and loss of parcels can be maintained a strategic range from.

4 A Novel Energy-Efficient Safe Host-Based Routing Protocol for Mobility Device Agents (MDA)

The epic safe host-based methodology is proficient and compelling by the methods for vitality productivity. The grouped depended approach is exhibited in this area.

So as to build up the scientific model, the accompanying lemmas are considered. The lemmas and the resulting hypothesis will build up the model by breaking down the sheltered host discovery.

Lemma 1 *Any calculation must change the sheltered host haphazardly and time to time so as to upgrade the existence time of the system.*
where
$T(\mathrm{CH})$ *indicates the protected host choosing capacity and returns the sheltered host for whenever example*, G *is the arrangement of bunches*, N *is the arrangement of hubs in any group, and* k *is the round number.*

Proof In order to prove the above lemma, this work demonstrates that,

$$\forall g \subset G \tag{3}$$

There exists a cluster g in the total network such that

$$\Phi(g) \neq \mathrm{NULL} \tag{4}$$

The number of non-dead or active nodes is not zero.
Further, the selected node, n

$$\forall n \subset N \tag{5}$$

And the randomly selected node to be considered as the new safe host, n'

$$\forall n(t) \subset N \tag{6}$$

Subsequently to be naturally understood that,

$$N \notin N' \text{ and } N' \notin N \tag{7}$$

So the recently selected safe host can be avoided similar to the last one.
Considering the $R(k)$ is the percentage of the safe host available in the N, then

$$1 - R(k)[k\,.\ \mathrm{mod}\ 1/(R(K))] \tag{8}$$

The remaining percentage of the safe hosts, available in the collection N.
Henceforth, the cluster head deciding the function can be formulated as

$$T(\mathrm{CH})T(\mathrm{CH}) = \frac{R(k)}{1 - R(k)[k\ .\ \mathrm{mod}\ 1/(R(K))]} \tag{9}$$

As the Eq. 7 clearly stands the point of not repeating safe hosts in the subsequent times, the energy consumption is also evenly distributed.

Lemma 2 *Any algorithm must select the safe host based on the comparisons of effective energy available in order to increase the life span of the network.*
where
Net_LSpan *denotes the life span of the network*, Net_Egy *denotes the energy of the network*, *and* N_Egy *denotes the energy of the node*.

Proof In order to prove the above-mentioned lemma, this work demonstrates that

$$\int_{\mathrm{MAX(Net\_\ Egy)}}^{\mathrm{MIN(Net\_\ Egy)}} \mathrm{Net\_\ Egy} \tag{10}$$

Max and Min denote the maximum and minimum energy of the network.
Subsequently,

$$\int_{\mathrm{MAX(N\_\ Egy)}}^{\mathrm{MIN(N\_\ Egy)}} \mathrm{N\_\ Egy} \tag{11}$$

Here, choosing any node n to be the safe host will result in

$$\mathrm{Res(N\_\ Egy)} = \frac{\mathrm{N\_\ Egy}(t)}{\mathrm{d}x\left(\mathrm{N\_\ Egy}_n\right)} \tag{12}$$

where Res denotes the effective energy left in the node.

After the random selection of the any safe host, the energy varies in the utilized and non-utilized node.

$$\mathrm{Res(N\_\ Egy)}_n < \mathrm{Res(N\_\ Egy)}_{n+1} \tag{13}$$

Further selection of the same node n will result in

$$\mathrm{Res(N\_\ Egy)}_{nn} \tag{14}$$

Repeated selection of the same node will result in

$$\mathrm{Res(N\_\ Egy)}_n \tag{15}$$

Thus, having a random shutdown of the node and result in

$$\text{Res(Net\_ Egy)}(t) \rightarrow \text{Min(Net\_ Egy)}(t) \tag{16}$$

Naturally to be understood that this will result in

$$\text{Net\_ LSpan} \rightarrow 0 \tag{17}$$

This effective will be visible in much lesser amount of time.

Henceforth, the proposed lemmas "Lemmas 1 and 2," this work discusses the novel algorithm,

Step 1. Initially, the list of active nodes will be defined as,

$$n \subset N \notin D \tag{18}$$

where "n is a node belongs to the cluster set N and does not belongs to the D, the dead cluster set."

It is proven that the random selection of the safe host will improve the life span of the network as referred from Lemma 1.

Step 2. Next, for the selected node, the energy status will be calculated.

$$\text{Res}(n) \leftarrow \overline{\text{Max(N\_ Egy}(n))} \tag{19}$$

It is observed from the above step that the consideration of the available energy will improve the life span of the network.

Step 3. Henceforth, the weight function consisting of the available energy and selection of non-repeating nodes will be considered as the safest nodes.

Where

CH denotes the safe host

$$\text{CH} = \prod_{\text{Res(N\_ Egy}(n))}^{\text{Max(N\_ Egy}(n))} n \oplus [n \subset N \notin D] \tag{20}$$

The routing table—RTab—captured the data for all the nodes in the network with the following parameters.

$$\text{RTab}\left(\text{N\_ Egy}_n, n_{\text{source}}, n_{\text{Destination}}, n_{\text{Next}}\right) \tag{21}$$

Step 4. Later, the nearest neighbor node will be decided by repeating the steps 1 to 4.

Step 5. Once the path is finalized, the data transfer process is carried out.

Step 6. Repeat the steps 1–5 whenever the network topology is modified.

Henceforth, the novel safe host-based algorithm may show the higher latency; however, the algorithm will demonstrate the higher energy awareness compared to the existing algorithms.

5 Results

The simulation is carried out on MATLAB with the standard datasets called "The upb/hyccups dataset" [14] and demonstrates substantial improvement. The improvements are shown in Table 1.

Table 1 Energy awareness with 30 nodes

Number of nodes	Energy disruptions in the network (Joules)		
	FSR	OORP	Novel technique
1	0.1486	0.100	0.0984
2	0.1472	0.099	0.0969
3	0.1458	0.099	0.0953
4	0.1444	0.099	0.0937
5	0.143	0.098	0.0919
6	0.1416	0.098	0.0903
7	0.1402	0.097	0.0887
8	0.1388	0.097	0.0871
9	0.1374	0.097	0.0856
10	0.136	0.096	0.084
11	0.1346	0.095	0.0823
12	0.1332	0.095	0.0808
13	0.1318	0.094	0.0792
14	0.1304	0.094	0.0777
15	0.1289	0.094	0.076
16	0.1275	0.094	0.0744
17	0.1261	0.094	0.0729
18	0.1247	0.094	0.0712
19	0.1233	0.093	0.0696
20	0.1219	0.093	0.0679
21	0.1206	0.093	0.0663
22	0.1192	0.092	0.0647
23	0.1178	0.092	0.0632
24	0.1164	0.092	0.0616
25	0.1151	0.091	0.0601
26	0.1137	0.090	0.0586
27	0.1124	0.090	0.0571
28	0.111	0.090	0.0556
29	0.1097	0.090	0.0542
30	0.1084	0.090	0.0526

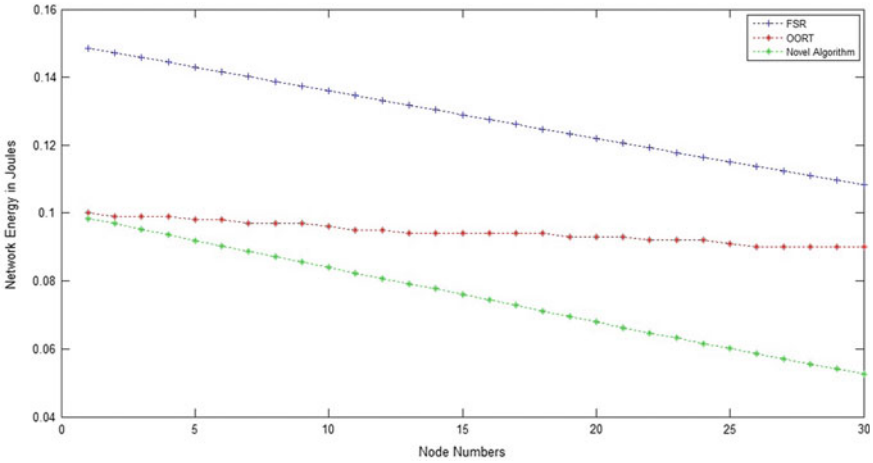


Fig. 1 Improvement in energy efficiency with 30 nodes

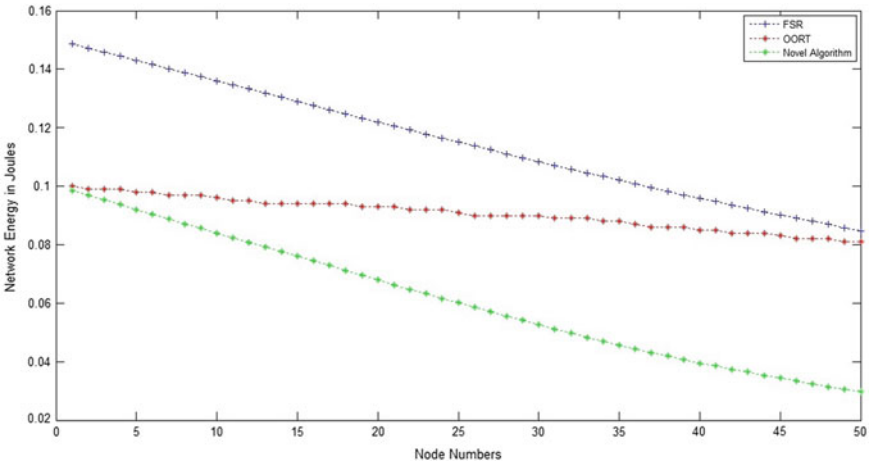


Fig. 2 Improvement in energy efficiency with 50 nodes

The improvement is observed visually (Figs. 1 and 2).

6 Conclusion

The considered framework in this work may except one of the most parts reveal a similar cause like way with the decrement of transmission increase, the framework center throughput cutoff will dependably increase. In this paper, we have checked

out the show defilement recognized by such egotistical (getting away hand) facility factors in mobile experts. We have checked and also evaluated a method, named 2ACK, to regard and decrease the effect of such poisonous host association weakness. Wide examination of the 2ACK arrangement has been executed to examine its presentation. We have actually installed some safety perspectives with 2ACK to inspect protection of the message by attesting the major hash code with the hash code supplied at the purpose. Our reproduction results display that the 2ACK setup keeps up to 91% bundle transport degree in spite of when there are 40% acting wickedly center points in the mobile masters that we have examined. One preferred placement of the 2ACK setup is its adaptability to regulate above with making use of the R2ACK criterion. With the purpose of improving the essentialness capacity of the MDA working with computations, this job recommends and sets up the unique celebration-based assisting figuring. The mix sets up the boosted outcomes stuck out from the present evaluations. Over the series of the evaluation, the work provides the demands of the MDA controlling evaluations with their memorable dismissal problems for some arbitrary framework. The job checks the display screens of OLSR, Babel, and DSDV in the electric motor of the positive figuring; ABR, AODV, and DSR under the hood of responsive computations ultimately separate the FSR and MRP and also the proposed systems. The figuring is revealed to have greater imperativeness earnings and also consistency for an exceptionally thick MDA. This job ultimately causes the unique evaluation regarding half renovation in the power care and the suggested version for processing the insistence adequacy of some irregular figuring for more updates.

References

1. Goldsmith A, Effros M, Koetter R, Medard M, Ozdaglar A, Zheng L (2011) Beyond shannon: the quest for fundamental performance limits of wireless ad hoc networks. Published at IEEE Communication on May 2011
2. Zhang J, Chen J, Sun Y (2009) Transmission power adjustment of wireless sensor networks using fuzzy control algorithm. Wirel Commun Mob Comput 9:805–818
3. Grossglauser M, Tse DN (2001) Mobility increases the capacity of ad hoc wireless networks. Published at "INFOCOM"
4. Gamal E, Mammen J, Prabhakar B, Shah D (2006) Optimal throughput-delay scaling in wireless networks—part I: the fluid model. IEEE Trans Inf Theory 52:2568–2592
5. Lorenzini E (2007) Cooperation. In: Proceedings of sustainable cooperative multi-hop wireless network (Online). http://www.research.microsoft.com/enus/um/people/ratul/…/nsdi2005-catch.pdf
6. Mariasy GF, Georgiadis P, Flitzanis D, Mandalas K (2006) Cooperation enforcement schemes for Mobile agents: a survey: research articles. Wirel Commun Mob Comput 6(3):319–332
7. Tamilselvan L, Sankaranarayanan V (2008) Prevention of co-operative black hole attack in Mobile Agent Network. J Netw 3(5):13–20
8. Liu K, Deng J, Varshney PK, Balakrishnan K (2007) An acknowledgment-based approach for the detection of routing misbehavior in Mobile agents. IEEE Trans Mob Comput 6(5):536–550
9. Rishiwal V, Verma S, Bajpai SK (2009) QoS based power aware routing in MDAs. Int J Comput Theory Eng 1(1):47–54

10. Huang C (2004) On-demand location-aided QoS routing in ad hoc networks. In: Proceedings of IEEE international conference on parallel processing, Aug 2004, pp 502–509
11. Lio W-H, Tseng Y-C, Shih K-P (2002) A TDMA-based bandwidth reservation protocol for QoS outing in a wireless mobile ad hoc network. In: Proceedings of IEEE international conference communication, vol 5, pp 3186–3190
12. Punde J, Pissinou N, Makki K (2003) On quality of service routing in ad-hoc networks. In Proceedings of 28th Annual IEEE conference on local area network, Oct 2003, pp 276–278
13. Wan P-J, Calinescu G, Li X, Frieder O, Minimum-energy broadcast routing in static ad hoc wireless networks. In: Proceedings of IEEE INFOCOM, Apr 2001, pp 1162–1171
14. The upb/hyccups dataset, Radu I. Ciobanu, Ciprian Dobre. https://crawdad.org/upb/hyccups/20161017/

A Novel Optimization AHBeeP Algorithm for Routing in MANET

A. V. Zade, R. M. Tugnayat and G. B. Regulwar

Abstract The world around us is becoming increasingly complex every day and changes dynamically. The problems that we face require adaptive and scalable systems that can offer solutions with ever-rising level of autonomy. Traditional approaches are becoming obsolete because they were designed for a simpler world. Therefore, any advancement in understanding and solving complex problems can have an impact on the entire set of disciplines in engineering, biology, sociology, etc. In this paper the ant colony optimization (ACO), genetic algorithm is evaluated and compares their performance with the novel proposed adaptive honey bee protocol (AHBeeP). The algorithms, stimulated by the supportive behavior of nature in colonies of animals and social insects, were initially applied to solve the traditional optimization problems. In today's scenario, the main challenge is to transfer the packets of data from source system to destination system. In the proposed approach, the optimization is used for transferring the data packets based on the honey bees intelligence to communicate each other in the form of dancing language that can be useful for finding the shortest route in the wireless networks and also in optimized way of pathfinding.

Keywords Swarm intelligence · ACO · AHBeeP · Waggle dance

1 Introduction

Swarm intelligence tactics are more hopeful for MANETs and WSNs due to the following prominent aspects interactions among themselves, availability of numerous paths, scalable performance robustness to failures, easiness of design and tuning. MANET is nothing but the collection of mobile nodes that intercommunicate each other on the basis of shared wireless channels working in self-configured, infrastructure-less networks. In mobile adhoc networks, the nodes are furnished

A. V. Zade (✉)
Research Scholar, SGBA, University, Amravati, India

R. M. Tugnayat · G. B. Regulwar
Principal, Shankarprasad Agnihotri College of Engineering, Wardha, Maharashtra, India

H. S. Saini et al. (eds.), *Innovations in Computer Science and Engineering*,
Lecture Notes in Networks and Systems 103,
https://doi.org/10.1007/978-981-15-2043-3_53

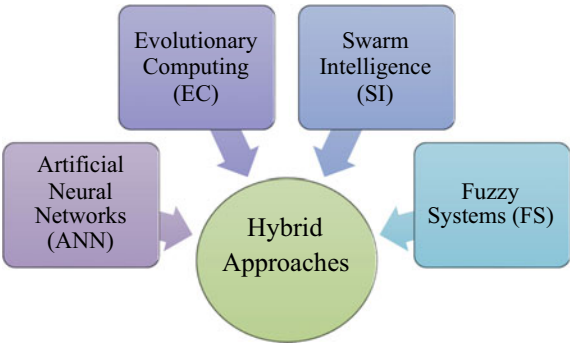


Fig. 1 General optimization approaches

with the connection establishment, flow and error control and connection termination capabilities. The mobile adhoc networks do not depend on any concrete infrastructure, and no one is having the centralized administration to control the network. In directive to connect every node in the network, each node will work as a router which will accept the data and forwards the packets of data to the other neighboring devices which are in the same range. With this approach, the mobile node will also work as a router, and with this feature, it shows the fast deployment of wireless networks.

The main task is to reduce the traffic congestion quite urgently because the amount of money lost due to congestion in traffic networks. Nature has always encouraged researchers; by simple perceiving the environment by simply noticing the outlines, the set of rules makes seemingly messy processes logical [1]. How do social insects communicate the messages optimally? These questions are answered by swarm intelligence (Fig. 1) [2].

Artificial bee colony optimization technique is currently involved in many research areas to crack optimization problems [3]. In real world network problems, social insect's intelligence can be adopted from environment and mimicking its behavior in our real world application problem statements.

The overall organization of the paper is as follows. Section 2 describes the challenges in mobile networks and types of networks exist. In Sect. 3, swarm intelligence paradigms are clarified in detail with ant colony and honey bee system algorithms. In Sect. 4, simulation environment with performance metrics are elaborated and analyzed both algorithms.

2 Dynamic Diversity Enhancement Swarm Optimization Algorithms

Social insects' behavior is always been fascinating to human being in every aspect [4]. In many areas, the capabilities of social insects surpass the human abilities. After observing the behavior of social insects and animals, we have been able to find many interesting solutions which we can co-relate or module into our generic problems.

In this research paper, a novel approach proposed as adaptive honey bee protocol (AHBeeP) for mobile adhoc networks takes footsteps on *swarm intelligence*. The first approach is ant colony algorithm, and the second novel approach is honey bee colony optimization [5]. The ants do not have direct communication instead they communicate by *stigmergy*. The shortest route discovery in ant colony is known as ant colony optimization which takes the help of pheromone.

2.1 Ant Colony Optimization (ACO)

Ant colony optimization is a swarm-based discrete search space approach which models the hunting behavior of ant colonies in nature. The ants through collaboration can solve the composite problems such as survival of fittest along with finding the shortest path to a food source [6]. This feature can be used to solve the engineering problems that require this kind of optimization. When ants move to find the food, we assume that they start their journey from their nest and walk in the direction of food source. At the point where the ant is having two directions for the food source, while moving, ants lay pheromone on its path [7]. The path which is having concentration of pheromone indicates the flow of swarm, and observing the pattern of pheromone, other ants will follow the same path. As time passes, the attentiveness of pheromone will also decrease; this effect is known as dispersion. The pheromone property is important because it helps to find the current issues by integrating dynamic path searching process.

While traversing from one location to another, ants leave pheromone trails on the edges connecting the two locations. The activated pheromone trails which are having more concentrated pheromone attract other ants that lead to pheromone trail accumulation [8]. As the pheromone evaporates, negative feedback is applied through that path and importantly restrains the ants from taking the same path and allows for continuous search for improved solutions.

2.1.1 Ant Colony Mechanism

In ant colony algorithm, new routes are discovered. For creating the new routes requires backward ant and forward ant. The forward ant establishes path by the pheromone track to the source node. In contrast, a backward ant establishes the pheromone track to the destination node [2].

In the process of destination finding, the forward ant arrives at to the target node. The target node extracts the information from the forward ant and destroys it. Afterward, it creates a backward ant and sends it to the source node. When the source node receives the backward ant from the target node, the path is established and data packets can be sent. Only one pheromone track is created by the forward ant toward

the source node, but the two pheromone tracks are created by backward ant toward the destination node [9]. In this way, numerous path routing is also maintained by ant colony.

2.2 Genetic Algorithm (GA)

Genetic algorithm is a powerful mechanism and better than the other traditional artificial algorithms.

Genetic algorithm does not break easily even though the inputs change slightly or drastically; the reasonable noise will not affect the outcome of genetic algorithm. Genetic algorithms are used in the fields like searching in a large state space, multi-model or n-dimensional surface in a state space. The main objective of genetic algorithm is to find the optimal solution in an optimized way.

Genetic algorithms use the mechanism as survival of fittest among individuals or consecutive generation of problem solving [10]. Genetic algorithm is based on an analogy with the genetic structure and behavior of chromosomes within the population of individuals using the following aspects,

(a) Each element from a population search for the resources on survival of fittest mechanism.
(b) The elements those are more successful in each competition will produce more offspring as compared to the elements which perform poor.
(c) Genes from good elements throughout the population, so those good parents will sometimes produce more offspring than other parents.
(d) Hence, from each successive generations, it produces more suited properties to their environments.

2.2.1 Genetic Operators

(i) Selection Operator: In the process of selection, the preference is given to better individuals and allows individuals to pass on their genes to the next generation individuals [11, 12]. The goodness of each individual depends on its fitness value. The fitness value is calculated by an objective function.
(ii) Cross-over Operator: This is the most important factor of genetic algorithm. Two elements/individuals are chosen from the given population by the selection operator. The values of two strings are exchanged by the following method, if S1 = 000000 and S2 = 111111, the cross-over point is 2, then S1 = 110000 and S2 = 001111.

The two off strings are created from this mating and are put into the next generation.
(iii) Mutation Operator: In this process, the portion of the new elements will have some of their bits flipped. The purpose of mutation is to maintain diversity

within the population and inhibit premature convergence. The applications of mutation and selection are parallel, noise-tolerant, hill-climbing algorithms.

2.3 Honey Bee Swarm Intelligence

In 1944, a professor of zoology Karl von Frisch made a Nobel winner revolutionary discovery that the bee informs other hive mates of the distance and direction of the food source. To communicate other honeybees, they use the dancing language known as waggle dance [13].

Honey bee dancing is one of the most intriguing behaviors in social insects. It is a form of direct communication that worker bees use to recruit other bees in the swarm to follow them to the resource site [3]. When a bee returns to the hive with a load of nectar that is sufficiently nutritious to guarantee return to the source, she performs a dance to share the information about the direction and location of the food source with other bees [5].

Dance patterns may contain two items of information, namely distance and direction of the food source. If a food foundation is located close to the hive which is less than 50 m, the bee performs a round dance. If the food source is at a greater distance more than 150 m, the honey bee performs a "waggle dance" [14] (Fig. 2).

The interval of the waggle dance execution is proportional to the length of the outbound flight [15]. The forager bee who is optimistic regarding the information walks upward while creating a waggle run pattern. The optimistic bee indicates that the nourishing point is in the same direction as with the sun. If the heads of the waggling bee are 50° to the right of vertical, her indication is that the nourishing point is 50° to the right of the sun [16].

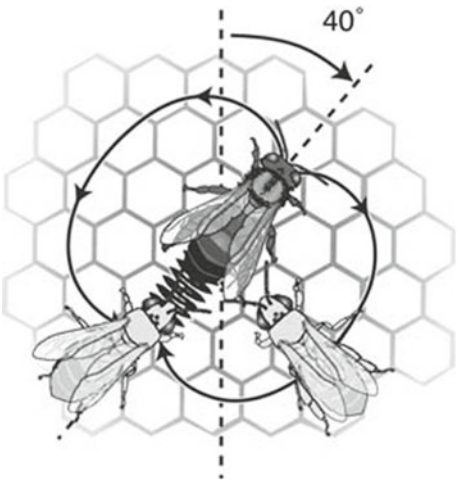


Fig. 2 Honey bee dancing language

2.3.1 Problem Statement

The main challenges of the wireless networks are the limited battery life and the mobility of nodes in the network. The mobility may arise different issues like connection establishment/termination. The intention is to mimic the behavior in wireless communications, where different protocols are tested already. The objective is to analyze the two swarm intelligence methodologies and implement these methods in real-life technical environment [2]. These two protocols, namely ant colony optimization (ACO) and adaptive honey bee protocol (AHBeeP), are analyzed in the simulation environment and find the best protocol for the efficient and effective data communication.

2.3.2 AHBeeP Algorithm

1. **Algorithm**

```
i = 0;
Create initial population,
Evaluate Fitness Value of initial population
Sort the initial population based on the fitness
result
while i ≤ Maxitr or
FitnessValue_i − FitnessValue_i-1 ≤ Err
   i.   i = i + 1
   ii.  Select the elite patches and non-elite best
        patches for neighborhood search.
   iii. Recruit the forager bees to the elite patches
        and non-elite best patches.
   iv.  Evaluate the fitness value of each patch.
   v.   Sort the results based on their fitness.
   vi.  Allocate the rest of the bees for global search
        to the non-best locations.
   vii. Evaluate the fitness value of non-best patches.
   viii. Sort the overall results based on their
        fitness.
   ix.  Run the algorithm until termination criteria
        met.
```

The algorithm starts with sending no scout bees randomly to selected sites, The fitness values of each site are evaluated and sorted from the highest to the lowest according to the (bp); best sites are also classified into two sub-groups, elite and non-elite best sites, and for the global sites, this process repeats [13]. Finally, the overall locations are sorted according to their fitness value and the process runs until the global optimum is found.

Table 1 Route handling instructions

dx = x-desx;
dy = y-desy;
diff = (dx*dx) +
(dy*dy);
distance1 =
sqrt(diff);
	dx = nx-desx;
	dy = ny-desy;
	diff = (dx*dx) +
	(dy*dy);
	distance1 =
	sqrt(diff);

where, x = x-coordinate of current node y = y-coordinate of current node desx = x-coordinate of destination node y = y-coordinate of destination node nx = x-coordinate of next node	

dist_diff = distance1-distance2
if(dist_diff > 0) {//Positive Direction}
else {//Negative Direction}	

2. **Route Handling and Link Quality**

The distance between the current node and destination is calculated as follows in Table 1.

The link quality is measured as follows,

D is measured as the distance between the node and its neighbor, and DT is measured as the distance difference between the node and destination and the neighbor and destination.

$$\text{DT} = \text{distance(node-destination)} - \text{distance(neighbor-destination)}$$

If DT is positive, then it is in positive progress toward destination. If DT is negative, then it is in negative progress toward destination.

$$\boldsymbol{Q}[] = \boldsymbol{D}[] + \boldsymbol{E}[] + \boldsymbol{S}[] + \boldsymbol{SS}[] + \boldsymbol{QL}[] + \boldsymbol{LD}[]$$

where $\boldsymbol{Q}$—Quality, $\boldsymbol{D}$—Distance, $\boldsymbol{E}$—Energy, $\boldsymbol{S}$—Speed, $\boldsymbol{SS}$—Signal strength, $\boldsymbol{QL}$—Queue length, $\boldsymbol{LD}$—Link delay.

Link quality measurement in AHBeep is measured in a single hop manner that reduces the overhead of protocol.

3 Simulation Environment

The Network Simulator-2 (NS2) is employed to analyze the behavior of two protocols, namely ACO and AHBeeP. Network Simulator-2 is the most widely used wired/wireless network simulator. Network simulator-2 targeted the group of people for the networking study and research. It provides substantial support for simulation

Table 2 Simulator parameters

Simulation constraints	
Simulator	Network Simulator-2.35
Protocols	ACO, genetic, AHBeeP
Simulation duration	50 s
Simulation area	600 m × 600 m
Number of nodes	50, 55, 60, 65, 70, 75, 80, 85, 90, 95, 100
MAC type	Mac/802.11
Network interface type	Phy/wireless phy
Link layer type	LL
Channel type	Channel/wireless channel

of traditional as well as discovered protocols over wired and wireless networks. The various simulation parameters required are summarized as follows in Table 2.

In above simulation experiment, a number of nodes are taken as 50, 55, 60, 65, 70, 75, 80, 85, 90, 95, 100. The protocols ant colony optimization, genetic algorithm and proposed adaptive honey bee protocol are analyzed under the IEEE standard parameters; the network metrics are used for evaluating the performance of various protocols.

4 Performance Metrics

For analyzing ACO and AHBeeP protocols, we focused on two important performance parameters which are packet delivery ratio (PDR) and throughput.

1. ***Packet Delivery Ratio (PDR)***: The fragment of all the acknowledged data packets successfully delivered at the destinations over the number of data packets sent by the source is known as PDR. The performance of any protocol is measured based on the higher value of PDR, higher the value of PDR, accepted straightforwardly.
   PDR = (Number of packets generated * 100)/Number of packets received
2. ***Throughput***: Throughput is nothing but the average number of messages delivered successfully per unit time at the receiver, i.e., acknowledged average number of bits delivered at the receiver per second [17].
3. ***Total Delay***: Network delay is an important design and performance characteristic of data communications. The delay of a network specifies how long it takes for a bit of data to travel across the network from one node or endpoint to another. It is typically measured in multiples or fractions of seconds. Delay may differ slightly, depending on the location of the specific pair of communicating nodes.
   Delay[i] = Receive_Time[i] − Sending_Time[i];
   Total_Delay[i] = Total_Delay[i] + Delay [i];

4. ***Average Delay***: Average delay parameter is totally based on the total delay of network. It is calculated as a ratio of total delay calculated for packet from sender to receiver divided by the count; here, count indicates the packet sequence numbers.
5. ***Routing Overhead***: Routing overhead is defined as the ratio of the total packet size of control packets including Hello packet, RREQ, RREP and RERR to the total packet size of data packets delivered to the destinations.

4.1 Results

The following chart graph shows the performance evaluation of ant colony optimization, genetic algorithm and adaptive honey bee colony protocol. For evaluation nodes are interpreted from 50 to 100 with the difference of 5. The performance metrics signify the implementation and serviceability of any protocol in the real-world scenario.

Figure 3 shows the comparison of ACO, genetic and AHBeeP with the packet delivery ratio (PDR). PDR is nothing but the ratio of number of packets generated to the number of packets received. It is clear that in the AHBeeP protocol, the PDR is very high. As we can increase the number of nodes from 50 to 100, the PDR continues with the high values. While in ACO as the number of nodes increases, the PDR drops slightly, because of the congestion in network or bulkiness of network. Genetic PDR increases as we increase the nodes. Hence, AHBeeP performs excellently well.

Figure 4 shows the comparison of ACO, genetic and AHBeeP with the throughput. We can clearly see that the AHBeeP provides more throughput as compared to the other two protocols; throughput is measured in Kbps.

Figure 5 shows the total delay comparison of ACO, genetic and AHBeeP. In this case, as the network becomes complex, the total delay in case of AHBeeP is very high as compared to the other protocols, because in AHBeeP, the received packets are more as compared to the other two protocols; hence, it took more time to reach to the destination.

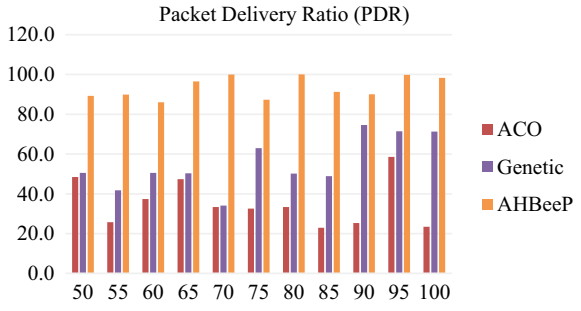


Fig. 3 PDR of ACO, genetic and AHBeeP

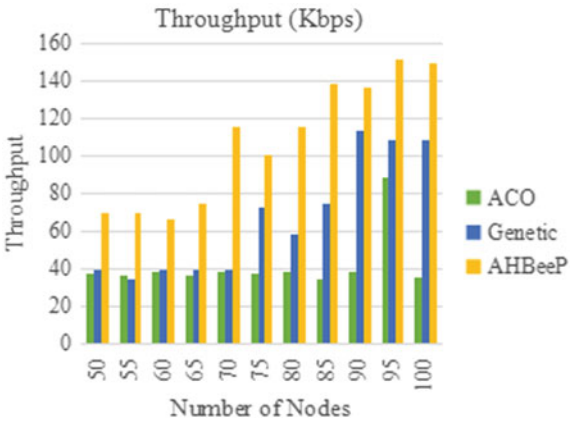


Fig. 4 Throughput of ACO, genetic and AHBeeP

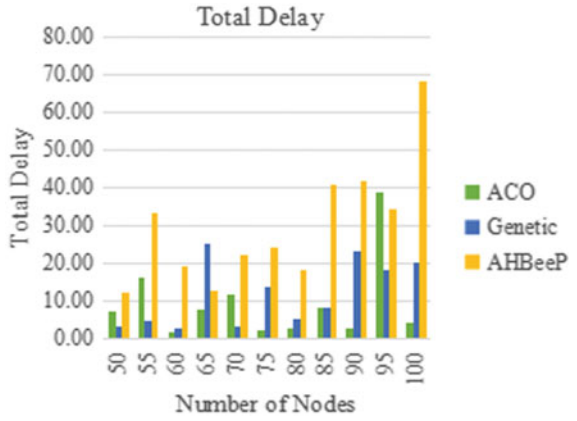


Fig. 5 Total delay of ACO, genetic and AHBeeP

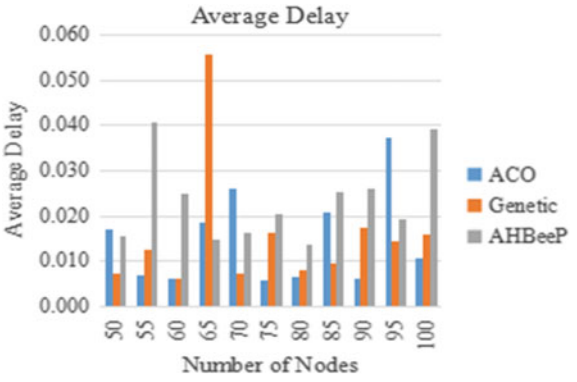


Fig. 6 Average delay of ACO, genetic and AHBeeP

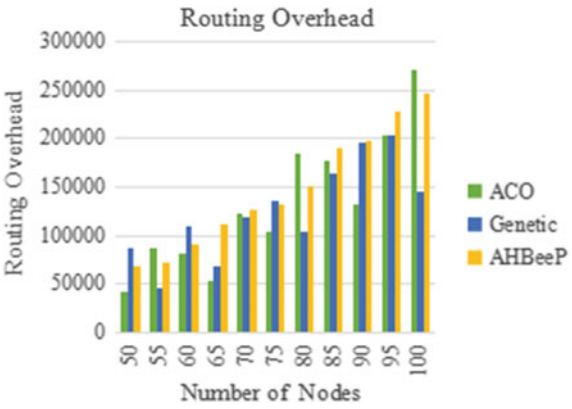


Fig. 7 Routing overhead of ACO, genetic and AHBeeP

Figure 6 shows the average delay comparison of ACO, genetic and AHBeeP. In this scenario, the mixed type of behavior is observed in these three protocols.

Figure 7 shows the routing overhead comparison of ACO, genetic and AHBeeP. As per the scenario, as the network is less complex, the overhead in proposed AHBeeP protocol is very less, and as the network becomes complex, the routing overhead is slightly increased, but in some of the cases, it is nearly same as with the other protocols.

5 Conclusions and Future Work

Swarm intelligence (SI)-based ACO, genetic and AHBeeP protocols provide exciting clarifications to network routing problems. AHBeeP-based routing protocol in MANETs will enhance the efficiency and reliability of packet delivery. The AHBeeP shows out performance for the effective and efficient data communication in terms of packet delivery ratio and throughput in the MANETs. AHBeeP helps in reducing control overhead due to their inherent scalable feature. The proposed AHBeeP approach signifies the transmission of data from source to destination in an effective way as compared to the swarm's ant colony optimization and genetic algorithm.

The research in swarm intelligence focused on two general approaches. One approach was to solve the optimization like problems using the swarm-based algorithms as tools, and the other approach is to model the multi-agent systems such that they look like swarms of animals in nature providing them as the input source for our practical approaches to solve complex issues. The future perspective will be to compare the solutions with other swarm intelligence techniques like genetic algorithms, colony of birds and fishes.

References

1. Giagkos A, Wilson MS (2014) BeeIP—a Swarm intelligence based routing for wireless ad hoc networks. Inf Sci 265:23–35 (Elsevier)
2. Zade AV, Tugnayat RM (2014) Ant Colony Optimization (ACO) in disaster information network. Int J Innov Eng Res Technol (IJIERT) 1(2). ISSN: 2394-3696
3. Zade AV, Tugnayat RM (2015) A honey bee swarm intelligence algorithm for communication networks. Int J Eng Sci Res Technol (IJESRT) 4(1):644–647. ISSN: 2277-9655
4. Kirby J, de Oca MAM, Senger S, Rossi LF, Shen C-C (2013) Tracking time-dependent scalar fields with swarms of mobile sensors. In: IEEE 7th international conference on self-adaptive and self-organizing systems. IEEE Computer Society, June 2013. ISSN: 978-0-7695-5129
5. Karaboga D (2005) An idea based on honey bee swarm for numerical optimization. Technical report-Tr06, Oct 2005
6. Iliea S, Badica C (2013) Multi-agent distributed framework for swarm intelligence. In: Proceedings of international conference on computational science, ICCS 2013, vol 18. Elsevier, pp 611–620 1877-0509
7. Kiatwuthiamorn J, Thammano A (2013) A novel optimization algorithm based on the natural behavior of the ant colonies. Procedia Comput Sci 20:90–95, 1877-0509 (Elsevier)
8. Momen S (2013) Ant-inspired decentralized task allocation strategy in groups of mobile agents. Procedia Comput Sci 20:169–176, 1877-0509 (Elsevier)
9. Gunes M, Sorges U, Bouazizi I (2002) ARA-the ant colony based routing algorithm for MANET's. In: Proceedings of the international conference on parallel processing workshops (ICPPW'02), 1530-2016/02. IEEE Computer Society
10. Benavidez P, Nagothu K, Ray AK, Shaneyfelt T (2008) Multi-domain robotic swarm communication system. In: SoSE '08 Proceedings of IEEE international conference on system of systems engineering, Singapore, June 2008, pp 1–6. ISBN: 978-1-4244-2172-5
11. Baras JS, Mehta H (2003) A probabilistic emergent routing algorithm for mobile ad hoc networks. In: Proceedings of WiOpt '03: modeling and optimization in mobile, adhoc and wireless networks, Sophia-Antipolis, France, 3–5 Mar 2003
12. Yuce B, Packianather MS, Mastrocinque E, Pham DT, Lambiase A (2013) Honey bees inspired optimization method: the bees algorithm. Insects J 4:646–662. ISSN 2075-4450
13. Friedman R, Shulman AK (2013) A density-driven publish subscribe service for mobile adhoc networks. J Ad Hoc Netw 11(1):522–540
14. von Frisch Karl (1967) The dance language and orientation of bees. The Belknap Press of Harvard University Press, Cambridge, MA
15. Nezami OM, Bahrampour A, Jamshidlou P (2013) Dynamic Diversity Enhancement in Particle Swarm Optimization (DDEPSO) algorithm for preventing from premature convergence. Procedia Comput Sci 24:54–65. In: 17th Asia Pacific symposium on intelligent and evolutionary systems, IES 2013. Elsevier, 1877-0509
16. Biradar A, Thool R (2014) Reliable genetic algorithm based intelligent routing for MANET. In: World congress on computer applications and information systems (WCCAIS). IEEE Xplore, 17–19 Jan 2014. ISBN: 978-1-4799-3351-8
17. Fahmy IMA, Nassef L, Hefny HA (2012) Predicted Energy-Efficient Bee-inspired Routing (PEEBR) path selection optimization. In: 2012, Proceedings of IEEE on 8th international conference informatics and systems (INFOS). ISBN: 978-1-4673-0828-1, 14–16 May 2012

Control of Two Degrees of Freedom Ball Balancer Using Image Processing

Kiran G. Krishnan, Kritika Dutta, Steve Abraham Eapen, Mathew Martin and Jeevamma Jacob

Abstract The ball-plate system is an unstable open-loop and nonlinear system having 2 degrees of freedom (DOF). This project aims to balance the ball on the plate at the centre or predefined coordinate by adjusting the angle of horizontal plate. The angle of horizontal plate is changed by tilting the plate both in X and Y axes. The actuation is done by two DC servo motors placed in both axes. The feedback of the ball is taken through an overhead camera by processing the images. OpenCV libraries are used for image processing purposes, and Robot Operating System is used as the middleware for the communication between the nodes.

Keywords 2 DOF ball balancer · Ball and plate system · Robot Operating System · OpenCV · Image processing · Control system · PID controller

1 Introduction

This paper presents the simulation and control of the 2 DOF ball balancer which works on image processing feedback rather than resistive touch feedback. Simulation of the system has been done in the Simulink. The simulations helped for getting a better understanding about the behaviour of the 2 DOF ball balancer. After getting a good simulation result, a system has been fabricated and control algorithms were implemented. In this system, a novel way of communication using Robot Operating System is implemented.

In this system of ball and plate, an overhead camera is placed for getting the feedback of the ball. The camera captures continuous frames of ball which will be processed using OpenCV in order to get the coordinates of the ball. The DC servo motors which are controlled by Arduino actuate the plate. Using the middleware ROS, all the data are communicated between nodes through messages.

Here, the required position of ball is achieved by decreasing the error in the current position and predetermined position. A PID controller is used here for decreasing the error for controlling the position and trajectory of the ball. Using this controller,

K. G. Krishnan (✉) · K. Dutta · S. A. Eapen · M. Martin · J. Jacob
National Institute of Technology, Calicut, Kozhikode, India

H. S. Saini et al. (eds.), *Innovations in Computer Science and Engineering*,
Lecture Notes in Networks and Systems 103,
https://doi.org/10.1007/978-981-15-2043-3_54

overshoot due to the high variation in the reference signal is reduced to a limit. In this project, an optimal PID controller is designed resulting in very low rise time, settling time, and negligible steady-state error.

In the literature review, it is found that there are 2 DOF ball balancer which works on the feedback from resistive touch screen or other methods [1]. Those types of feedbacks are very expensive and prone to damage quickly. By implementing a proper vision system, these problems can be solved. There are systems which have implemented vision. But that is through a different software called processing, and the communication is not that fast [2]. This problem is solved through this novel system.

2 Analysis

2.1 Modelling

The free body diagram of a ball on a plate in *X*-axis is as shown in Fig. 1.

$$m_{\mathrm{b}}\ddot{x}(t) = \Sigma F = F_{\mathrm{x,t}} - F_{\mathrm{x,r}} \tag{1}$$

where m_{b} = the mass of the ball, x = the ball displacement, $F_{\mathrm{x,r}}$ is the force due to ball's inertia, and $F_{\mathrm{x,t}}$ is the translational force on the ball generated by gravity.

Friction and viscous damping are neglected. The forces acting on the ball by the gravity are depicted as follows:

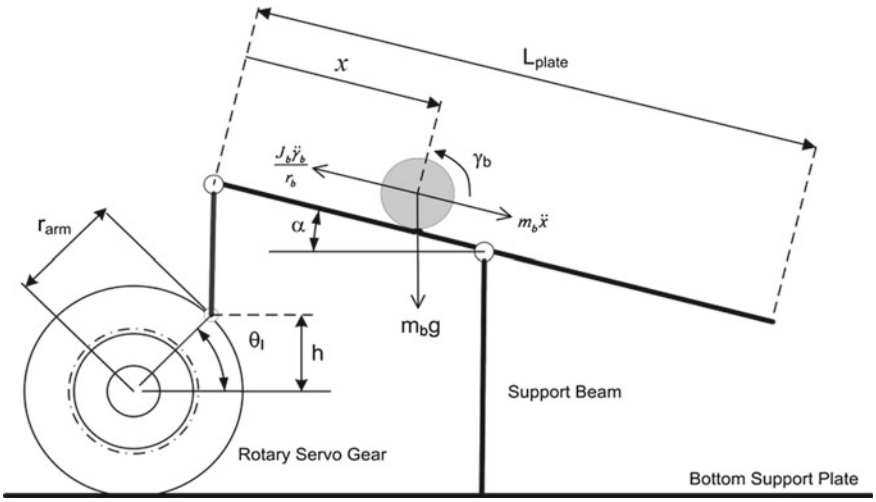


Fig. 1 Free body diagram of ball on plate

$$F_{x,t} = m_b g \sin\alpha(t) \tag{2}$$

The force caused by the rotation of the ball is:

$$F_{x,r} = (\tau_b / r_b) \tag{3}$$

where r_b = the radius of the ball and τ_b = the torque which equals $\tau_b = J_b \ddot{\Upsilon}_b(t)$ where Υ_b is the ball angle.

Substituting (2) and (3) in (1) and solving for the linear acceleration gives [3]

$$\ddot{x}(t) = \frac{2 m_b g r_{arm} r_b^2}{L_{plate}\left(m_b r_b^2 + J_b\right)} \theta_l(t) \tag{4}$$

2.2 Simulation

Simulations were done using MATLAB-Simulink for the Quanser 2 DOF ball balancer system [4]. Solving the obtained transfer function, corresponding PID controller coefficients' values were calculated. The control design was for 10% overshoot and 4 s settling time. The result of the simulation was 10.64% overshoot and 4.2 s settling time [5]. The theoretical K_p, K_d, and K_i values are 5.83 rad/m, 2.91 rads/m, and 3.69 rad/ms, respectively. These values were further tuned for the ball to achieve stability, and thus, K_p, K_d, and K_i values were observed to be 7 rad/m, 3.6 rads/m, and 6 rad/sm, respectively. This change in the calculated and observed values is because in simulation the weight of the plate is taken as negligible [6]. Figure 2 shows the servo response, Fig. 3 shows the position response of the ball, and Fig. 4 shows the servo voltage response when an impulse is given. The voltage rating of the servo motor is 5 V. We can see that the simulated result is reaching up to the rated voltage of the servo motor.

3 System Overview

The ball and plate system consists of five major hardware components, namely Arduino (Mega), servo motor, Microsoft Lifecam, Lithium polymer battery, and a universal joint. The Arduino (Mega) board offers digital and analog inputs and outputs as well as PWM output which can be programmed using Arduino IDE. The servo motor controls the orientation of the plate. Its position is defined by the width of duty cycle of the PWM pulses arriving from Arduino. The Microsoft Lifecam is used to obtain the visual feedback. The lithium polymer battery is used as the power

Fig. 2 Simulated servo angle response

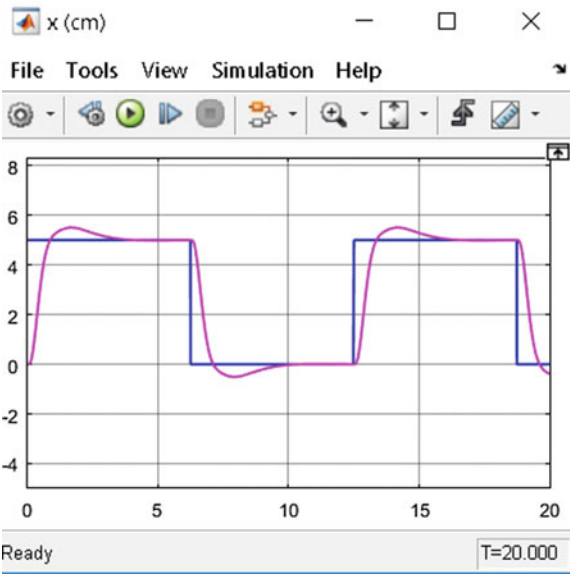


Fig. 3 Simulated position response of the ball

source, while the universal joint facilitates the movement of the plate along the *X* and *Y* axes.

Fig. 4 Simulated servo voltage response

3.1 Hardware

The base and plate of the system are made up of wooden planks. The plate is made in a square shape. It is fixed to the base using a universal joint. This joint facilitates the smooth motion of the plate in both X and Y directions [7]. The end of servo is attached with the plate using a rigid rod. Two PVC pipes joined with a joint are made for mounting the overhead camera. Figure 5 shows the image of the system hardware.

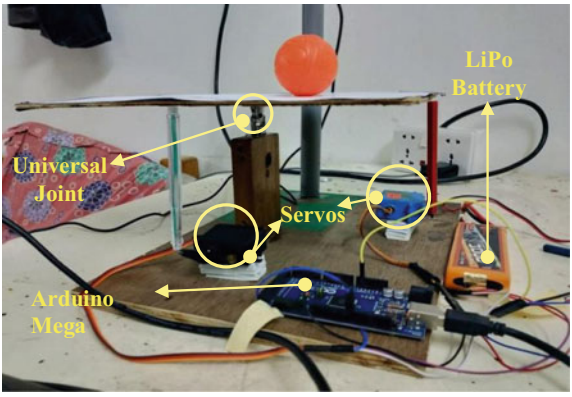


Fig. 5 Hardware of the system

3.2 *Electrical*

In this system, two DC servos are used for actuating the plate in *X* and *Y* directions. For the actuation, Arduino Mega development acts as the brain. ROS and Arduino are interfaced using rosserial_arduino making it the subscriber node. Two servos are connected to the microcontroller which subscribes the values of angles that are to be actuated by *X*-axis servo and *Y*-axis servo. Those values will be written to the servo so that it rotates to the required angle. Arduino Mega is used because it has more dynamic memory when compared to Arduino UNO. Since Robot Operating System (ROS) utilizes more dynamic memory, it may lead to sync error in development board which has less dynamic memory. Figure 6 shows the schematic diagram of electrical system design.

In this system, PID controller is used for decreasing the error [8]. Generally, the midpoint of the plate is fixed as the set point. So, here the error is defined as the difference between the present position and the set point [9]. Then, the error is fed into the PID controller to calculate the PWM that to be sent to the microcontroller to actuate the plate so as to reduce the error that is to balance the ball in the set point. Figure 7 depicts the block diagram of the closed-loop ball-plate system.

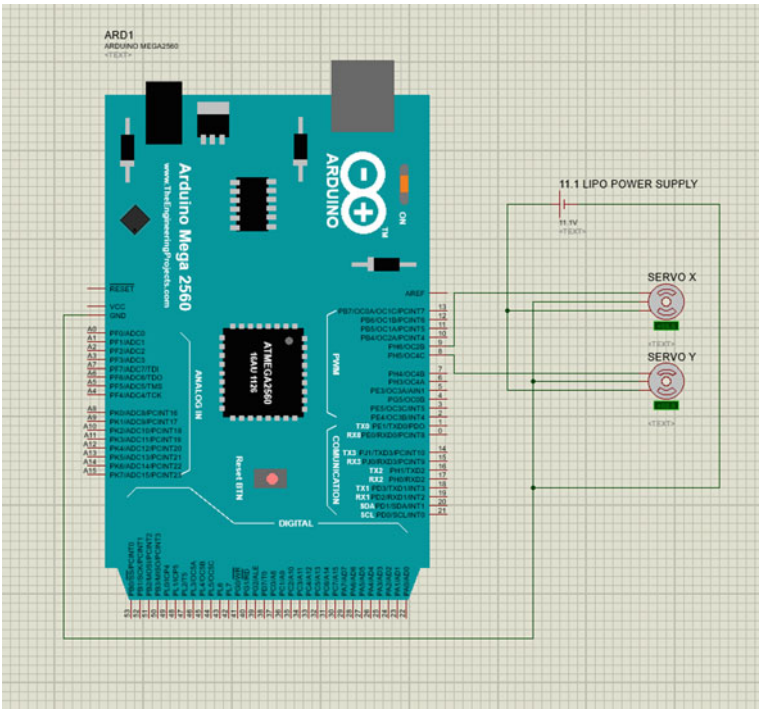


Fig. 6 Electrical schematic diagram of the system

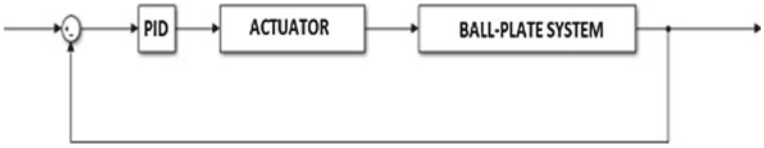


Fig. 7 Diagram of the closed-loop ball-plate system

3.3 Software

The main software used in this system is OpenCV, ROS, and Arduino IDE. OpenCV and ROS are a set of libraries which are coded in C++ language. OpenCV is used for image processing application [10], and ROS is used as a middleware for the communication between nodes [11]. OpenCV and ROS are interfaced using CVBRIDGE.

Here, mainly there are three nodes:

- usb_cam node—publishes the images taken by the overhead camera.
- ball_follower node—subscribes the images published by the usb_cam node and does the required processing publishing the angle to which the servo rotates for minimizing the error.
- Arduino—angles published by the ball_follower node are subscribed by the Arduino node and will actuate the servo accordingly. Figure 8 depicts the ROS nodes used in the system. Figure 9 shows the ROS node graph which depicts all the nodes and topics which are being subscribed or published.

The images subscribed by ball_follower node are in RGB colour space. For convenience, it is converted into HSV colour space. Then, the image is thresholded so as to isolate the ball from the surrounding by converting it into a binary image. Figure 10 shows the thresholded image of ball. Then, using moment method, the

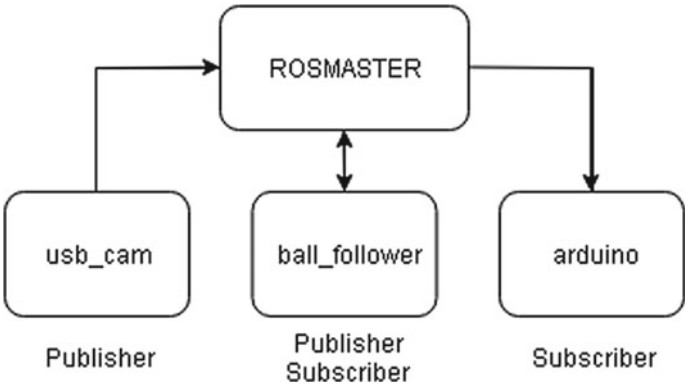


Fig. 8 Flowchart of ROS nodes used in the system

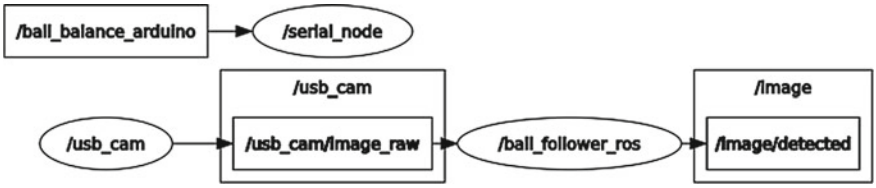


Fig. 9 ROS node graph

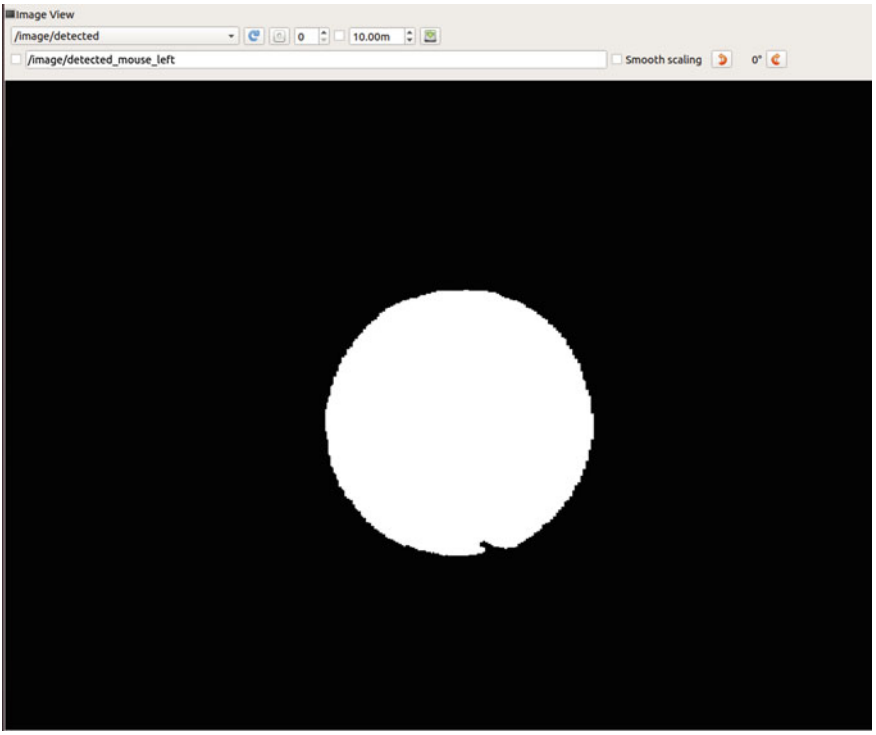


Fig. 10 Thresholded image of ball

centre coordinates of the ball can be found out. The middle point of plate is taken as the reference point. The difference between this position of the ball and the reference point is taken as error in the ball's position which is fed to a PID loop. The output from the PID loop is the angle of both the servos (X-axis servo and Y-axis servo) that to be rotated to minimize the error. The angles are published by the ball_follower node. Figure 11 shows the published angles. These angle values are subscribed by the Arduino node, which actuates the servo to attain the angle.

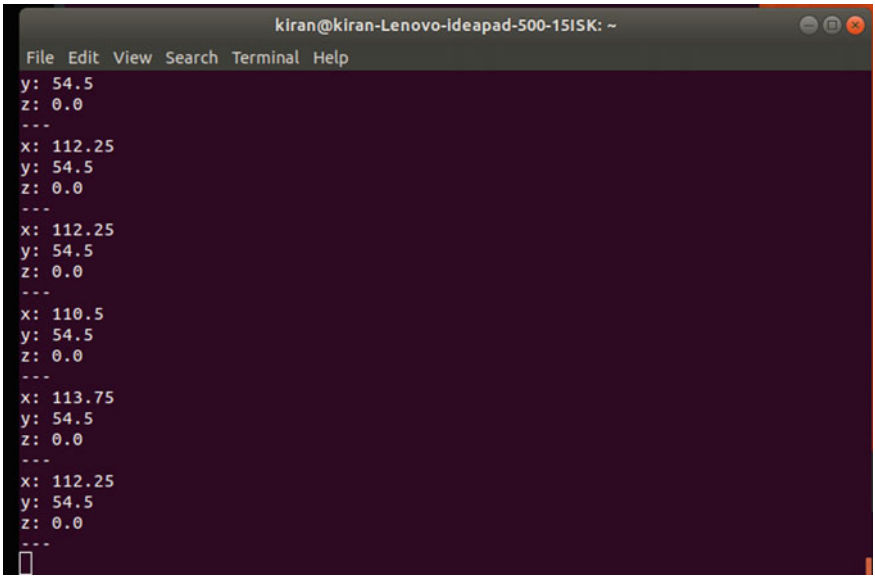


Fig. 11 Servo angles

4 Results and Discussions

The PID controller designed for the system helped the ball to be balanced at the centre of the plate. The total size of the frame captured by the camera is 320 pixels. Considering the centre of the plate as the reference point, the maximum error in the ball position is 160 pixels. Setting the maximum angle that the servo can rotate to be 120°, we get out K_p coefficient to be 0.75. This was tuned further when implemented on the ball-plate system for its stability. There are some disturbances in the plate due to the vibration of servo motors. Among PID controller coefficients, K_i has very small value making the system a PD controlled system. Overshoot and settling time are minimized. Figure 12 shows the servo angle response when the ball is going to achieve its stable position. Figure 13 shows the final ball and plate system.

5 Conclusion

In this paper, the aim was to balance a ball on the top of the plate at the centre or a predefined coordinate by adjusting the angle of horizontal plate. In many of the existing systems, they are using an expensive resistive touch panel for tracking the ball and providing feedback. But here, vision system is implemented in order to track the ball which is less expensive.

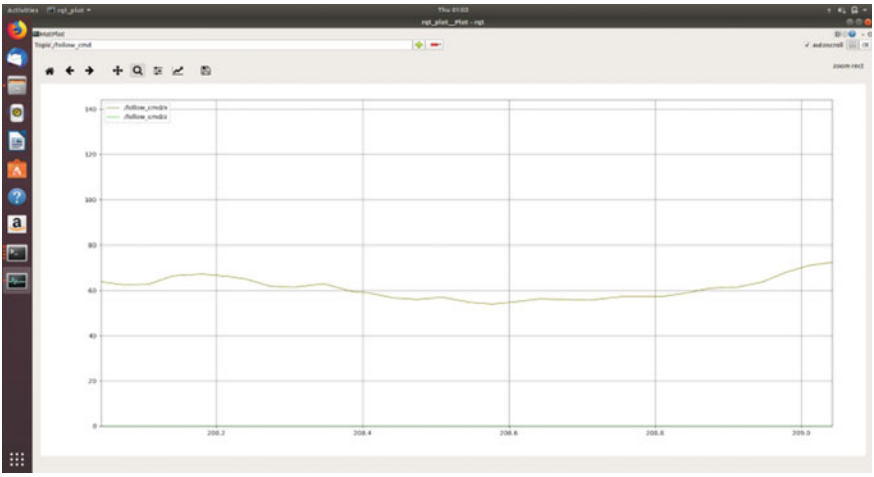
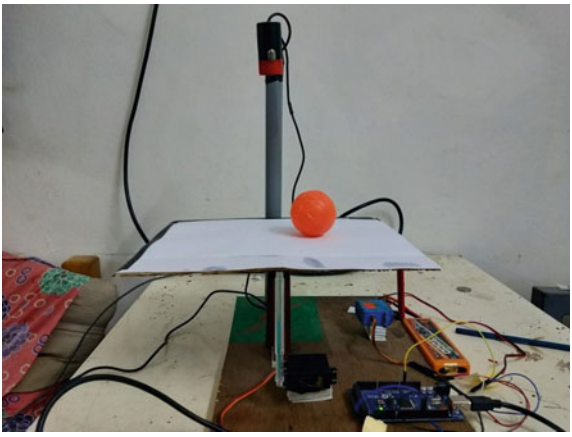


Fig. 12 Experimental response of servo angle

Fig. 13 Final ball and plate system



There were problems in this system such as removing noise from frames captures, and rejecting disturbances in order to maintain a static ball position balancing. The noises were removed from the images, but disturbances are still there due to the vibration of servo motors.

In this system, a new way of communication system or middleware was used when compared to other ball and plate systems. Integration of information and data using ROS is a novel way.

References

1. Ali E, Aphiratsakun N (2015) AU ball on plate balancing robot. In: IEEE international conference on robotics and biomimetics (ROBIO), held at Zhuhai, China, 6–9 Dec 2015
2. Kumar J, Showme N, Aravind M, Akshay R. Design and control of ball on plate system. Int J Control Theory Appl
3. Sinaga EF, Manurung EB, Chee VA, Djajadi A (2011) Building and controlling a ball and plate system. In: International conference on advances in communication, network and computing, held at Bangalore
4. Itani A. Ball plate balancing system using image processing. Master of Science thesis in Mechatronics Engineering, Graduate School of Applied Sciences of Near East University
5. Dusek F, Honc D, Rahul Sharma K (2017) Modelling of ball and plate system based on first principle model and optimal control. In: International conference on process control (PC), held at Slovakia, 6–9 June 2017
6. Christensen J, Humble J, Mattinson J. Ball-balancing platform design documentation. College of Engineering Utah State University
7. Quanser Inc. (2013) 2 DOF ball balancer. Students' Manual pp 5–9
8. Bang H, Lee YS (2018) Implementation of a ball and plate control system using sliding mode control. IEEE Access, 21 May 2018
9. Kasula A, Thakur P, Menon MK (2018) GUI based control scheme for ball-on-plate system using computer vision. In: IEEE Western New York image and signal processing workshop, 5 Oct 2018
10. https://en.wikipedia.org/wiki/OpenCV as on 22 Apr 2019
11. http://wiki.ros.org/ROS/Introduction as on 22 Apr 2019

A Bengali Text Generation Approach in Context of Abstractive Text Summarization Using RNN

Sheikh Abujar, Abu Kaisar Mohammad Masum, Md. Sanzidul Islam, Fahad Faisal and Syed Akhter Hossain

Abstract Automatic text summarization is one of the mentionable research areas of natural language processing. The amount of data is increasing rapidly, and the necessity of understanding the gist of any text is just a mandatory tool, nowadays. The area of text summarization has been developing since many years. Mentionable research has been already done through extractive summarization approach; in other side, abstractive summarization approach is the way to summarize any text as like human. Machine will be able to provide a new type of summarization, where the understanding of given summary may found as like as human-generated summary. Several research developments have already been done for abstractive summarization in English language. This paper shows a necessary method—"text generation" in context of Bengali abstractive text summarization development. Text generation helps the machine to understand the pattern of human-written text and then produce the output as is human-written text. A basis recurrent neural network (RNN) has been applied for this text generation approach. The most applicable and successful RNN—long short-term memory (LSTM)—has been applied. Contextual tokens have been used for the better sequence prediction. The proposed method has been developed in the context of making it useable for further development of abstractive text summarization.

S. Abujar (✉) · A. K. M. Masum · Md. Sanzidul Islam · F. Faisal · S. A. Hossain
Department of CSE, Daffodil International University, Dhaka 1027, Bangladesh
e-mail: sheikh.cse@diu.edu.bd

A. K. M. Masum
e-mail: mohammad15-6759@diu.edu.bd

Md. Sanzidul Islam
e-mail: sanzidul15-5223@diu.edu.bd

F. Faisal
e-mail: fahad.cse@diu.edu.bd

S. A. Hossain
e-mail: aktarhossain@daffodilvarsity.edu.bd

H. S. Saini et al. (eds.), *Innovations in Computer Science and Engineering*,
Lecture Notes in Networks and Systems 103,
https://doi.org/10.1007/978-981-15-2043-3_55

Keywords Natural language processing · Deep learning · Text Preprocessing · Text generation · Abstractive text summarization · Bengali text summarization

1 Introduction

Machine learning and data mining algorithms perform better after using a large number of labelled datasets. The importance of using a large dataset is that it helps the machine to understand the pattern based on any specific or general requirements, form that dataset, and be able to produce the better output. Text summarization is one the most necessary branch of natural language processing research. Extractive text summarization relies on the frequency, word and/or sentence repetitive nature, several word/sentence scoring methods, and some other lexical analysis [1]. Text summarization in both English and Bangla language has already been successfully developed. But this type of summarization may not useful in this days. The necessity of doing research nowadays is to develop machines to understand the context of any information given and be able to produce the summary based on its understanding. This type of summarization is in a stage of making comparison with human-generated summaries, and it is called abstractive summarization. Nowadays, information in every language is available in Internet or offline. Major research on this domain has done for English language and a few in Bengali language. The Bengali language has several limitations in data preprocessing. The best way of overcoming several problems is converting those texts into Unicode [2]. Dataset is the major contribution towards successful research outcome; large scale of labelled dataset is must for this purpose. RNN processes the sequence data very well because of its recurrent structure. Its hidden units are updated all the time, and it has no limitation in sequence length. Both forward and backward computation helps the neurons to understand the sequence [3]. Majority of classifiers cannot provide expected result if the dataset is very small. For abstractive summarization, machine requires the understanding of human-written text structure, from where machine can understand the pattern of human-written text. Based on this understanding, machine will provide summary by its own. To write a new sentence, machine needs to use its previous learning patterns of human-written sentence. In this way, that predicted summary contains incomplete sentences and may get the complete and corrected form. This paper represents the research implementation of text generation. The entire preprocessing, dataset structures and results have been discussed.

2 Literature Review

LSTM is most widely used RNN model in current days [4]; here, based on contextual token, every neuron gates helps the model in the process of predicting the next pattern more accurately. With this consequence, bidirectional LSTM model has

been built [5]. When there are so many varieties in data sequence, this type of LSTM helps to generate sequence data and makes the entire model more easy and useful. Several direct or embedded sentence generations have been done using LSTM [6]. Sequence generative adversarial nets (SeqGan) used Monte Carlo method to identify the next predicted token. This method has also applied using neural network decoder with domain-based knowledge for dialogue generation [7]. Sentence generation is entirely a decision-making system, and a computational representation any information, which requires to understand the sequence of data in many forms. It follows a goal-oriented method; several reinforcement learning models have applied for sentence generation [8], such as actor-critic algorithm. Ho et al. [9] explained the relation between GAN and inverse reinforcement learning. Hu et al. [10] have done several researches to reduce the loss between input and target output data using encoder–decoder problem; recently, VAE achieved outstanding result. Abstractive methods required deep investigation of the given text as input and extract the knowledge purpose of generating new sentence. Tanaka et al. [11] have explained several content selection technique as well rewriting methods. With improvement consequence of sentence generation, abstractive methods will be more accurate and machines will be able to predict and be able to complete writing the whole sentence considering the predicted contextual tokens. Text generation is significant for the arrangement to grouping word order. In this paper, we attempted to clarify a technique for how to create Bengali word next succession utilizing LSTM and RNN.

3 Methodology

Language modelling is the most important part of modern NLP. There is some part of the task such as text summarization, machine translation, text generation, and speech-to-text generation. Text generation is a significant part of language modelling. A well-trained language model does acquire knowledge of the probability of the event of a word based on the previous series of words. In this paper, we discussed n-gram language modelling for text generation and created a recurrent neural network for training model. Figure 1 shows our work methodology flow.

A. *Data collection and preprocessing*

Since we are working with Bengali text, we need a good dataset. We use our own dataset which was collected from social media. Our dataset contains several types of Bengali post such as group post, personal post, and page post. There are some obstacles to collect Bengali data such as the structure of Bengali text. But in our dataset, we try to reduce all of those obstacles to keep a pure Bengali text. Our dataset contains text data with their type and text summary. For our working purpose, we use only text and their summary to generate a sequence of next Bengali word.

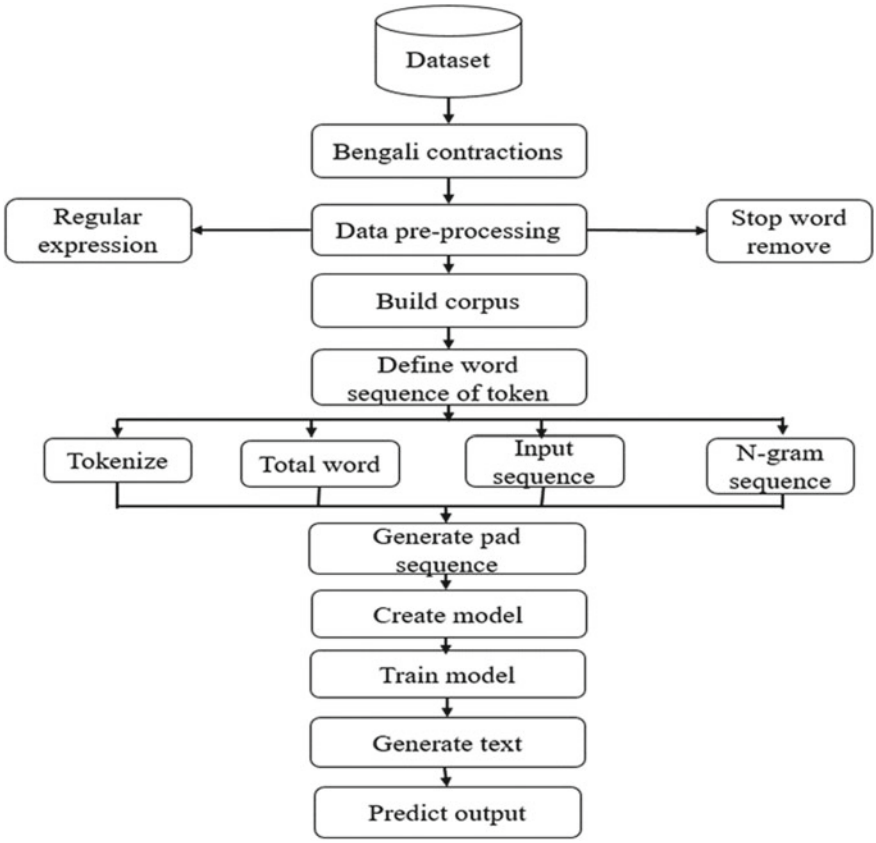


Fig. 1 Working flow for text generation

Before preparing dataset for text generation, we need to add Bengali contractions because contractions contain a short form of a word such as " বি.দ্র" = " বিশেষদ্রষ্টব্য", " ড" = " ডক্টর". After collecting dataset, we need to a clean dataset to generate text. So for clean data, we remove whitespace, digits, and punctuation from Bengali text and remove Bengali stop words from a Bengali stop word text file. Finally, we clean the text and create a list which contains text with their summary. Then, we create a corpus for text generation.

B. *n-Gram Tokens Sequence*

For text generation language model required a sequence of the token which can predict the probability next word or sequence. So we need to tokenize the words. We use keras build-in tokenize model which extracts word with their index number from the corpus. After this, all text transforms the sequence of the token. In n-gram, the sequence contains integer number token which was made from the input text

Table 1 Example of n-gram sequence token

n-Gram text	Token sequence
হাইটেক পার্ক	[103, 45]
হাইটেক পার্ক নির্মাণ	[103, 45, 10]
হাইটেক পার্ক নির্মাণ কাজ	[103, 45, 10, 24]
হাইটেক পার্ক নির্মাণ কাজ হাতে	[103, 45, 10, 24, 33]
হাইটেক পার্ক নির্মাণ কাজ হাতে নিয়েছে	[103, 45, 10, 24, 33, 67]
হাইটেক পার্ক নির্মাণ কাজ হাতে নিয়েছে সরকার	[103, 45, 10, 24, 33, 67, 89]

corpus. Every integer number represents the index of the word which is in the text vocabulary. The example is given in Table 1.

C. *Pad Sequence*

Every sequence has a different length. So we need to pad sequence for making sequence length equal. For this intention, we use keras pad sequence function. For the input of the learning model we use n-gram sequence as given word and the predicted word as next word. The example is given in Table 2. Finally, we can acquire the input X and the next word Y which is used for training model.

D. *Proposed Model*

A recurrent neural network works extremely good for sequential data. Because it's can remember it output cause of exterior memory. It can predict upcoming next sequence using memory and also deep understanding with its sequence compared to other algorithms. When it can consider the current state, it can remember what it learns from the previous state. RNN has the long short-term memory (LSTM) that helps to remember the previous sequence. Generally, recurrent neural network has two inputs: one is its present input and another is recent previous because remembering both the sequence current input and previous input helps to generate a complete text.

Table 2 Example of pad sequence

Given word	Next word
জ্যামের	*জ্যামের জন্য*
জ্যামের জন্য	*জ্যামের জন্য এক্সাম*
জ্যামের জন্য এক্সাম	*জ্যামের জন্য এক্সাম মিস*

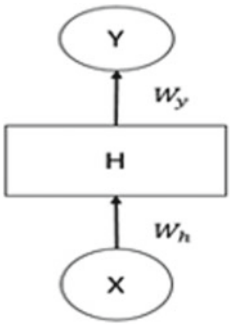


Fig. 2 Recurrent neural network

RNN applies weights of the sequence as input with time and produces weights of next sequence as output (Fig. 2).

The formula will be,

$$H = \sigma(W_{\mathrm{h}} * X) \tag{1}$$

$$Y = \mathrm{Softmax}\left(W_{\mathrm{y}} * H\right) \tag{2}$$

Here,

σ = Activation Function
X = Input, Y = Output, H = Hidden State, W = Weight

In our proposed model, we use the weight (w) of text sequence as input with the time (t). LSTM cell can store previous input state and then work with the current state. In Fig. 3, the input is a previous state and is the current state. When working in the current state, it can remember previous, and then using activation function, it can predict the next word or sequence. For training our model, we define keras sequential

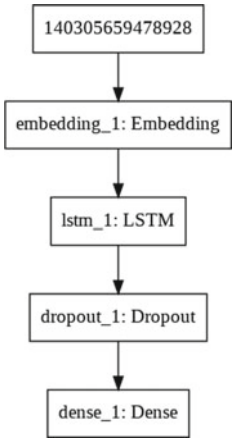


Fig. 3 Visualizing LSTM model structure

model and embed the total word with input sequence. Define LSTM with 256 units and 0.5 dropouts. Add dense which is equal of the total word and use softmax activation function. For loss function calculation, we use "categorical crossentropy" and use "Adam" optimization function.

Algorithm 1 *for Bengali text generation*

```
Set function model create(max sequence length, total word):
    declare Sequential()
  add(Embedding(total word, number of word, input word length))
    add(LSTM(size))
    add(Dropout(value))
    add(Dense(total words, activation function))
    compile(loss, optimization)
    return model
create model(max sequence length, total words)
```

In this segment, we demonstrate our model graphical view. Here, remarkable id is the contribution of the procedure which will proceed to the dense or yield layer.

Figure 4 shows a short view of the working model; here, LSTM can store the previous sequence. When working with the current state and it finds the next sequence to use the activation function. Softmax activation calculates the probability and keeps only the correct next sequence.

i. *Long Short-Term Memory:*

Long short-term memory is a part of the recurrent neural network. It is used to disappear the gradient and abolish gradient. Every LSTM cell has three gates such as Input Gate, Forget Gate and Output Gate. Also a cell state which added information via the gates.

$$i_t = \sigma\left(w_i\left[h_{t-1}, x_t\right] + b_i\right) \tag{3}$$

$$f_t = \sigma\left(w_f\left[h_{t-1}, x_t\right] + b_f\right) \tag{4}$$

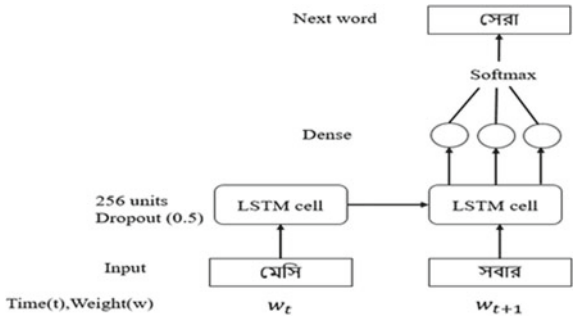


Fig. 4 View of proposed model

$$o_t = \sigma\left(w_o\left[h_{t-1}, x_t\right] + b_o\right) \tag{5}$$

$$c_t = f_t * c_{t-1} + i_t * \sigma\left(w_c\left[h_{t-1}, x_c\right] + b_c\right) \tag{6}$$

$$h_t = o_t * \sigma\left(c_t\right) \tag{7}$$

Here, i_t = input gate's, f_t = forget gate's, o_t = output gate, c_t = cell state, h_t = hidden state, σ = activation function.

ii. *Activation function:*

The softmax function is the logistic activation function, which is used to deal with classification problems. It maintains the output between 0 and 1 calculations probability. The formula for softmax function is,

$$\sigma(\mathrm{Z})_j = \frac{\mathrm{e}^{z_j}}{\sum_{k=1}^{k} \mathrm{e}^{z_k}} \tag{8}$$

Here, z is the input to the output layer and j indexes the output.

4 Experiment and Output

After creating the model function, we need to train our model. We fit the model with the current and next word. Set the epochs size 150 and set verbose = 2. Train model almost 3 h; it gives a better accuracy 97% with loss 0.0132. Figure 5 shows model train accuracy graph, and Fig. 6 shows loss graph of the model.

Previously, several research works were completed for English text generation with one direction RNN or LSTM. But in the Bengali language, very few research works were completed using LSTM for text generation. In this paper, we applied a

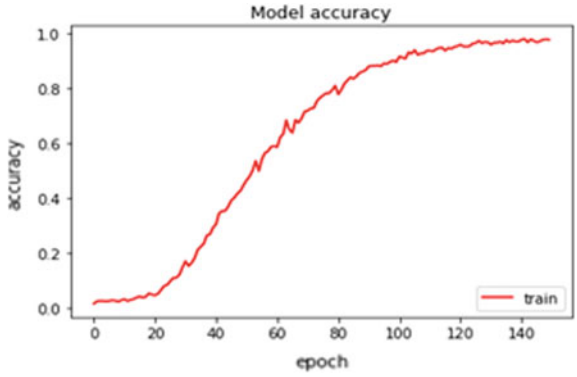


Fig. 5 Model accuracy graph

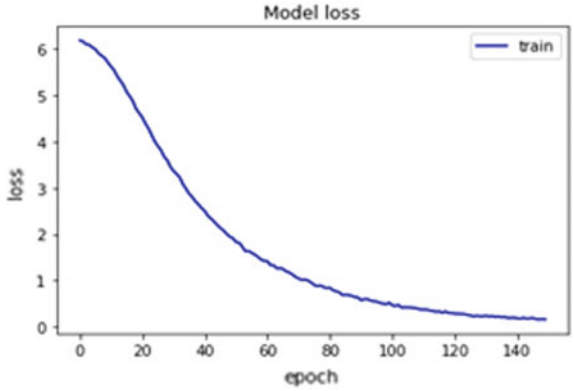


Fig. 6 Model loss graph

Table 3 Comparison of using LSTM and general LSTM

Approach	Accuracy (%)	Loss
General LSTM	93	0.01793
Using LSTM	97	0.0132

Table 4 Bengali text generation

Given text	Output
হাইটেক পার্ক	হাইটেক পার্ক নির্মাণ কাজ হাতে নিয়েছে সরকার
উজ্জ্বল অর্থের	উজ্জ্বল অর্থের প্রয়োজনে মিথ্যা সংবাদ প্রচার করে

method and processed Bengali text for text generation and provided a better output. Algorithms' performance comparison is given in Table 3.

In this experiment, our main goal is to create the next sequence of words. For output, we have created a function where we set a token list and seed text for showing output. We have fixed the seed word and set the length of predictor next word and call the model with maximum sequence length. Table 4 shows our experiment result.

5 Conclusion and Future Work

We have proposed a good method for generating an automatic Bengali text generation. Since no model gives accurate result, our model provides better output and maximum output is accurate. Using our proposed model, we have easily generated a fixed length and meaningful Bengali text. There are some limitations already discussed in this paper, such as this model cannot generate text without having the length of the text and n-gram sequence is needed which is a lengthy process. Sometimes, the order of the sentence is not correct in giving output.

There are some defects in our proposed methodology such as cannot generate random length text. We need to define the generating text length. Another defect is we need to define pad token for predict next words. In our future work, we will make an automatic text generator which provides a random length Bengali text without using any token or sequence.

Acknowledgements We would like to thank our DIU-NLP and Machine Learning Research Lab for providing all research facility and guidance. We would also give special thanks to our Computer Science and Engineering department for supporting in completing our research.

References

1. Abujar S et al (2017) A heuristic approach of text summarization for Bengali documentation. In: 8th IEEE ICCCNT 2017, IIT Delhi, Delhi, India, 3–5 July 2017
2. Abujar S, Hasan M (2016) A comprehensive text analysis for Bengali TTS using Unicode. In: 5th IEEE international conference on informatics, electronics and vision (ICIEV), Dhaka, Bangladesh, 13–14 May 2016
3. Schuster M, Paliwal KK (1997) Bidirectional recurrent neural networks. IEEE Trans Signal Process 45(11):2673–2681
4. Hochreiter S, Schmidhuber J (1997) Long short-term memory. Neural Comput 9(8):1735–1780
5. Graves A, Fernández S, Schmidhuber J (2005) Bidirectional LSTM networks for improved phoneme classification and recognition. In: Artificial neural networks: formal models and their applications—ICANN 2005, pp 753–753
6. Yu L, Zhang W, Wang J, Yu Y (2016) Seqgan: sequence generative adversarial nets with policy gradient. arXiv preprint arXiv:1609.05473
7. Li J, Monroe W, Jurafsky D (2017) Learning to decode for future success. arXiv preprint arXiv:1701.06549
8. Sutton RS, Barto AG (1998) Reinforcement learning: an introduction, vol 1, issue 1. MIT Press, Cambridge
9. Ho J, Ermon S (2016) Generative adversarial imitation learning. In: Advances in neural information processing systems, pp 4565–4573
10. Hu Z, Yang Z, Liang X, Salakhutdinov R, Xing EP (2017) Controllable text generation. arXiv preprint arXiv:1703.00955
11. Tanaka H, Kinoshita A, Kobayakawa T, Kumano T, Kato N (2009) Syntaxdriven sentence revision for broadcast news summarization. In: Proceedings of the 2009 workshop on language generation and summarisation, UCNLG+Sum '09. Association for Computational Linguistics, Stroudsburg, PA, USA pp 39–47

A Bio-acoustical Perceptual Sense* for Early Medical Diagnosis and Treatment

Vijay A. Kanade

Abstract Humans have five basic senses that are essentially outward bound. These senses take care of the human survival process. Concurrently, there is an enormous degree of involuntary activity unfolding within a human body that humans are literally not aware of. Some of the examples include water circulating through the body, blood flow within the body, the functional activity of lungs, heart, kidneys, brain, etc. The research proposal discloses a first-of-its-kind method of developing an inward bound 'sense' for harnessing perception beyond the 'five senses' which are distinctively outward bound. The proposal involves monitoring, recording and analyzing the acoustic fingerprint of the blood around the blood vessels as it flows through them. This would allow the medical fraternity to regularly track and monitor internal bodily parameters which could detect abnormalities in the human body at a very early stage. Thus, the developed 'inward sense' would prove to be helpful for diagnosis of any disease in its preliminary phases.

Keywords Bio-acoustical perceptual sense · Acoustical membrane implant · Electrodal wristwatch · Galvanic coupling · Blood vessels · Acoustic wave pattern

1 Introduction

A healthy human body normally produces sounds of various kinds as it functions. These sounds are very innate to living beings. The variety of sounds produced is a consequence of the smooth working of the physical organs functioning within us. Some of these sounds include: sound of air moving through the nose, mouth, bronchi, lungs; sounds heard from the rhythmic movements of the valves of the heart; blood flow through the blood vessels; gas movement through the alimentary canal, etc.

The body's sounds discussed above change their blueprint when the body is hit by a disease. The breathing pattern changes significantly, thereby producing irregular, variable and erratic sound(s). This further impacts the sounds generated by bronchi or

V. A. Kanade (✉)
Intellectual Property Research, Pune, India

H. S. Saini et al. (eds.), *Innovations in Computer Science and Engineering*,
Lecture Notes in Networks and Systems 103,
https://doi.org/10.1007/978-981-15-2043-3_56

lungs. Further, narrowing of blood vessels or valvular diseases of heart both hamper the normal blood flow, thereby disturbing the normal sounds produced by them.

In the medical world today, some of these sounds such as cracking sound produced by arthritic joints, broken bones are considered as dreadful. The sound produced in flesh body round about the infectious wound is an alarming signal signifying the inception of gas gangrene. Further to this, a lack of any sound is considered to be equally horrifying. No sound in the bowel region implies it is a call for immediate medical attention.

The importance of body sound thus lead to the invention of stethoscope in 1816 which made the clinical study in the medical sector efficient and easier. However, in spite of the sufficient knowledge about the role 'sound of organs' played, there has been no significant step taken to track the acoustical parameters produced by the human body. It is further important to understand that the abnormal sound pattern may not essentially relate or link to a particular disease, but rather associate to the change in specific bodily mechanism or alteration in physical structure.

Thus, the research proposal focuses on recording and monitoring acoustical fingerprints produced by bodily organs/fluids for early detection of abnormalities in the human body [1].

2 Literature Survey

2.1 Wearable Implants in Healthcare

Implantable wearables in healthcare include devices or implants that are embedded within the body parts or just layered under the skin for monitoring and tracking the health condition of an individual. Such a technology is termed as 'embeddable technology' that has been making rounds for quite some time in and around the healthcare domain.

These implants are battery powered which operate wirelessly. Some of the well-known applications of such wearable implants include blood sugar monitoring chips, brain implants for tracking neurological events, intelligent tattoos, heart monitoring sensors, fitness trackers, activity trackers, etc.

The implantable hardware can help in knowing or identifying the health concerns of any individual simply by regularly collecting bodily data and communicating it to the concerned health personnel [4].

These wearables need to essentially be in contact with the bodily constituents in order to monitor its parameters. Implying, the wearables have to become an integral component of the human body so that they can track the body's progression. However, the implants possess certain potential drawbacks such as: data accuracy, excessive information, etc. Further, during wireless communication, the wireless implants emit energy in the form of non-ionizing electromagnetic radiation (i.e., radio frequency) that can be easily absorbed by the tissues, cells in its vicinity. Therefore, the wearables

can cause complications to the human cellular mechanism. Thus, the need exists for implants to have a bird's-eye view of the human system and yet monitor its functioning on a regular basis without disturbing the harmonious ecosystem of the human body.

2.2 Wearable Devices for Blood Flow Monitoring

The human body contains about 65–70% water—implying, for a normal adult, approximately 60% of his/her weight is body fluid. Therefore, water constitutes an essential component of the human body [3]. The water that we intake reaches every organ in the human body within 30 min of its ingestion. During this process, water gets absorbed by the intestine and also circulates to every organ with a certain configuration of body fluid which is termed as 'blood.' Blood helps in carrying oxygen and nutrients to the cells and removing waste from the cells of the body. Further, with a significant rise in body temperature, the blood gets circulated more to the skin for allowing required heat to be dissipated through sweating, etc. Thereby, blood is observed to assist in regulating body temperature as well. Thus, 'blood' as the body fluid plays a significant role in the context of any living being.

Hence, blood flow characteristics in any cell/tissue act as a measure for determining the cells (or tissues) well-being. As per the medical research, the blood flow can vary depending on the kind of physiological change that takes place within the body, i.e., local blood flow increases with infectious or inflammatory conditions; further, local blood flow reduces significantly with diabetic condition or cardiac failure. Hence, if physicians could keep a track of this very blood flow, then they could be in a better position to treat a patient.

The researchers at the University of Illinois have dwelled into this subject area wherein they have developed an 'epidermal electronic' sensor system that monitors skin health, i.e., in patients having skin grafts. The device helps in recording the blood flow in larger blood vessels such as veins in the forearm. Further, the device can also record the blood flow through tiny vessels which are just near the surface of the skin. As the research stands today, the sensory system is capable of sensing only up to the depth of two millimeters.

The operative mechanism of the device is as disclosed. The device initially heats the skin and then tracks and records the heat flow. The heating apparatus is placed over an artery or vein under the skin's surface. Once the skin absorbs the heat, the blood flowing through the nearby vessel takes the heat away. The temperature sensors track and record the heat flow as it distributes via blood. Thus, the sensor system artificially infuses heat into the skin and records data of the heat flow for monitoring skin health [2].

3 Objectives

The research proposal focuses on tracking and recording the acoustical properties of blood flow by 'sensing' the flow characteristics via an acoustical membrane implant. The research addresses the following two primary objectives:

1. Harnessing inward perceptual sense by monitoring and tracking acoustical fingerprint of bodily fluids (i.e., blood) flowing through the blood vessels.
2. Early abnormality detection for medical diagnostics.

4 Hardware Framework

The proposed hardware for employing a perceptual sense includes the usage of: (a) acoustical membrane implant that is placed under the skin in close proximity of the arteries/veins/capillaries/arterioles and (b) electrodal wristwatch worn on the wrist.

4.1 Acoustical Membrane Implant

The method utilizes acoustical membrane implant having miniature sensors for capturing and monitoring acoustic parameters within the human body that decides the irregularities occurring within the body as each abnormality has an associated change in the acoustic fingerprint produced by the surrounding of the organ or the organ itself. The membrane is implanted under the skin around the arteries/veins/capillaries/arterioles in the hand or wrist area. The mentioned implant takes continuous acoustic measurements of blood flowing through the blood vessels mentioned above.

4.2 Electrodal Wristwatch

The apparatus further consists of a wristwatch with electrodes embedded in its hardware structure (i.e., electrodes are positioned on the downward-facing portion of the watch which is in touch with the skin surface). The membrane implant communicates the recorded acoustical changes of the underlying biological layers to the wristwatch through the process of 'galvanic coupling.' Hence, the implants convey the acoustical information of its surrounding to the wristwatch periodically. The watch and implant are 'time synched' which allows the status of an individual to be tracked on regular basis. Further, the watch transmits the collated 'time-synced' data wirelessly to the monitoring unit handled by the subject.

It has been seen previously that the on-body devices interact wirelessly with the implants through radio frequency (RF) wave spectrum. However, galvanic coupling introduces a new paradigm wherein a power optimized and safer means of communication is established between the body implant and the electrodal wristwatch. The communication involves two-way traffic disclosed below:

Surface-to-Implant Communication

The signal transmitter of the communication system is placed on the skin surface (such as watch in this case) and the signal receiver is embedded inside the membrane implant. The signal transmitter sends a current signal, and the signal reaches the receiving membrane through the skin in order to achieve communication. The very method is utilized as a communication mode for electric energy transfer to the implanted membrane.

Implant-to-Surface Communication

In the implant-surface communication system, the current signal sent from the membrane implant is currently coupled with the on-skin electrode device like watch through the human tissue.

In the above manner, implants relay the gathered information to the electrodal wristwatch regularly. Now, since the wristwatch and implants are 'time synced,' the changes in any of the acoustic wave parameters (i.e., amplitude, frequency, phase) recorded while the blood flows through the vessels can be studied seamlessly at any instance of time. The collected data (i.e., by the wristwatch) is transferred wirelessly to the nearby mobile device for further analysis.

5 Experimental Setup

It is a well-known fact that as the fluids flow through a medium such as pipe or blood vessel, it creates a certain sound pattern in and around the very medium. The research proposal deals with a novel method and apparatus for monitoring, recording and analyzing the fingerprint of the sound pattern that is created around the blood vessels as the blood flows through it. The blood flow through each of the arteries, veins, capillaries and arterioles has a characteristic fingerprint which is obtained by plotting amplitudes of the vibrations versus the frequencies of vibrations sensed by the membrane implant. By acquiring the plot of amplitude versus frequency derived from the acoustic wave pattern sensed from the blood vessel, the health parameters with respect to change in blood flow are tracked in time.

The operative model of the disclosed proposal is as given in Fig. 1.

As seen in Fig. 1, acoustical membrane implant is placed just under the skin surface of the human finger. The membrane is placed in such a way that geometrically it is in closest proximity to the close-by and accessible blood vessel (i.e., artery, vein or capillary). As the blood flows through the target blood vessel, the membrane continually monitors the acoustic waveform produced around the blood vessel.

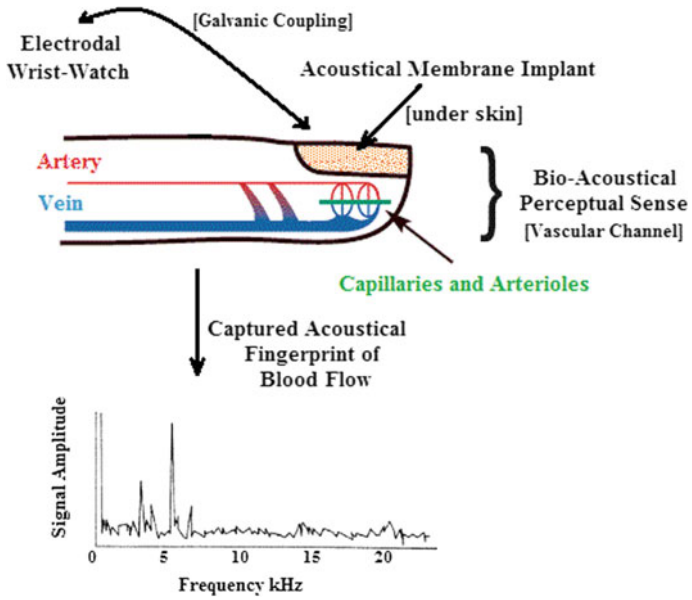


Fig. 1 A bio-acoustical perceptual sense mechanism

The model thus produces a graphical plot for the acoustic wave captured by the membrane implant. It is seen that changes in volume of blood flowing through the artery/vein/capillary/arteriole produce the change in the acoustical output of the very blood vessel, resulting in the waveform similar to one seen in the above graph.

In case of any abnormalities in the tissue/cell/organ physiology, the blood flow pattern changes. As the blood flow gets altered, the acoustic wave pattern recorded by the implant shows a shift. The event recorded by the implant is subsequently transferred or communicated to the on-skin electrodal wristwatch. The user of the wristwatch can thus interpret the values shown on the watch and take corresponding action as necessary. Thus, the proposed system allows the doctor to track the abnormalities unfolding within the human body (i.e., patient) at a primary stage. This fosters early medical diagnostic treatment of the patient.

5.1 Experimental Components

The following table discloses the specification factors of different experimental components that need to be considered while designing the framework for bio-acoustical perceptual sense. Customization of these specifications can be explored based on the expected output (i.e., effect) from the system (Table 1).

Table 1 Specifications of the experimental setup

Experimental components	Specifications to consider
Acoustical membrane implant	Size ≈ Grain of rice Length ≈ 11–13 mm (approx. ½ inch) Diameter ≈ 2 mm
Electrodal wristwatch	Electrode on the back of the wristwatch, i.e., on surface touching subject's wrist
Bio-acoustical properties of blood flow	Frequency Amplitude Wavelength Phase change
Communication: 1. Surface-to-implant 2. Implant-to-surface	Mechanism: galvanic coupling

6 Conclusion

Thus, the research proposal discloses a first-of-its-kind 'bio-acoustical perceptual sense' that is essentially inward bound for monitoring/tracking acoustic properties of bodily fluids flowing within the human body. As the 'water' circulates over the surface of the 'Planet Earth,' it also circulates inside the living body in the form of body fluids. In both scenarios, water acts as an imperative and essential ingredient for maintaining the active life process.

Acknowledgements I would like to extend my sincere gratitude to Dr. A. S. Kanade for his relentless support during my research work.

References

1. Diatschenko V et al (1993) Passive acoustic detection of flow regime in a multi-phase fluid flow. US5353627A
2. Orcutt M (2015) New wearable device can measure your blood flow. MIT Technology Review, 30 Oct 2015
3. Rehydration—the human body and water. Otsuka Pharmaceutical Co., Ltd., https://www.otsuka.co.jp/en/nutraceutical/about/rehydration/water/body-fluid/
4. Schukat M et al (2016) Unintended consequences of wearable sensor use in healthcare. Contribution of the IMIA Wearable Sensors in Healthcare WG, 10 Nov 2016

Product Review Analysis Using Social Media Data Based on Sentiment Analysis

S. M. Mazharul Hoque Chowdhury, Sheikh Abujar, Ohidujjaman, Khalid Been Md. Badruzzaman and Syed Akhter Hossain

Abstract In this current world where everyday people are generating a large amount of data and different business organizations are becoming more and more dependent on it, it has become very important to come out of the traditional methods of data analysis and focusing on the techniques that can prepare much more accurate and valid result to make business decision more easy and simple. This thesis proposes a technique to collect and analyze Twitter posts based on a different keyword-based product searching to generate products market statistical report. Using this program, it can be determined that if any product is getting popularity or losing its market. Few types of results were generated in this project. Each of them has their own type of importance. Overall this type of application can be trusted support for a business analyst or decision makers.

Keywords Emotion · Product review · Polarity · Social media · Sentiment analysis · Wordcloud

S. M. M. Hoque Chowdhury (✉) · S. Abujar · Ohidujjaman · S. A. Hossain
Department of Computer Science and Engineering, Daffodil International University, Dhaka, Bangladesh
e-mail: mazharul2213@diu.edu.bd

S. Abujar
e-mail: sheikh.cse@diu.edu.bd

Ohidujjaman
e-mail: jaman.cse@diu.edu.bd

S. A. Hossain
e-mail: aktarhossain@daffodilvarsity.edu.bd

K. B. Md. Badruzzaman
Department of Software Engineering, Daffodil International University, Dhaka 1207, Bangladesh
e-mail: khalid@daffodilvarsity.edu.bd

H. S. Saini et al. (eds.), *Innovations in Computer Science and Engineering*,
Lecture Notes in Networks and Systems 103,
https://doi.org/10.1007/978-981-15-2043-3_57

1 Introduction

In the present age of information and technologies, information is power. The more information we have on a certain fact, the more precise we can be with our decisions and deductions. We all know that information is nothing but processed data. Now, data is not anything rare. Social networks like Facebook and Twitter where people are posting their thoughts and opinions on hundreds of matters can act as a gigantic pool of data. Nowadays, 500 million tweets are posted on the walls of Twitter on a daily basis. As a part of data analyzing, data or data mining analyzing, the sentiment of Twitter data is also important to know the sentiment of the user. The analyzed data can be used for research, business and market study, product review, etc. Though all the available Twitter data will not be useful for different business decision making, but most of them will be. This research focuses on the technique to use those data for different decision making techniques and making the analysis process much more accurate so that the targeted people get the benefit from it. The updated computerized process will reduce the complexity and as well as ensure the maximum accuracy of the data throughout the analysis.

2 Proposed Model

In this research, first the system will be connected to Twitter through Twitter API. Next, it will collect the data based on product name as keyword and preprocess it to remove unnecessary data. After preprocessing, the data will be analyzed using Bayesian algorithm. The analysis will produce some different types of outputs like emotion, polarity and wordcloud. Each of those output classes has their own type of representation. The proposed model's workflow is given in Fig. 1.

3 Literature Review

A lot of researchers are working hard all over the world to improve sentiment analysis techniques and its result. If we compare the present state with the past 15 years, a large amount of change and improvement will be found. It is not possible to mention every single work right now. But, some of them will be discussed below to light the path of sentiment analysis from the past to the present. Fang and Zhan worked on product review data, and in their work, they tried to improve the fundamental problem of sentiment analysis [1]. They tried to tackle the problem of sentiment polarity categorization. In 2013, Cambria et al. worked on the development of sentiment analysis and opinion mining [2]. They studied about the past, present and future of sentiment analysis. Mukherjee and Bhattacharyya worked on feature specific sentiment analysis for product reviews [3]. In 2010, Liu worked on multifaceted problem

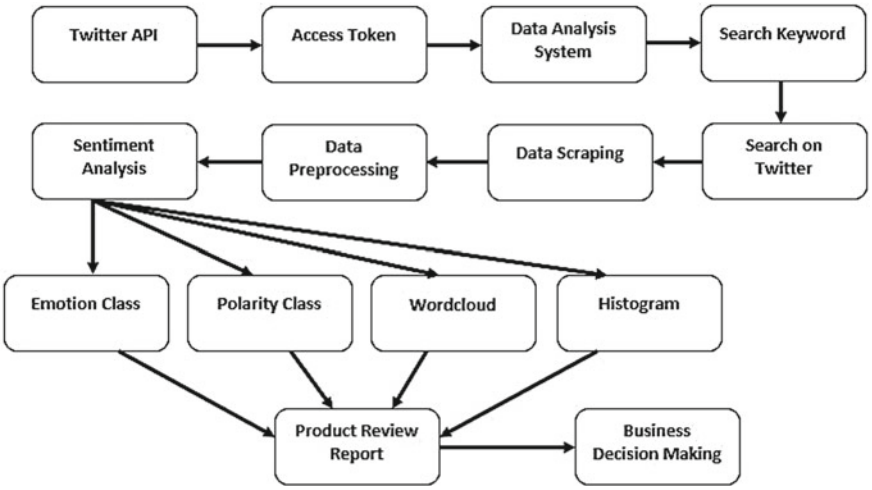


Fig. 1 Workflow block diagram of the system

of sentiment analysis [4]. In the year 2012, Zhang et al. worked on product weakness finding from Chinese reviews by using aspect-based sentiment analysis [5]. In their work, they used customer feedback to improve the product by providing the data to the manufacturer. On the other hand, Wei and Gulla worked on sentiment learning on product reviews via sentiment ontology tree [6]. Haddia et al. worked on the role of text preprocessing in sentiment analysis [7]. In this research, they explored the role of text preprocessing in sentiment analysis, and report on experimental results that demonstrate that with appropriate feature selection and representation, sentiment analysis accuracies using support vector machines (SVM) in this area may be significantly improved. Melville et al. worked on sentiment analysis of blogs, and they used lexicon-based analysis in their research [8].

4 Experiment and Observation

In this research, naïve Bayes algorithm was used to analyze the collected data from Twitter. As previously explained, the system is connected with Twitter using Twitter API using the keys provided with it. Collected data will be stored in a csv file, so it can be reused if needed.

4.1 Data Preprocessing

As data will be scraped from Twitter, therefore it will not be in such a way to process and get good result. Unnecessary and special characters will increase the time of data processing and as well the accuracy may drop. So, to get a better result it is important to preprocess the data first. During preprocessing, the system will remove extra columns of data, which will not be used during data analysis, and with that, other garbage data like links, special characters, other languages, and different signs will be removed too. The R program which is mentioned as system will do this work.

4.2 Data Analysis

In data analysis part of the system, collected and stored data from Twitter based on search keyword will be analyzed using naïve Bayes algorithm. Here, the system will analyze the data in three different parts. They are polarity analysis, emotion analysis and wordcloud. As the target of this system is to provide good support to the business decision makers, so it is important to make the result as clear as possible to them. Naïve Bayes algorithm uses two types of word library or bag of words. One of them is polarity library, which has two classes and they are positive and negative. Any word other than positive or negative is considered as neutral word. According to the analysis, while determining polarity of data, the system will first calculate each tweets polarity by determining the score of it. Here, the positive words and negative words will be counted separately. Then, negative word value will be subtracted from positive value. If the result is positive, the polarity of the tweet will be positive, and if the result is negative, then the polarity is negative. Otherwise, it will be neutral. Finally, the sum of positive and sum of negative polarity will create a bar diagram as output. Another part of the output is emotion class analysis. If, in a single tweet, multiple emotion class word exists, then the class will be taken which has the highest number of words in the sentence. Based on that, each tweet will be tagged with an emotion class. Finally, the result will be constructed as polarity class by using summation of all the tweets of each emotion class. The last section of analysis is wordcloud. In wordcloud, the system will count the word frequency to build the cloud. Then, most frequent words will appear in the wordcloud.

4.3 Result and Discussion

Based on the analysis, there are three types of output generated. Among the large dataset, a small amount of data is considered to be analyzed in this part to visualize the output. The polarity class output is given in Fig. 2.

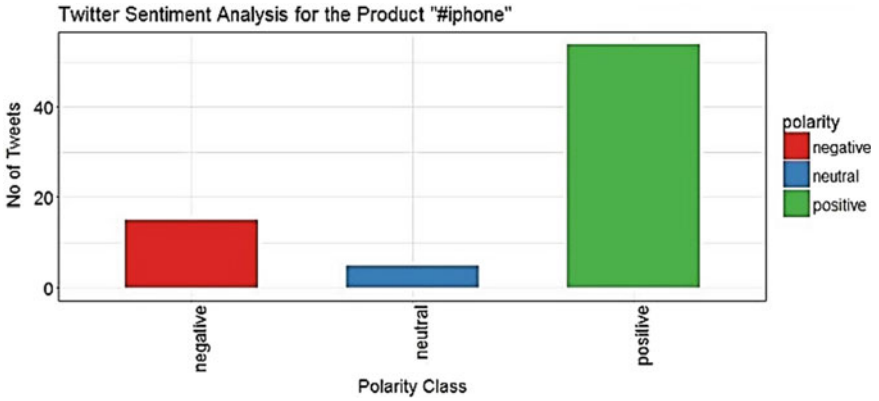


Fig. 2 Polarity class output

On the other hand, a lexicon-based analysis was done to compare the result of the analysis. First of all, the polarity is calculated using the dataset, and the output is generated for the search keyword or product name iPhone.

From Fig. 3, it can be seen that three classes of emotion were found from the analysis. Joy has the highest number of tweets and has little difference with sadness class. Some tweets were found as surprise class. But, most of the tweets are in the unknown class. Based on the dataset, emotion class number can increase up to seven classes. From the wordcloud shown in Fig. 4, it can be seen that users are surprised about different free applications of iPhone, and they have joy about skin, technology, performance and different other topics. But also, they are sad about the price of the phone. So, at least, a minimum idea can be made by using the wordcloud for a product.

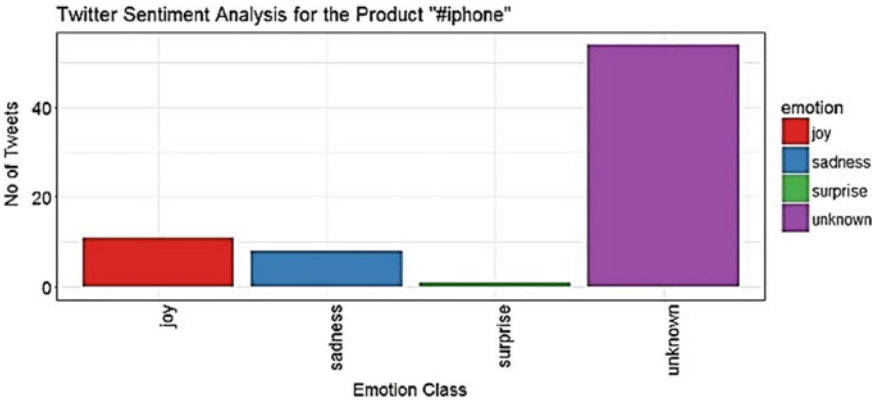


Fig. 3 Emotion class output

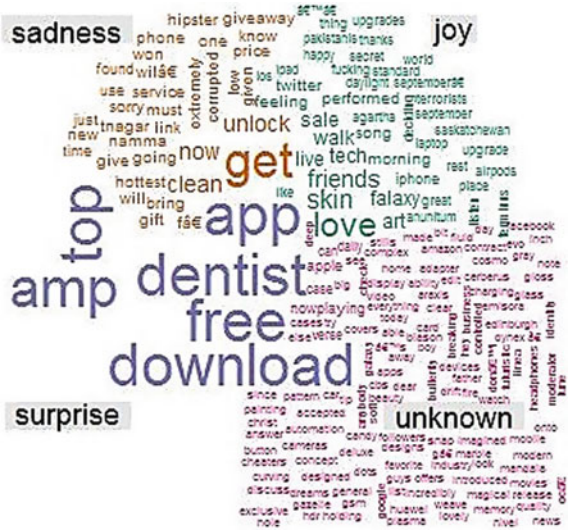


Fig. 4 Wordcloud output

5 Conclusion

Day by day, market place is expanding and becoming more and more competitive. Therefore, market analysts and business experts are focusing in the customer demand to develop their product as well as business. Now social media can be used to find user's needs and complain as it is one of the most reliable and easy techniques. It has become one of the most important parts of business to develop itself. Though a lot of researchers are working on this sector, more work is needed to be done. In near future, social media will be the key to become a successful business man.

References

1. Fang X, Zhan J (2015) Sentiment analysis using product review data. J Big Data. https://doi.org/10.1186/s40537-015-0015-2
2. Cambria E, Schuller B, Xia Y, Havasi C (2013) New avenues in opinion mining and sentiment analysis. IEEE Intell Syst 28(2):15–21
3. Mukherjee S, Bhattacharyya P (2012) Feature specific sentiment analysis for product reviews. In: Computational linguistics and intelligent text processing. Lecture notes in computer science, vol 7181. Springer, Berlin, Heidelberg
4. Liu B (2010) Sentiment analysis: a multi-faceted problem. In: IEEE intelligent systems, vol 25
5. Zhang W, Xu H, Wan W (2012) Weakness Finder: Find product weakness from Chinese reviews by using aspects based sentiment analysis. Expert Syst Appl 39(11):10283–10291
6. Wei W, Gulla JA (2010) Sentiment learning on product reviews via sentiment ontology tree. In: 48th annual meeting of the Association for Computational Linguistics, Uppsala, Sweden, pp 404–413

7. Haddia E, Liua X, Shib Y (2013) The role of text pre-processing in sentiment analysis. Procedia Comput Sci 17:26–32
8. Melville P, Gryc W, Lawrence RD (2009) Sentiment analysis of blogs by combining lexical knowledge with text classification. In: Proceedings of the 15th ACM SIGKDD international conference on knowledge discovery and data mining, Paris, France, pp 1275–1284. https://doi.org/10.1145/1557019.1557156. ISBN: 978-1-60558-495-9

Air Quality Monitoring with IoT and Prediction Model using Data Analytics

J. Srishtishree, S. Mohana Kumar and Chetan Shetty

Abstract In India, with the advancing urbanization and rapid developments in the transportation has led to a serious concern called *Air Pollution*. It is becoming an *Invisible Killer*. Air pollution levels, particularly in cities, are the most alarming threats posed to humanity. However, the existing air quality monitoring systems do not measure the pollutants at the ground level. Although the actual exposure to human beings happens at the ground level, as the emissions from the vehicles are directly inhaled. So, there is a deep mismatch between the ambient levels of air quality measured and the actual pollutants that people inhale at the ground level. This paper focuses to monitor the real-time pollutants using the sensors for the pollutants PM2.5, NO_2 and CO as these are the major pollutants from the vehicular emissions and pose serious impacts on human health. Our proposed system uses deep learning-based Long Short-Term Memory (LSTM) algorithm for forecasting the pollutants as this will influence the decision making to improve the city's quality of air and helps the people plan their day accordingly and take precautions when the pollution levels are unsatisfactory. Finally, our work gives the comparison between prediction of the pollutants at the ground level and ambient air quality levels.

Keywords Long Short-Term Memory (LSTM) · Particulate Matter 2.5 (PM2.5) · Internet of Things (IoT)

1 Introduction

Air is the most vital natural resource for the survival and existence of all the life forms on this planet. Life forms which include animals and plants depend on air for all their

J. Srishtishree (✉) · S. Mohana Kumar · C. Shetty
Department of Computer Science and Engineering, Ramaiah Institute of Technology, Bengaluru, India

S. Mohana Kumar
e-mail: mohanks@msrit.edu

C. Shetty
e-mail: chetanshetty@msrit.edu

H. S. Saini et al. (eds.), *Innovations in Computer Science and Engineering*,
Lecture Notes in Networks and Systems 103,
https://doi.org/10.1007/978-981-15-2043-3_58

basic needs. Hence, for the existence of all the living organisms, it requires a good quality of air which is free from the harmful pollutants. Air is a mixture of several gases such as nitrogen, oxygen, carbon dioxide, argon and some small quantities of other gases. If the composition of air is altered by any means, then it is known as air pollution. It also refers to the release of pollutants from various sources into the air that are dangerous to the human health and to the planet as a whole. Constant exposure to air pollution increases the risk of strokes, lung cancer, heart disease, respiratory diseases and even shortens the average life span of human beings.

With such impacts by the pollutants in the atmosphere, they can be classified into two types:

- Primary pollutants—When the materials are released to the atmosphere in their unmodified forms or which are emitted directly from the sources and pose health risks are primary pollutants.
  Examples—carbon monoxide, nitrogen oxides and particulate matter.
- Secondary pollutants—When the primary pollutants interact with one or more gases or with sunlight to produce new harmful compounds are called as secondary pollutants.
  Examples—ozone, photochemical smog and mists.

The pollutants PM2.5, NO_2 and CO are the emissions majorly from the vehicle exhausts, industries and burning of fuels. NO_2 is a suffocating irritant and its high concentration causes asthma bronchitis and other respiratory diseases. Inhaling PM2.5 (it is a minute inhalable particle, which has the diameter of about 2.5 μm and 30% less than the average human hair diameter) will increase the risks of cardiovascular disease and respiratory problems. And CO reduces the oxygen transport in the body.

According to the study by Urban Emissions and Centre for Study of Science, Technology and Policy (CSTEP) [1], it is estimated that private modes of transport may lead to an increase in particulate matter 2.5 pollution by more than 70% by 2030 in the Indian cities.

With such adverse effects, it is necessary to tackle the issue. But some of the challenges to overcome are:

- Insufficient air quality data—There are not required number of monitors to give us the real picture on air quality in Indian cities.
- Inadequate understanding of sources of pollution—With no emission database, it is difficult to analyse the sources which contribute the most.
- Policy and administrative challenges—Policy makers lack the evidence and capacity to tackle air pollution through a multi-stakeholder approach.
- Limited citizen involvement—With not enough information on exposure and health impacts, the public perceives ambient air to be good.

These challenges can be solved using the technological advancements. New generation of sensors, IoT platform and other innovations have led to the emergence of low-cost sensor devices which are smaller, portable and can measure the values and report the air quality in near real-time. *Big data* capabilities, such as machine

learning and analytics, can be used to the pollutant's data and other related data sets to gain the insights of causes and its fluctuations in air pollution levels.

In our proposed system, we monitor and predict the pollutants level for *Bengaluru* city. Emissions mainly from vehicles are said to be a key contributor to air pollution in this city. The air quality here is progressively getting worse, and young children are particularly vulnerable as they breathe at twice the rate of adults and breathe closer to the ground, where pollution is more concentrated. About 25% of Bengaluru's children have asthma [2] and around 40% increase in the number of lung cancer patients who are non-smokers [3]. Drivers, traffic policemen, security guards, municipal workers, etc., are among the worst affected people by the air pollution. The severe impact on health, productivity and quality of life that they face is a cause of concern to the administration. Hence, minimizing the air pollution effects is a serious concern.

2 Related Work

Zheng et al. [4] developed an air quality monitoring system using the LPWA network, and the system is having the capability to sense the pollutants in a large coverage area, and the pollutants data measured is then transmitted to the cloud storage. Their experimental results proved that the proposed system to sense the air quality was reliable. But, their monitoring system only measures PM2.5 and PM10 pollutants. In our paper, we are considering two more additional pollutants, CO and NO_2 for monitoring purpose.

Soh et al. [5] developed an air quality prediction model based on deep learning algorithm using the spatial–temporal relations. This work forecasts the quality of air up to 48 h using the multiple neural network algorithm, artificial neural network, long short-term memory and convolutional neural network algorithm. The predictive model, spatial–temporal deep neural network (ST-DNN), uses information from the monitoring stations across different locations. Pollutants particulate matter 2.5 and 10, temperature, wind speed, relative humidity and direction of wind data are also used. The data set used for this work are from Taiwan and Beijing locations and are obtained from the Environmental Protection Administration. In our proposed system, we are using the historical data obtained from pollution control board and real-time data obtained from the IoT device deployed at the surface level and give the comparison between the data set and the actual exposure to the pollutants.

Kang et al. [6] highlight the different big data and machine learning approaches for forecasting and provide the comparison between various machine learning algorithms and the parameters used and illustrate some of the challenges and future research requirements. One of the challenges is the requirement of the real-time analysis of the air by developing a monitoring and evaluation system for the analysis at multiple levels. In our analysis, we are using the deep learning-based long short-term memory algorithm for time series data analysis rather than the traditional time series model like autoregressive integrated moving average (ARIMA). And our experiment provides solution to one of the challenges stated in Kang et al. [6] paper, which is

the development of the monitoring device to collect the real-time pollutants data continuously, unlike the traditional approach of considering the average value for the day by regulating the device only few times in a week.

Carducci et al. [7] illustrate the citizen's attitude and behaviours using different information sources with respect to the awareness about the air pollution. The case study states that, during a certain time in Italian cities, there witnessed a peak levels of air pollution particularly for PM10 which caused an alarm and was widely reported by the mass media. Later, they tried to investigate the citizen's awareness and interests towards the air pollution. It was found that, despite high-media coverage and satisfactory self-perceived knowledge, the majority of the respondents judged the information negatively and declared a limited adoption of pro-environmental behaviours. Hence, it is important to improve the citizen's knowledge and their involvement in overcoming the problem.

3 Proposed Solution

3.1 System Architecture

In our proposed system, we have used historical and real-time sensor data set to train the LSTM prediction model. The forecasted values are then compared based on the national air quality standards, which will categorize the pollution levels as good, satisfactory, poor and severe based on the pollutant's concentration. These values will help the government for policy making, taking appropriate decisions and enforcing action plans. Also, it will create awareness for the citizens about the actual air they breathe (Fig. 1).

3.2 Real-Time Pollutants Monitoring System

The monitoring exercise helps to focus on areas of interest such that it has a high probability of influencing decision making to improve the city's quality of air. Public places, where the city experiences high levels of pollution often go unrecognised and has an impact on commuters, and the people living around these major roads.
Experimental set-up:

- A low-cost sensor monitoring device was developed using the sensors PM2.5 Dust Sensor, MQ-9 Carbon Monoxide Sensor Module, MQ135 Air Quality Gas Sensor Module and DHT22 Temperature and Humidity Sensor Module (Fig. 2).
- These sensors are interfaced using the Arduino programming to read the values from the sensors, and the python programming was used in the Raspberry pi to store the values that are continuously monitored in the excel file along with the time stamp.

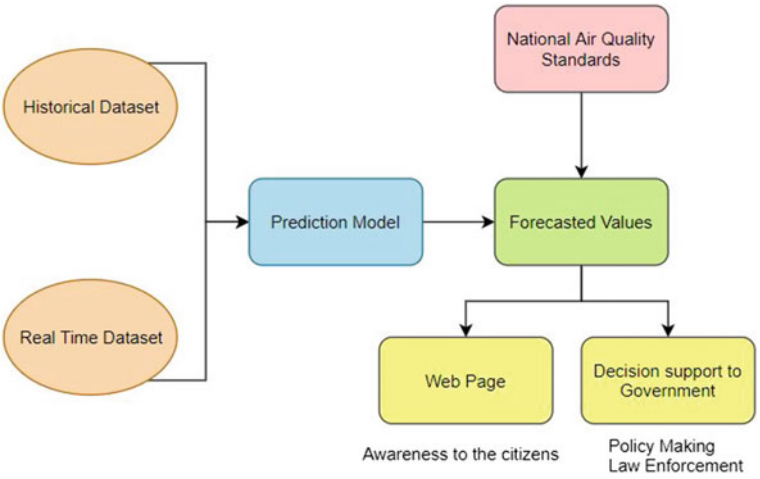


Fig. 1 Architecture of the proposed system

- Monitoring device was deployed in one of the most polluted area (*Whitefield*) of Bengaluru. It was kept around three feet above the ground level near one of busy roads to monitor the pollutants for a span of two months.
- The data was getting recorded for a time interval of every 15 min.

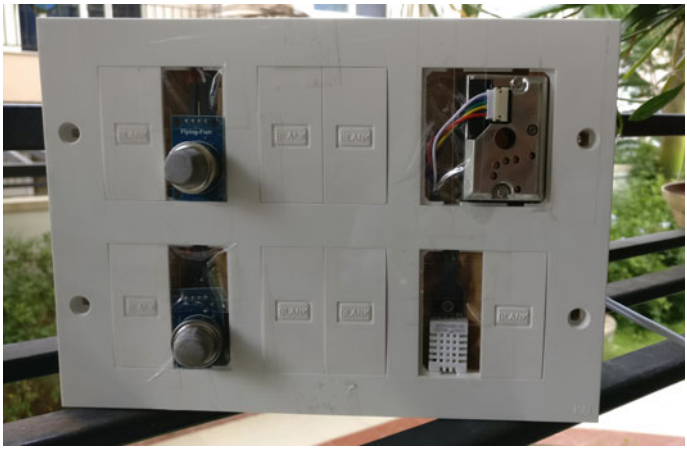


Fig. 2 Image of the monitoring device developed

Table 1 Data set information

Data source	Location	Duration	Type	Parameters	Samples
Karnataka State Pollution Control Board (KSPCB)	Bengaluru	6-year data set (2013–2018)	Monthly average data	PM2.5, NO_2, CO	501
Sensor data	Bengaluru (Whitefield)	2 Months (April and May 2019)	Every 15 min data	PM2.5, NO_2, CO, temperature and humidity	5856

3.3 Data Preparation

Data is the cornerstone for intelligence analysis. Every *big data* analysis and *deep learning* projects start from data acquisition and collection. In our analysis, we have two sources of data (Table 1).

3.4 Deep Learning Algorithm

In our project, we have used the time series-based *long short-term memory model* to predict the pollutant concentration. LSTM is an *artificial recurrent neural network architecture* used in the field of deep learning. It is well suited for time series data for classifying the data, processing as well as making predictions. LSTM is a model in which it will not only store the current data in the memory but also consider the previous data as well [8]. Hence, for predicting the pollutants, considering the previous values is important, so the time series-based approach is a suitable model to predict the pollutants. LSTM model involves two phases: training and testing phase.
Training Phase:

- Input layer—The first layer is the input layer where inputs like the measured values of the pollutants over a period of time are passed to the LSTM model. It is a vector, which holds pollutants data.
- Hidden layer—In the hidden layer, the output of one model at a certain time, say t, is going to be the first parameter which is an input for the model for the next time interval $t + 1$ [8]. The hidden units are internally connected, and the output of one will be the input to the next hidden unit. Similarly, the output of one LSTM module will be the input to the next LSTM module. Likewise, the concentration of the pollutants in the last hour/month based on the data set will be the input to the next module in the series.
- Dense layer—In the dense layer, all the results from the hidden layers are connected together and the output values specify each pollutant [9].

Table 2 RMSE of the pollutants of different data sources

Data source	Type	Prediction	PM2.5	NO_2	CO
KSPCB	Historical data atmospheric air levels	Next 1-month average	8.644321	6.952704	10.600214
Sensor	Sensor data measured at ground level	Next 1 h	3.512671	1.623452	5.651928

Testing phase: In this phase, there is a comparison between the predicted values and the actual values observed for a specified time. RMSE is then calculated to check the accuracy of the model. The lower RMSE values indicate less error. Hence, the model with lower RMSE gives better prediction.
Evaluation metric: The evaluation metric is Root Mean Square Error (RMSE) value. It is a standard equation to calculate the prediction errors. The residuals or the prediction errors measure the deviation of the data points from the regression lines. Equation 1 represents the RMSE calculation, where P is the predicted values, A is the actual values and n is the number of samples.

$$\text{RMSE} = \sqrt{\frac{\sum_{i=1}^{n} (P_i - A_i)^2}{n}} \tag{1}$$

3.5 *Results and Analysis*

By training the model using two different data sets, it showed that the historical average monthly data's prediction gave the average value of the next month. On another part, by training the model with real-time data, it is possible to predict the values for next 1 hour pollutants concentration. By comparing the data collected, it stated that the pollutant concentrations measured using the monitoring device at the ground level measured high concentration of the pollutants than the ambient air level concentrations. And the prediction of the pollutants trained by the real-time data gave a better RMSE value (less prediction error) than the prediction of the historical data's RMSE value (Table 2).

3.6 *Graphs and Visualization of Analytics Results*

See Fig. 3.

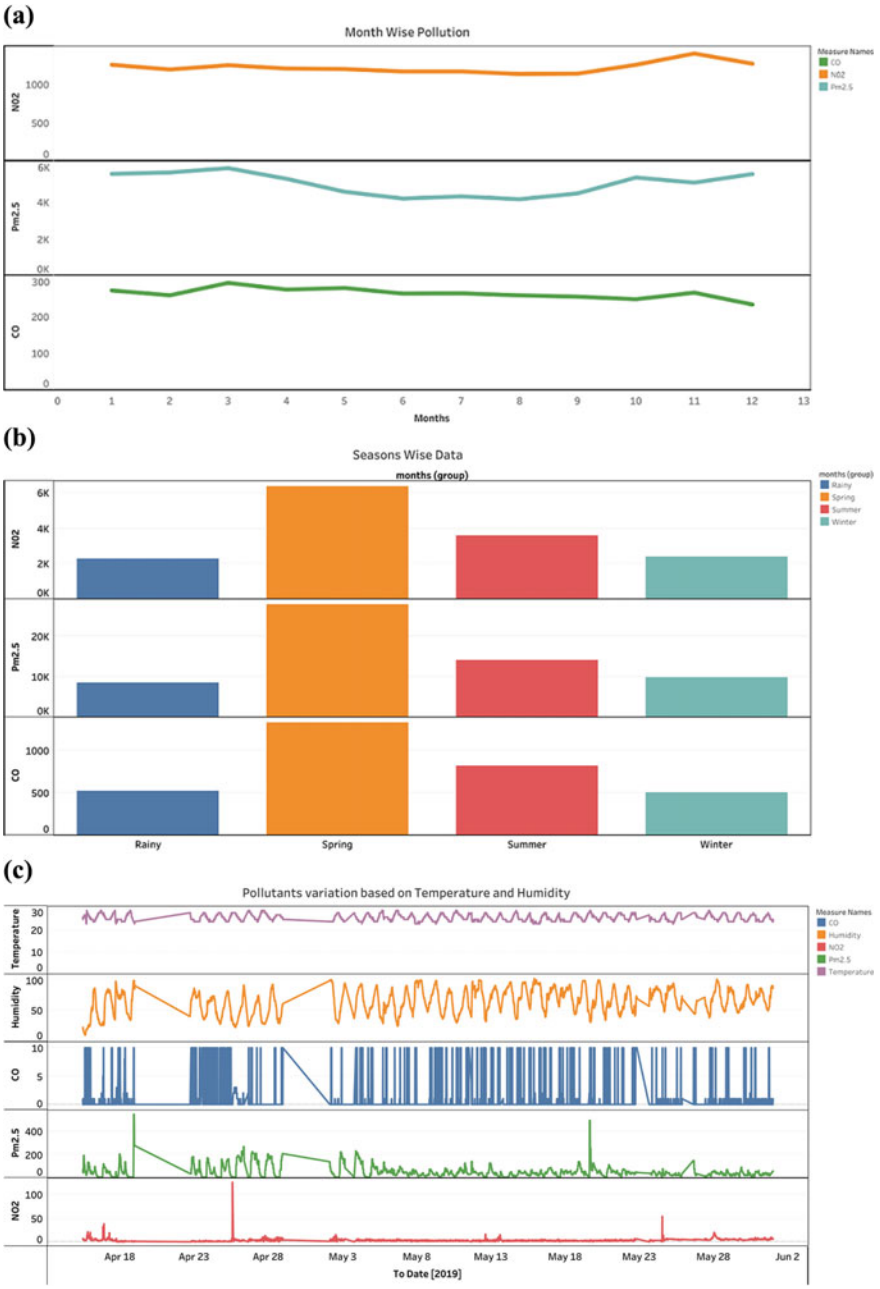


Fig. 3 Graphs **a** highlight the variation of the pollutants across the months, **b** show the pollutants concentration based on the seasons (spring, rainy, summer and winter), **c** show pollutant fluctuations along with the temperature and humidity and **d** represent the pollutant patterns during the weekdays and weekends [10]

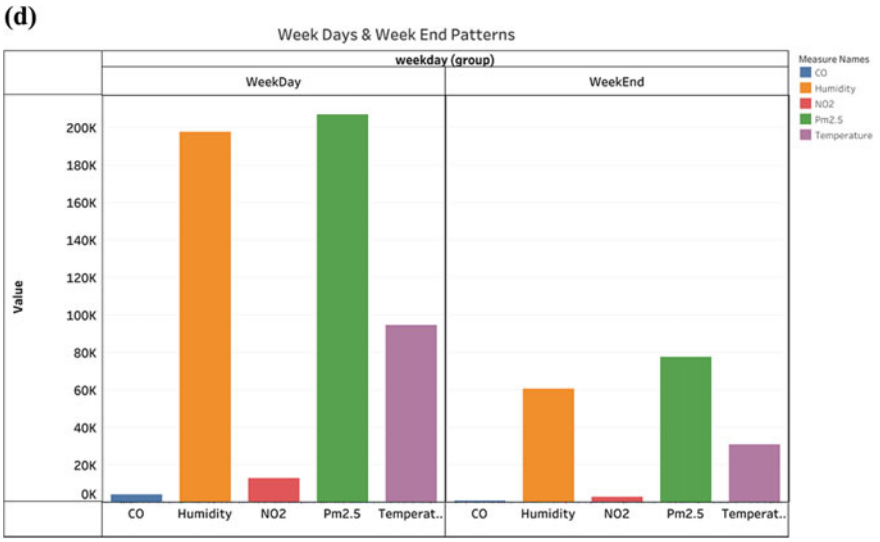


Fig. 3 (continued)

4 Conclusion

According to our analysis, the prediction of the pollutants gives comparatively less RMSE when the training of the data had more samples, i.e. in the real-time analysis at surface level even though only two-month data was trained for the model. So, it is clear that real-time monitoring gives the better prediction results. Also, the graphs plotted shows that the weekdays contribute more pollution than the weekends, which clearly specifies that the major source of pollution is from the vehicles, and these emissions are the major threat to human health. Graphs (Fig. 3) also depicts that multiple other parameters like temperature and humidity also influence the air pollution levels.

Therefore, IoT and Big Data Analytics plays an important role to tackle the air pollution levels in the cities. As they give the actual insight of the data and help us in making better decisions, law enforcement and policies by the government to take necessary measure to combat this problem. Also, by publishing the actual and predicted pollutants levels, it brings an awareness to the citizens. Overall, with the real-time pollutants data and powered by collective actions, this serious concern can be tackled and reduce its effects.

References

1. https://www.thehindu.com/news/cities/bangalore/air-pollution-in-bengaluru-to-go-up-by-74-by-2030-study/article26064689.ece
2. https://timesofindia.indiatimes.com/city/bengaluru/25-Bangalore-children-have-asthma/articleshow/12945868.cms
3. https://www.deccanherald.com/content/647098/bengaluru-hospitals-see-more-heart.html
4. Zheng K, Zhao S, Yang Z, Xiong X, Xiang W (2016) Design and implementation of LPWA-based air quality monitoring system. IEEE Access
5. Soh P-W, Chang J-W, Huang J-W (2018) Adaptive deep learning-based air quality prediction model using the most relevant spatial-temporal relations. IEEE Access
6. Kang GK, Gao JZ, Chiao S, Lu S, Xie G (2018) Air quality prediction: big data & machine learning approaches. Int J Environ Sci Dev 9
7. Carducci A, Donzelli G et al (2017) Air pollution: a study of citizen's attitudes and behaviors using different information sources. Epidemiol Biostat Public Health 14
8. Chaudhary V, Deshbhratar A, Kumar V, Paul D (2018) Time series based LSTM model to predict air pollutant's concentration for prominent cities in India. In: UDM, Aug 2018, London, UK
9. Athira V, Geetha P, Vinayakumar R, Soman KP (2018) DeepAirNet: applying recurrent networks for air quality prediction. In: International conference on computational intelligence and data science (ICCIDS 2018)
10. Yi X, Zhang J, Wang Z, Li T, Zheng Y (2018) Deep distributed fusion network for air quality prediction

Bangla Speaker Accent Variation Detection by MFCC Using Recurrent Neural Network Algorithm: A Distinct Approach

Rezaul Karim Mamun, Sheikh Abujar, Rakibul Islam, Khalid Been Md. Badruzzaman and Mehedi Hasan

Abstract There are a number of languages accent differential applications that detect the different accents in assorted languages. The studies which have done before most of them are based on the English language and different languages throughout the world. A few researches have been performed in Bangla regional language accent differential applications, which is not conclusive for the system to be able to manage Bangla accented speakers. In this paper, we report regional language accent detection experiments of different types of Bangladesh. We demonstrate a strategy to observe Bangladeshi different accents which exploit Mel frequency cepstral coefficient (MFCC) and recurrent neural network (RNN). Listening from the people of different places in Bangladesh creates an accent differentiation results performed by the speakers. This experimental result shows the adaptation of the people to adapt of the regional languages.

Keywords Accent differential application · MFCC · Recurrent neural network · Bangladeshi accent

R. K. Mamun · S. Abujar (✉) · R. Islam · M. Hasan
Department of Computer Science and Engineering, Daffodil International University, Dhaka 1207, Bangladesh
e-mail: sheikh.cse@diu.edu.bd

R. K. Mamun
e-mail: rezaul15-7934@diu.edu.bd

R. Islam
e-mail: rakibul15-8040@diu.edu.bd

M. Hasan
e-mail: mehedi15-8015@diu.edu.bd

K. B. Md. Badruzzaman
Department of Software Engineering, Daffodil International University, Dhaka 1207, Bangladesh
e-mail: khalid@daffodilvarsity.edu.bd

H. S. Saini et al. (eds.), *Innovations in Computer Science and Engineering*, Lecture Notes in Networks and Systems 103,
https://doi.org/10.1007/978-981-15-2043-3_59

1 Introduction

Human being intercommunicates with distinct dialects. For communication, people use different languages. These languages are an amazing way to exchange a person's thoughts to another person. But their variations are the way of talking to people in various places. The way of talking is called language dialect. If people cannot be in touch properly, there will be a misunderstanding. Therefore, the detection of the regional dialects is more important. Language detection is the foremost issue in natural language work in the computer science field. There are many developed countries that have successfully worked with their own languages and the dialects' detection and come with many software. Before us, there are several teams in Bangladesh who had worked this type of language dialect case, and they successfully did their work. Bangla is one of the well-off languages worldwide [1]. Over 250 million people speak in native Bengali language expect several people who are speaking in the Bengali dialect.

There are numerous sorts of language accents in the Bengali language. The accents of the Bengali languages (Bangla Upobhashashomuho) are a piece of the eastern Indo-Aryan language that originates from the gathering of the Indo-European language family what is generally spoken in the Bangla area of South Asia. Despite the fact that the verbally expressed lingos of Bengali are commonly understandable with neighboring accents, they sometimes need shared clarity with the standard Bengali language and sometimes would not be comprehended by local speakers of standard Bengali.

People speak in different regional languages in different regions in Bangladesh. Dhaka (old), Chattagram, Sylhet, Rajshahi, Khulna, Barishal, Mymensingh, Rangpur, and Noakhali are major spoken dialects in Bangladesh. Although these dialects are understandable by neighboring dialects, the speakers of standard Bengali cannot understand these dialects.

1.1 Literature Review

A lot of works have been done in recent years to detect distinct Bangla language variations and other languages which have adequate accuracy in classifying speech signal. Many researchers have utilized different methods and models to get more efficient results.

Zheng et al. addressed a combination of dialect identification, dialect discriminatory audible features, acoustic adjustment, and model selection to the Chinese-accented speech identification problem [2]. Following experiment was based on MFCC and GMM achieved result that shows and 1.0–1.4% absolute reduction of character error rate over the foremost progressive acoustic modeling techniques on Wu-accented Chinese speech. This experiment shows that once the degree of accent

Table 1 Comparison of GMM-UBM and i-vector

Corpus	GMM-UBM	i-vector
Call friend	18.73	15.06
FSD	24.13	20.01

varies considerably, accent categorization followed by model choice will considerably enhance performance. Behravan et al. compared the accent of Finnish dialect with the i-vector execution and GMM-UBM structure in Call friend and FSD corpora (EER %) [3]. These results are much closer in both experiments. Both scores are shown in Table 1.

Buch et al. used the HSNM structure and they developed a structure for language identification and accent variation detection and got useful represent for both long- and short-distance language-independent features [4]. For a German accent, they got an accuracy rate of 69.6% compared to 75.5%, and for a Mandarin accent, this rate is 36.4% compared to 77.6%.

Das et al. [5] perform to detect speech dialect of language from various regions and used differing types of systems, such as (MFCC), (GMM), (SVM) and they used (ANN). After using all the systems (written above) that show the result in research work, the (GMM) adaption gives better performance than different system. Bhatia et al. [6] introduced input signal extraction options with the employment of Mel frequency cepstral constant (MFCC) for additional efficient performance. K-nearest neighbor (KNN) rule has been utilized to gauge the minimum geometrician distance to research on different speaker accents. Abujar et al. [7] introduced the pre- and post-processing of Bengali speech data and also proposed some text processing methods using Unicode, which is necessary while we combine both consonant and vowel speeches together.

1.2 Methodology

MFCC represents Mel frequency cepstral coefficients. As it should be obvious, there are four words in the contraction which are Mel, frequency, cepstral, and coefficients. The possibility of MFCC is to change over sound in time area into frequency signal so we can see all the data present in discourse signals. In any case, simply changing over time area signals into frequency signal may not be exceptionally ideal. We can accomplish something beyond changing over time space signals into frequency area signals. Our ears have cochlea, which essentially has many channels at low frequency and not many channels at high frequency. This can be mirrored utilizing Mel channels. So, the possibility of MFCC is to change over time area signals into frequency signal motion by mirroring cochlea work utilizing Mel channels (Fig. 1).

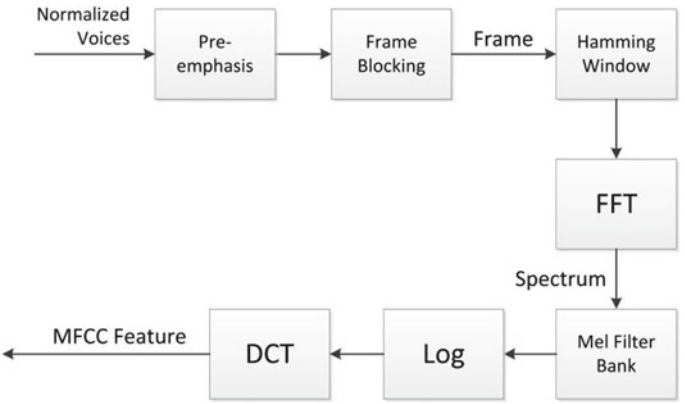


Fig. 1 Block diagram of MFCC

1.3 Steps for MFCC Computation

(a) *Pre-emphasis Filtering*

The $q(n)$ input signal is transmitted to the high-pass filter

$$q_2(n) = q(n) - a * q(n-1) \tag{1}$$

where $q_2(n)$ is the output voice signal and a value ranges from 0.9 to 1.0. The z-transform is performed

$$T(n) = 1 - a/z$$

The objective is to compensate for the high-frequency portion suppressed during sound production.

(b) *Framing*

The articulation wave is segregated into frames of ~25 ms with overlap of ~1/3 frame size.

(c) *Hamming Window*

For the continuity of the start and endpoint of the frame, each frame is multiplied by a hamming window. Hamming is $q(n)$ * $w(n)$ where the hamming window is $w(n)$.

(d) *Fast Fourier Transform*

In this step, we execute the FFT to get the enormity of the frequency of every frame assuming that the signal inside the frame is periodic.

(e) *Triangular Band-Pass Filtering*

The magnitude of the frequency is multiplied by the set consisting of approximately triangular band-pass filters and the positioning of the filters' synchronous

with the Mel frequency. Mel frequency is corresponding to the log of linear frequencies.

(f) *Discrete Cosine Transformation*

DCT is applied to the log energies E_k acquired from the trilateral filters to obtain L Mel frequency cepstral coefficients (MFCCs). DCT is very suitable for compression of energy and it is chosen for that. DCT is described in Eq. (2)

$$Y(k) = \sum_{l=0}^{L-1} \cos\left[\frac{\pi}{L}\left(l + \frac{1}{2}\right)m\right] E_k; \quad 0 \leq m \leq l - 1 \tag{2}$$

where $L = 26$.

We retain sole 12–13 DCT coefficients out of 26. The reason abaft this is the first few DCT coefficients correspond to low frequency.

2 Recurrent Neural Network for Voice Analysis

Recurrent neural network (RNN) is the ramification of artificial neural communities, wherein nodes are linked to every different from the directed graph along with corporeal series. This permits it to expose transient powerful conduct. Not at all account like feed-forward neural networks, RNNs can utilize their internal state (memory) to technique series of resources of inputs [8].

In an RNN, the records go via a loop. While it settles on a choice, it mulls over the prevailing information, and furthermore, what it has received from the statistics resources, it got in advance [9]. The two pictures underneath delineate the difference within the records circulation among an RNN and a feed-forward neural network (Fig. 2).

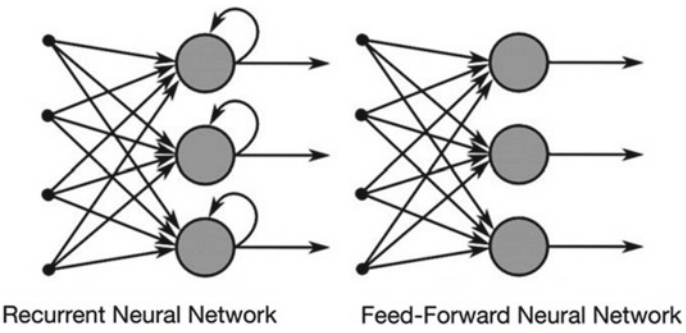


Fig. 2 RNN and FFNN

A well-known RNN has a brief time period memory. In mixture with a LSTM, they likewise have a long-term memory; however, we can examine this similarly below.

Additionally, note that while feed-forward neural networks map one contribution to one yield, RNN's can map one to many, many to many (interpretation), and many to one (classifying a voice) (Fig. 3).

After applying MFCC, we have performed RNN to differentiate different dialects. At the time of utilizing this method, it checked the voice activity several times till it cannot find similarity of voice or accent (Fig. 4).

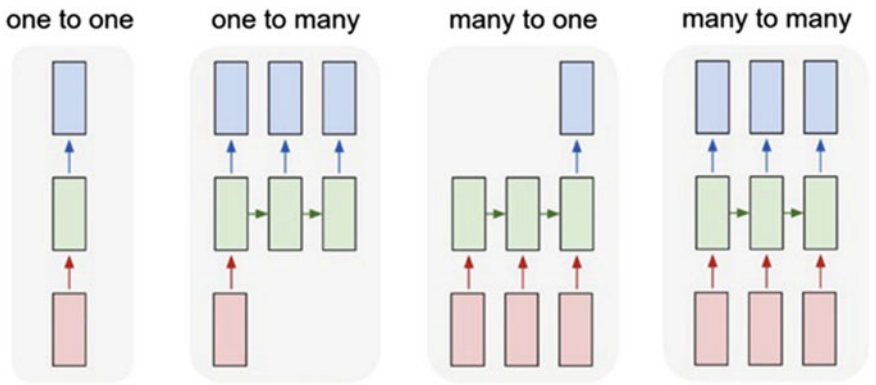


Fig. 3 Map relation

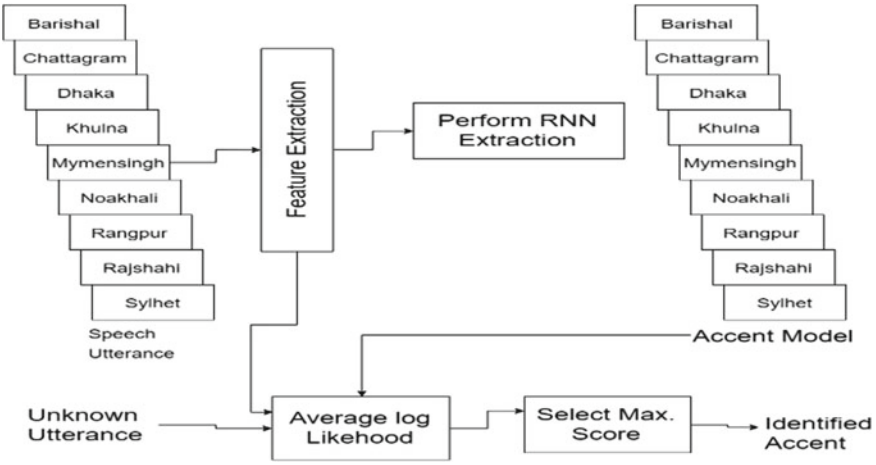


Fig. 4 Usual method for our dialect recognition system

3 Collection of Data

Data collection occupies a primary function of our research. It is certainly a difficult task. At the first stage, we have gathered the voice of Dhaka (old), Chattagram, Sylhet, Rajshahi, Khulna, Barishal, Mymensingh, Rangpur, and Noakhali. Smart voice recorder turned into and used to report voice samples at 16 kHz sample rate and 16-bit quantization. Sample collection system entails some questions which have been asked by us to the volunteers, and then their responses have been recorded in voice recorder. We have taken voices from noisy-free environment as better as possible.

4 Result Discussion

In our experiment, the accent variation detection is tracked using nine local languages of Bangladesh, which are related to Bangla language. In this paper, we use diverse methodology of complement assurance utilizing recurrent neural network based on MFCC. We audited the grouping of highlights based on MFCC coefficient got from the input signals. We considered the preparation information must be kept for assurance of accent to more prominent precision as well. It is seen that every language highlights and distinguished proficiency with the least mistakes.

After collecting the different dialects from several regions of Bangladesh, we have used the dialects in our system. Then the system analyzes the dialects with data sets, and we also removed noise and silence part from recordings of voices. We generated frequencies and tried to divide the frequency segment like windowing which we have discussed before. After that, we tried to compare the segment of frequencies with existing data sets. Besides, at the time of analyzing data sets, we are getting false alarm rates. Another approach is that we have created a model that can record real-time voice activities that can identify the voice of individuals, and it shows the voice which people say.

In our system, we have got some false alert rate and miss rate for different functions of our system. If the accuracy rate is higher, we call it a minimum experimental result. But, if the accuracy rate and equal error rate (EER) is equal, we can say it average result.

By using the following algorithms, we got some results from our collected data, comparing among the data sets. Here, a table has been illustrating the results of the detection percentage of the accent variation (Table 2; Fig. 5).

Table 2 Experimental result of our system

Dialects	Accuracy rate (%)	EER%
Chattagram	69	31
Sylhet	75	25
Rajshahi	77	23
Khulna	68	32
Barishal	83	17
Mymensingh	72	28
Rangpur	76	24
Noakhali	78	22
Dhaka	72	28

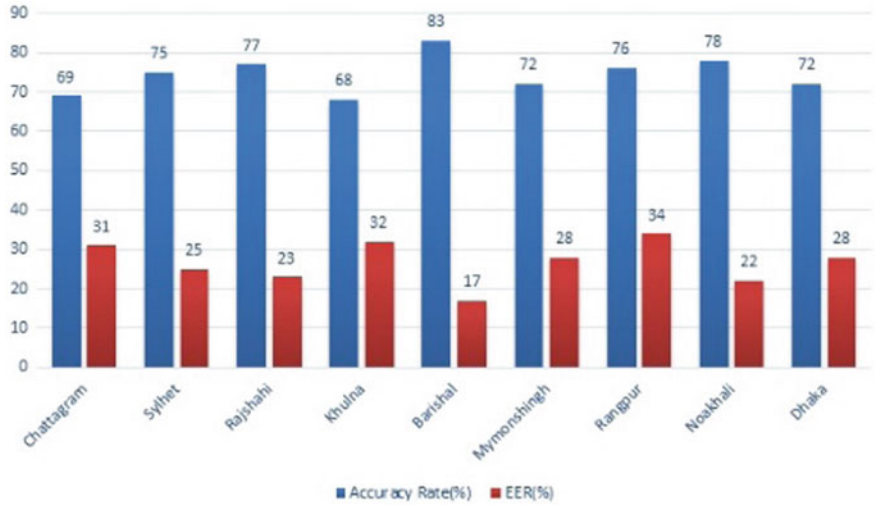


Fig. 5 Comparison chart of accuracy and error

5 Conclusion and Future Work

We report the diverse methodology of complement assurance by utilizing the recurrent neural network algorithm based on MFCC. We, in this paper, audited the grouping of highlights based on MFCC coefficient and got input signals. We considered the prepared information must be kept for the assurance of accent with more prominent precision as well. It is seen that every language highlights and distinguished proficiently with the least mistakes. In the future, we have intended to discriminate among more dialects by the system so that the accent of more regions can be recognized uniquely.

Acknowledgements This research was upheld by DIU NLP and ML and Research Lab. Some volunteers of the university worked to collect voice records from students, who are from different regions of Bangladesh, and they were highly accorded to share their regional accents to carry through the voluntary tasks and voices were recorded with a smart voice recorder. They have asked different questionnaires by volunteers and participants replied that in a regional accent, and then it was recorded. We are appreciative of the local speakers who made a decision to share their voices and who have taken an interest in the study. We are also thankful to our two unnamed critics for their precious comments in revising our paper.

References

1. Hoque AKM (2006) Bengali segmented speech recognition system. Undergraduate thesis report, Computer Science and Engineering, BRAC University
2. Zheng A, Sproat R, Gu L, Shafran I, Zhou H, Su Y, Jurafsky D, Starr R, Yoon S-Y (2005) Accent detection and speech recognition for Shanghai-accented Mandarin. University of Illinois, IBM T. J. Watson Research Center Johns Hopkins University, Stanford University (*references*)
3. Behravan H, Hautamäki V, Kinnunen T (2013) Foreign accent detection from spoken Finnish using i-vectors, vol 2. School of Computing, University of Eastern Finland, Oxford, Joensuu, Finland
4. Buch S, Gauthier J, Tsang A (2014) Language identification and accent variation detection in spoken language recordings. CS 229 Final Project, Computer Science Department, Symbolic Systems Program Stanford University
5. Das PP, Allayear SM, Amin R, Rahman Z (2016) Bangladeshi dialect recognition using Mel frequency cepstral coefficient, delta, delta-delta and Gaussian mixture model. In: 8th international conference on advanced computational intelligence, Chiang Mai, Thailand, 14–16 Feb 2016
6. Bhatia M, Singh N, Singh A (2015) Speaker accent recognition by MFCC using K-nearest neighbour algorithm: a different approach. Int J Adv Res Comput Commun Eng 4(1)
7. Abujar S, Hasan M (2016) A comprehensive text analysis for Bengali TTS using unicode. In: 2016 5th international conference on informatics, electronics and vision (ICIEV), Dhaka, pp 547–551
8. Vasantha Kumari R, Vani JayaSri G, Venkateswarlu RLK (2011) Speech recognition by using recurrent neural networks. Int J Sci Eng Res 2(6). ISSN 2229-5518
9. Graves A (2012) Sequence transduction with recurrent neural networks. In: ICML representation learning workshop

Bangla Continuous Handwriting Character and Digit Recognition Using CNN

Fuad Hasan, Shifat Nayme Shuvo, Sheikh Abujar, Md. Mohibullah and Syed Akhter Hossain

Abstract There are several works in Bangla handwritten character recognition. Here a new methodology proposed to recognize the character from continuous Bangla handwritten character. The system's main components are preprocessing, feature extraction, and recognition. There is a strong possibility that is found in Bangla words, and characters are overlapped. This problem often happens in handwritten texts like a consecutive character appears on another character. When it comes to Bangla characters, segmentation becomes much more difficult. To build an effective OCR system of Bangla handwritten text, recognition of characters is important as much as segmentation of characters. Here the main purpose is creating a system, which takes continuous Bangla handwritten text images as an input and then segments the input texts into its constituent words and finally segments each word into individual characters. In this present study, here we used EkushNet dataset model which includes 50 basic characters, 10 character modifiers, 52 frequently used conjunct characters, and 10 digits. By using our algorithm, we are able to segment 95% words from text and 90% characters from the words. Overall, in this present OCR system here recognition and segmentation of characters from handwritten *Bangla* texts are effectively dealing with the probable problems.

F. Hasan · S. N. Shuvo · S. Abujar (✉) · S. A. Hossain
Department of Computer Science and Engineering, Daffodil International University, Dhaka, Bangladesh
e-mail: sheikh.cse@diu.edu.bd

F. Hasan
e-mail: fuad15-9901@diu.edu.bd

S. N. Shuvo
e-mail: shifat15-9836@diu.edu.bd

S. A. Hossain
e-mail: aktarhossain@daffodilvarsity.edu.bd

Md. Mohibullah
Department of Computer Science and Engineering, Comilla University, Comilla, Bangladesh
e-mail: mohibullah@cou.ac.bd

H. S. Saini et al. (eds.), *Innovations in Computer Science and Engineering*,
Lecture Notes in Networks and Systems 103,
https://doi.org/10.1007/978-981-15-2043-3_60

Keywords Preprocessing · Segmentation · Removing matra · Modifier detection · Neural network · Recognition

1 Introduction

In this globe, every region has separate languages. As Bangla is one of the most familiar languages in the world, and approximately, 220 million people apply Bangla for their utterance and writing motive. In this present paper, we work on Bangla language. Therefore, recognition of Bangla continuous handwritten characters has a great significance. This present article describes a system which can recognize continuous handwritten Bangla texts and digits. OCR is a system which optically reads the document to human-readable form to machine-understandable form. This system is very popular in practical life applications like language processing, library automation, reading aid for blind, post office, banks, and government documents digitalized. This system has a few modules, which are given below in a sequence such as preprocessing, line segmentation, word segmentation, character segmentation, character recognition. To obtain the best result, convolutional neural network (CNN) has been used as a classifier for character recognition system.

2 Literature Review

In 1870, a retina scanner which was invented by Carey [1] is an image transmission system and it is the first character recognition system. There are two different types of Bangla scripts and the existing one is machine printed and another is handwritten. In the past few years, there are many researches which have been done in handwritten character recognition in Bangla language. This research-related works also achieve great success. There are a few works that are available for Bangla printed character recognition system. Some significant works have been done in back years such as "A complete Bangla OCR System for printed Characters" [2], "A complete OCR System for Continuous Bengali Characters" [3], "An end-to-end System for Bangla Online Handwriting Recognition" [4], "A hierarchical approach to the recognition of handwritten Bangla characters" [5], "A complete printed Bangla OCR System" [6]. All these papers stated above show various methodologies that have been introduced by different authors. Maximum works are done in printed continuous character recognition. But a very few deals have been done with a complete OCR for handwritten continuous character. From that standpoint, this paper is mainly proposed only continuous handwritten character recognition. In this work, continuous characters are segmented using some traditional methodology as well as some new methodology.

3 Proposed Methodology

In this paper to the recognition of continuous handwritten character from sentences, we present a new segmentation method for character. The main part is done in the character segmentation which has many phases that are following below (Fig. 1).

3.1 Prepossessing

In this section, here we preprocess the input image. First step has been done by converting the original image as grayscale image and then removing the noise from the image and then convert the image as binary image into finding the foreground area from the image.

3.2 Line Segmentation

Text line detection has been done by detecting the position between two consecutive lines. Scanning the row horizontally if it finds white pixels, then it is a text, where the pixels are white considering as text figure. If a horizontal row is totally black, it is denoting a gap between two lines. That is how a line can be detected. In past studies, there are many works which have been done in handwriting line segmentation in different languages—English [7], Hindi [8]—and achieve great success (Fig. 2).

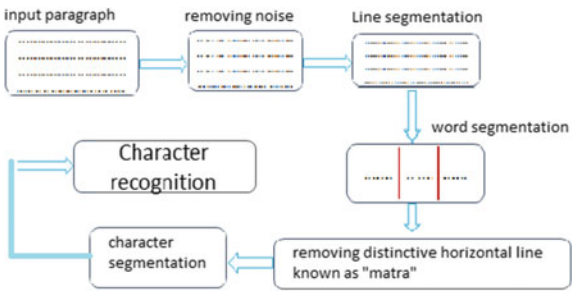


Fig. 1 OCR system

Fig. 2 Line segmentation

Fig. 3 Box is indicating gaps between two words

Fig. 4 Word segmentation

3.3 Word Segmentation

The images are defined with binary pixel values, which is a binary image and then compute the sum of pixels of each column of the image. If the sum of each column is less than or equal to ten (as black pixel value is zero), then it is considered as a gap between two words, shown in Fig. 3. If fifteen connected gaps in both sides of the word are found, then it is considered as a word. After finding the word, remove unwanted vertical and horizontal gaps (if sum of black pixels is zero) from the word shown in Fig. 4.

3.4 Character Segmentation

This module finds an individual character from the segmented word (Figs. 5 and 6). Here, the main problem occurs that Bangla language has a distinctive horizontal line known as "matra" which connected all the characters in a word. Bangla language also has modifiers and some occurs in the upper part and some occurs in the lower part of the image. In every word, there can be different types of modifier which have been used. Some words can have both the modifiers shown in Fig. 7. To segmentation of character from word, each word image is resized to $h \times w$. Different types of word image can be found (i) with no modifier, (ii) upper-part or lower-part modifier and (iii) with both upper- and lower-part modifiers. To identify different types of words with different modifiers, there has been a flag indicator set. For different types of modifiers, different methods are used for the segmentation of character. Different types of words with modifiers were described in Fig. 7.

Fig. 5 Before matra elimination

Fig. 6 After matra elimination

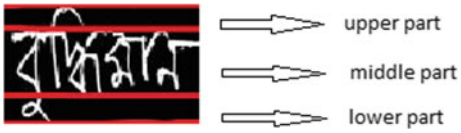


Fig. 7 Word with both upper-part and lower-part modifiers

Fig. 8 Indicating characters

Fig. 9 Segmented character with no modifier

3.4.1 Word with No Modifier

Considering that Bangla language has "matra," the upper part of the word was removed from the image. As the main body part of maximum Bangla character occurs in the middle part, considering that, the main body of the word is taken from the lower part of the image. To elimination of matra take the main body part by this equation (Height-25). Here height is 100. From that image, the connected white pixels in *y*-axis are considered as an individual character shown in Fig. 8. After indicating each character, removing the unwanted vertical gaps finally separates each character shown in Fig. 9.

3.4.2 Word with Upper-Part or Lower-Part Modifier

For identifying the word with single modifiers, the lower part is shown in Fig. 12a and the upper part of image is shown in Fig. 12b which is taken from the main image in Fig. 10 and then splits the image into three different parts shown in Fig. 12a, b. Each portion is here 1/3. If a word has an upper-part modifier, then at least the sum of the black pixels of one portion (1/3) of upper-part image will be zero. That is how an upper-part modifier detection has been done. But in the lower part of the splitted image, in three portions, there is no zero (sum of black pixels) shown in Fig. 12a. If a word has a lower-part modifier, then at least the sum of black pixels of one portion of the image of lower part will be zero shown in Fig. 16. After identifying the word with modifiers, if a word has upper-part modifier, then the upper part is removed from the image or if a word has lower-part modifier, then the lower part is removed from the image. Then the same process will be used to find the connecting point as Sect. 3.4.1 and to the segmentation of each character (Figs. 11 and 13).

Fig. 10 Modifier above the matra

Fig. 11 Upper-part modifier detection

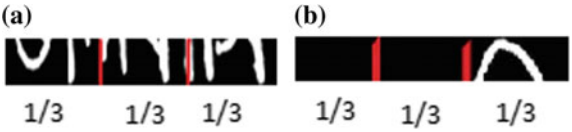


Fig. 12 **a** Lower part. **b** Upper part

Fig. 13 Segmented character with upper part

Fig. 14 Lower part

The lower-part modifier is connected with the word most of the time. To remove the lower-part modifier from the word, calculate the starting white pixel point and ending point vertically from the lower part of the image. After segmenting of each character, the modifier is added after that character which belongs to this modifier (Figs. 14, 15 and 16).

3.4.3 Word with Both Upper- and Lower-Part Modifiers

After discussing the above two sections if a word has a both upper- and lower-part modifiers, then at least one portion (1/3) of both upper part and lower part has at least one zero portion, shown in Fig. 17. For that reason, the word has both

Fig. 15 Upper part no modifier detected

Fig. 16 Lower-part modifier detected

Fig. 17 Word with both lower- and upper-part modifier

Fig. 18 Segmented character and upper-part modifiers

upper- and lower-part modifiers and then the same process will be used for character segmentation as mentioned in Sects. 3.4.1 and 3.4.2 (Fig. 18).

4 Classification and Recognition

For classification and recognition here, we use EkushNet [9] model. This model can recognize the characters used in our daily life. It contains Bangla handwritten 50 basic characters, 10 digits, 10 modifiers, and 50 compound characters. This model uses EkushNet [10] dataset. It is cross-validated with CMATERdb [11] dataset, which recognition accuracy is 97.73% till now which is the best accuracy for Bangla handwritten character recognition model (Fig. 19).

5 Experimental Result

Few test samples of handwritten word image which is recognized by EkushNet are correctly in Fig. 20. By using this segmentation method from thousands of segmented character, about 70% character is recognized properly. In Fig. 21, some word image is recognized falsely by EkushNet.

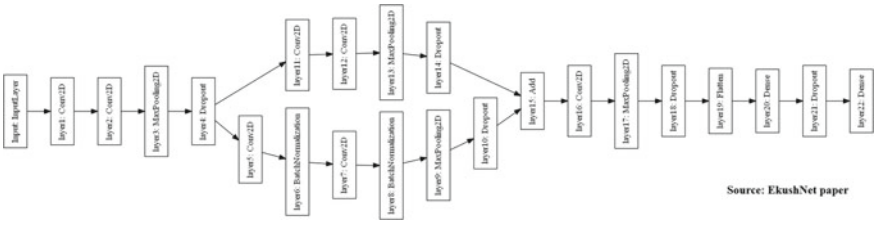


Fig. 19 Architecture of EkushNet

Fig. 20 Word image recognized correctly

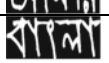
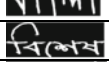
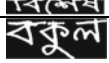
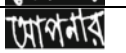
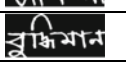
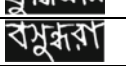
1		আমার
2		বাংলা
3		বিশেষ
4		বকুল

Fig. 21 Word image falsely recognize

1		সোনার
2		আপনার
3		বুদ্ধিমান
4		বসুন্ধরা

6 Conclusion and Future Work

An approach for the character recognition of Bangla handwritten continuous texts and digits is presented in this paper from the beginning. The whole work describes through point to point as the main image converting the binary image, noise removing, line segmentation, word segmentation, removing matra, modifiers detection, character segmentation, and recognition. The hard work and the main challenge are in the character segmentation portion, while two characters are simultaneously connected. To get a great performance from an OCR system, it is dependent on proper feature extraction of characters. For printed text, the size and font are same, but this is more difficult task to segment characters from different handwritten texts which are different in shape and size. In the future with more resources and a robust feature, the extraction of characters can achieve a better result and recognition performance.

References

1. Mantas J (1986) An overview of character recognition methodologies. Pattern Recogn 19:425–430
2. Jacobs IS, Bean CP (1963) Fine particles, thin films and exchange anisotropy. In: Rado GT, Suhl H (eds) Magnetism, vol III. Academic, New York, pp 271–350
3. Mahmud JU, Raihan MF, Rahman CM (2003) A complete OCR system for continuous Bangla characters. In: IEEE TENCON-2003: proceedings of the conference on convergent technologies for the Asia Pacific
4. Bhattacharya S, Maitra DS, Bhattacharya U, Parui SK (2016) An end-to-end system for Bangla online handwriting recognition. In: 15th international conference on frontiers in handwriting recognition, pp 373–378
5. Basu S, Das N, Sarkar R, Kundu M, Nasipuri M, Basu DK (2009) A hierarchical approach to recognition of handwritten Bangla characters. Pattern Recogn 42(7):1467–1484

6. Chaudhuri BB, Pal U (1998) A complete printed Bangla OCR system. Pattern Recogn 31:531–549
7. Louloudis G, Gatos B, Pratikakis I, Halatsis C (2009) Text line and word segmentation of handwritten documents
8. Sindhushree GS, Amarnath R, Nagabhushan P (2019) Entropy-based approach for enabling text line segmentation in handwritten documents
9. Shahariar Azad Rabby AKM, Haque S, Abujar S, Hossain SA (2018) EkushNet: using convolutional neural network for Bangla handwritten recognition. Procedia Comput Sci 143:603–610. ISSN 1877-0509
10. Ekush: a multipurpose and multitype comprehensive database for online off-line Bangla handwritten characters. https://github.com/shahariarrabby/Ekush. Accessed 20 Jun 2018
11. Sarkar R, Das N, Basu S, Kundu M, Nasipuri M, Basu DK (2012) Cmaterdb1: a database of unconstrained handwritten Bangla and Bangla–English mixed script document image. Int J Doc Anal Recogn (IJDAR) 15(1):71–83

An Efficient Security Mechanism for Cloud Data Using Elliptic Curve Digital Signature Algorithm with Wake–Sleep

S. Jerald Nirmal Kumar, S. Ravimaran and A. Sathish

Abstract As cloud computing ends up common, increasingly touchier data are being concentrated into the cloud. For the refuge of information protection, delicate information more often than need not to be mixed before redistributing, which makes viable information use a difficult assignment. The proposed structure gives the protection to information in order. In this structure, cloud service provider (CSP) chooses the best host utilizing wake–sleep algorithm. After server choice, client encrypts their information utilizing homomorphic encryption. But it is lagging to reduce computation time and needs an additional security so we adopt and utilize elliptic curve digital signature algorithm (ECDSA). This additional encryption method gives the high security during transmission of data and also avoids bandwidth, less computation time and finally less storage space attained on both the sides.

Keywords Wake–sleep algorithm · Elliptic curve digital signature algorithm · Cloud service provider

1 Introduction

Cloud technology is utilizing a system of isolated host facilitated on the Web service to process and putting away information, as opposed to on a neighborhood host. The worldview perception of cloud permits administration such as information stockpiling and preparing. An utilization of cloud moved toward becoming need into the different online exercises in last couple of years. Since the finish of Moore's law, it is never again financially reasonable or mechanically conceivable to contract the span of transistors. Individuals wish the vast majority of administrations inside a restricted period with the goal that offices can be helpful to them in accomplishing something in an alternate way [1].

S. Jerald Nirmal Kumar (✉) · A. Sathish
Anna University, Chennai, India

S. Ravimaran
M.A.M College of Engineering, Trichy, India
e-mail: principalmamce@mamce.org

H. S. Saini et al. (eds.), *Innovations in Computer Science and Engineering*,
Lecture Notes in Networks and Systems 103,
https://doi.org/10.1007/978-981-15-2043-3_61

Cloud computing issues makes a well-established evaluation of cloud computing security that is hard for two essential reasons. Initially, as is valid for some exchanges about hazard, fundamental vocabulary, for example, 'chance', 'risk' and 'helplessness,' is regularly utilized as though they were compatible, without respect to their particular definitions. Second, few out of every odd issue that is raised are explicit to cloud computing. We can accomplish a precise comprehension of the security issue 'delta' that cloud computing truly includes by investigating how cloud computing impacts each hazard factor [2]. One significant factor concerns vulnerabilities: Cloud computing makes certain surely known vulnerabilities progressively noteworthy and includes new vulnerabilities.

One of the fundamental issues in cloud is to accomplish effective planning for cloud, considered for the research. The apportioning of undertaking among the assets in effective manner, so as to improve the exhibition, is the primary point of planning. Booking is a period taking procedure to search a prominent arrangement. Most extreme algorithms set aside long effort to create most ideal arrangement. Cloud provides stockpiling administrations to clients since they manage the remote information in Web; simultaneously, it leads to different security problems in both ends [3]. Issues such as vulnerabilities, information break, account seizing, administration capturing, and denial of service (DoS) and noxious insiders [4] occur while computing in cloud.

The rest of the parts represents the related works in Sect. 2, followed by proposed methodology in Sect. 3 and result and discussion in Sect. 4.

2 Literature Survey

Makhloufi et al. [5] examined blossom fertilization calculation: flame fly algorithm (FFA) and CSA to decide the ideal stream in the Adrar control framework. They demonstrated that cuckoo search algorithm is superior to firefly algorithm and flower pollination algorithm to discover ideal arrangement.

Aqeel Khalique et al. [6] presented the elliptic bend using elliptic curve digital signature algorithm (ECDSA). In contrast to the common logarithm issue, whole number factor issue, no inner exponential time calculation was addressed in elliptic bend logarithm issue. Thus, the quality per-keybit was generously more noteworthy in a calculation that utilizes elliptic bends.

Otte et al. [7] clarified that it is conceivable to manufacture an adaptable square chain for every specialist for accomplishing adaptability. Such a methodology pursues the standard of permanent chain, yet utilizes a request of fleeting communications for every specialist. In this manner, every specialist could have a beginning square and henceforth accomplishes a specific versatility. In any case, such methodology does not address the 'absence-of-control' impediment.

Mareli and Twala [8] demonstrated that cuckoo search algorithm (CSA) is convincing and effective in explaining worldwide enhancement. In exploratory outcome,

it is demonstrated that cuckoo search algorithm is superior to differential evolution (DE), PSA, and simulated annealing (SA).

Tawalbeh et al. [9] proposed framework in security for cloud dependent on information features and characterization. Based on variety of data, author discussed various security issues.

3 Proposed Methodology for Data Security Using Double Authentication Strategy

3.1 System Model

3.1.1 Owner

An individual or gathering of concern gives the information to its purchasers through cloud setup. Proprietary encodes the instructive information utilizing ECDSA and forwards to scramble information Pi to cloud through secure Web channel.

3.1.2 Consumer (C)

A unique person or group of sectors need to access the information in cloud through Web for their tenacities. Cloud will store the encrypted data using ECDSA the cyper text is compared with the tag t. If the comparison is similar means then consumer can decrypt the cipher text using proposed methodology finally we got the original data.

3.1.3 Cloud Service Provider (CSP)

The main trusted resource for cloud is CSP. It established the secured information from the proprietary, it additionally encrypt the data by means of homographic encryption [10] to maintain confidential and secured data at cloud side. CSP use an optimization Wake Sleep Algorithm optimized server and stores this data which is encrypted twice in cloud. Further, it is an authority to retrieve original data using homographic encryption, when consumer (C) entreaty raw data contacts. The CSP translates business information from twofold encoded structure into single-scrambled structure and leads the information to consumer in encrypted form, where consumer wants to perform decryption.

3.2 Effectual Host Selection Using Wake–Sleep Algorithm

3.2.1 The 'Wake' Stage

Recognition associations (from what might be contribution to what might be yield) terminate neurons. Generative associations (driving from yields to inputs) are then changed to build likelihood that they would reproduce the right action in the layer beneath—closer to genuine data from tactile information.

3.2.2 The 'Rest' Stage

The procedure is turned around in the 'rest' stage—neurons are terminated by generative associations, while recognition associations are being adjusted to expand likelihood that they would reproduce the right action in the layer above—further to genuine data from tactile information.

The large portion of the hazard evaluation for demonstrating the learning stage. Variational Bayesian learning depends on probabilities. Quite possibly, an approximation is performed with slipups, harming further data portrayals. Another drawback relates to entangled or defiled data tests, making it hard to construe an illustrative example.

The wake–rest algorithm has been recommended not to be amazing enough for the layers of the induction network to recuperate a decent estimator of the back conveyance of inactive variables; this conduct of wake–rest algorithm is received by cuckoo search algorithm to locate a best arrangement. Markov chain arbitrary pass is useful in wake–rest algorithm to amend its presentation's normally motivated meta-heuristic methodology, and it is utilized for most ideal looking.

The data stored in different virtual machines then select productive host to store the client's information where cuckoo search algorithm is linked and produces wake–rest automatic training to get an optimal arrangement utilizing Helmholtz machine.

3.3 Data Storage Security Using ECDSA

As the problem defined, if a user wants to keep the unique information not to get affected by the external condition. At that point, it is conceivable to use the homomorphic encryption. In the event if one user does not know a specific task, at that point it can without much of a stretch be re-appropriated from different machines where the information trades between the users at different points ought to be maintained privately.

It can compromise the classification by the utilization of homomorphic encryption where it allows the client to move the encoded information, and calculation is performed on the scrambled information. The homomorphic encryption wording

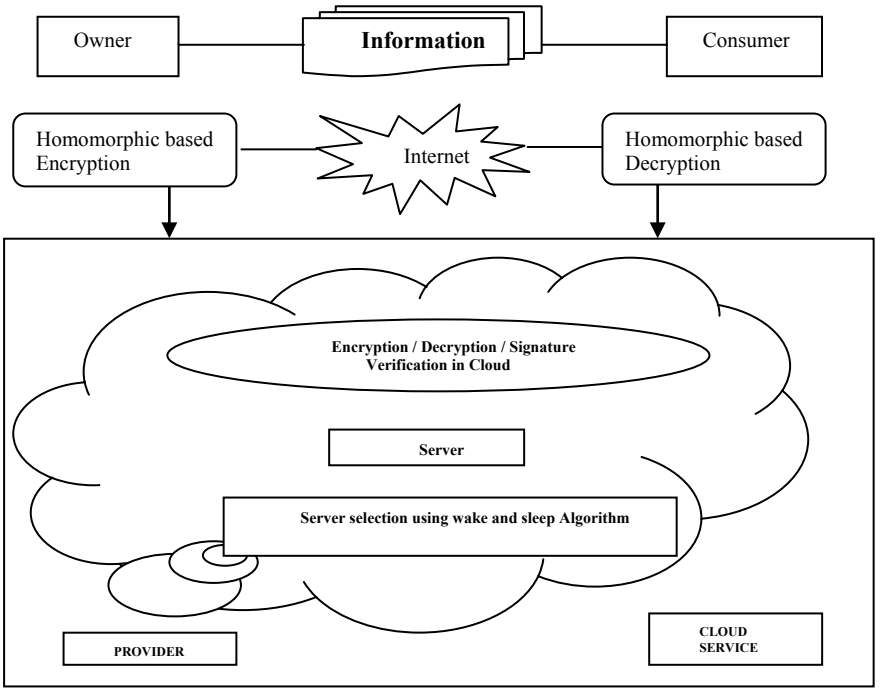


Fig. 1 Proposed architecture

requirement for the method is shown below.

$$\text{Input}_{\text{message}} = P_i \tag{1}$$

where input is the message that the file needs to encrypt for providing security with confidential manner and P_i indicates the plaintext which consists of enormous data, i.e., $P_1, P_2, \ldots, P_n$. After that, P_i can be encrypted using the key M_1, where P_i transferred plaintext to ciphertext, which is to be passed to the cloud for the operation.

$$P_1, P_2, \ldots, P_n = \sum_{i=1}^{1} P_i \tag{2}$$

The P_i is forward to the consumer and owner to decrypt it with the help of M_1 and get the solution from Eq. 1 that is the complete explanation of the same, and also consumer can verify the plaintext using the same key to retrieve the original data.

3.4 Efficient Additional Security Using Elliptic Curve Digital Signature Algorithm

In our work, key size is higher so our works take higher computation time which leads the higher storage space and high bandwidth. To tackle this issue, competent cryptographic mechanism is necessary so additionally we adopt elliptic curve digital signature algorithm (ECDSA) for high security and reduce the computation time which leads to reduce the storage space.

ECDSA Key Generation
(1) The object key M_1 pair related to specific set of Ec domain attribute I=(v, KW, f, g, L, s, t)
E->Elliptic Curve

- Select random integer I in the interval [1, s-1]
- Work out v=iU
- M is a public key v, F'S private key is I (3)

ECDSA Signature Generation
The message C_i and individual key M_1 pair related to specific set of Ec dominion attribute I=(v, KW, f, g, L, s, t)

- Select random integer p=[1, s-1]
- Work out Pu=d_1 and w=d_1 mod s
- Compute P^{-1} mod s
- Work out x=P^{-1}{m(r)+iw}mod s p is SHA-1
- If X = 0 back to step 1 (4)

ECDSA Signature Verification
To authenticate m signature (w, x) on r, G, find an authenticated copy of M's field attribute and public key m

- Verify the integer w and x between the intervals [1, s-1]
- Compute c=x^{-1} module s and m®
- Work out z_1=m(r) c mod s and z_2=wc mod s
- Work out z_1U+z_2V=(d_0, d_0) and b=d_0 mod s
- Agree the signature if and only if b = w (5)

4 Result and Discussion

The optimization and efficiency of the framework which is proposed improved a lot when compared with existing mechanism like RSA-AES and ECIES. The analysis is performed with valid encryption and decryption time for various techniques.

4.1 Environmental Setup Description

The encryption time, decryption time and re-encryption time for the lost data must always be low for obtaining efficient result. The experimental result is implemented in the working platform of Java.

4.2 Performance Analysis for the Proposed Methodology

The SHA-1 yields shown along with the private and public set of keys

SHA-1 Input=FGH
SHA-1 Output=6h04gigg59k682gfg51k591357ff5h3jfjfjf611991g2
Private M=673010267638187748529649531374572693694527263863428836 89
Public d of M=575285842952620825072469087252824179126889002578277926
Public e of M=65276773i211723757286612264218663467007538406290652950804.

Furthermore, the taken input contains text file adopted and signature is validated and then verified by the values w and x.

Signature Generation

Input File='FGHI'
Private: 0snsb68hd93bngd5biin90n0073bu77xt55bdndx7bd35bii97gjjfst66jjbctxu.

Signature

w=0s92nnsb5s792bx98wbi926vx772bgxh8359xbixbw5x93t9bxi6gnb827iuwewb
x=0bs772n8ndxv2w53n369nd0nd388211vivg7vcbb6f8bceiyvxuu877wvc79bxb8d.

4.2.1 Encryption Time

The time taken to process the plaintext to ciphertext by high-level security algorithm is evaluated which is termed as encryption time.

4.2.2 Decryption Time

The process of converting the encrypted to its original data is termed as decryption. It is vice versa to encryption. The authorized user with secret key or password is required to decrypt the encrypted message.

Table 1 describes the comparison strategy of the proposed method and existing method with different parameters like encryption time and decryption time based on the key length when compared to RSA-AES with the parameter encryption time and

Table 1 Execution time for ECDSA

Security level	RSA-AES			ECIES			ECDSA		
	Key length	Encryption time (ms)	Decryption time (ms)	Key length	Encryption time (ms)	Decryption time (ms)	Key length	Encryption time (ms)	Decryption time (ms)
80	1024	1.81	1.81	160	7.41	7.36	160	6.98	6.75
112	2048	6.42	6.53	224	13.73	13.31	224	12.37	12.13
128	3072	18.88	19.01	256	16.96	17.27	256	15.69	16.72
192	7680	240.55	239.76	384	40.77	39.75	384	38.47	38.55
256	15,360	1827.05	1834.1	512	81.52	82.84	512	80.25	79.94

decryption time. With smaller key sizes, ECDSA provides equal level of security. Size of the data for RSA is more belittled than ECIES and ECDSA. Message is encrypted for the function of key and size of the data for both ECIES and RSA. ECDSA key size is comparatively smaller than RSA key size, resulting that the encrypted message in ECDSA is much smaller.

5 Conclusion

The crucial goal is to investigate data security issues and structure to assist as data security. The system is designed to plan security mechanism apart from data order just as it chooses efficient server for data storage. Cuckoo search algorithm (CSA) has been applied for choosing the most proper server to achieve distributed computing efficiently using wake–sleep algorithm. Data trustworthiness is the primary objective achieved through homomorphic encryption with encryption at client end. In order to reduce computation time and less storage space, we have adopted ECDSA encrypted at cloud server. It upgrades client-side data security in the cloud. Finally, the system manifests the affirmation of trustworthiness, validation, and privacy of data.

References

1. Ghorbel A, Ghorbel M, Jmaiel M (2017) Privacy in cloud computing environments: a survey and research challenges. J Supercomput 73:2763–2800
2. Tebaa M, Hajji SE (2014) From single to multi-clouds computing privacy and fault tolerance. IERI Procedia 10:112–118
3. Tebaa M, El Hajji S, El Ghazi A (2012) Homomorphic encryption applied to the cloud computing security. In: Proceedings of the world congress on engineering, vol 1, 4–6 July 2012
4. El Makkaoui K, Ezzati A, Hssane AB (2015) Challenges of using homomorphic encryption to secure cloud computing. In: 2015 IEEE international conference on cloud technologies and applications (CloudTech), pp 1–7
5. Makhloufi S, Mekhaldi A, Teguar M (2016) Three powerful nature-inspired algorithms to optimize power flow in Algeria's Adrar power system. J Energy 116:1117–1130
6. Khalique A, Singh K, Sood S (2010) Implementation of elliptic curve digital signature algorithm. Int J Comput Appl 2(2):21–27
7. Otte P, de Vos M, Pouwelse J (2017) TrustChain: a Sybil-resistant scalable blockchain. Future Gener Comput Syst 1-1
8. Mareli M, Twala B (2017) An adaptive Cuckoo search algorithm for optimisation. Appl Comput, Inf
9. Tawalbeh L, Darwazeh NS, AlQassas RS, AlDosari F (2015) A secure cloud computing model based on data classification. Procedia Comput Sci 52:1153–1158
10. Tebaa M, Hajji SE (2014) Secure cloud computing through homomorphic encryption

Enabling Internet of Things (IoT) Security via Blockchain Framework

M. S. Urmila, Balaji Hariharan and Rekha Prabha

Abstract In today's world of technological advancements, technologies such as data science, big data and IoT play a huge role in simplifying human life. Access control is a major concern for any data source. Legitimate access to confidential data is important to ensure privacy, integrity, authenticity and confidentiality. It is further very important to devise access control in situations where data is critically private, such as in the case of health care. Access control policies stored in a centralized storage are prone to security breaches due to single point of failure. Blockchain is a decentralized storage system which is based on peer-to-peer network architecture. It is immutable and helps in recording transactions between two parties in a permanent and verifiable manner. The project concentrates on storing the access control policies of a healthcare data source and the transactions that follows in a blockchain. The results of storage of policies and transactions are shown in Remix IDE using Ethereum blockchain framework.

Keywords Blockchain · IoT · Wireless security · Cyber security

1 Introduction

Some of the prominent use cases of IoT can be seen in the fields of agriculture [1, 2], health care [3, 4], surveillance [5], etc. By definition, medical IoT data should be private and confidential. The patient should be able to control the access to his/her private data which otherwise could lead to identity thefts and data manipulation. Current approaches such as centralized authentication to the data server are prone to attacks and single point of failure. The setup cost is also high for centralized

M. S. Urmila (✉) · B. Hariharan · R. Prabha
Amrita School of Engineering, Amrita Center for Wireless Networks & Applications (AmritaWNA), Amrita Vishwa Vidyapeetham, Amritapuri, India

B. Hariharan
e-mail: balajih@am.amrita.edu

R. Prabha
e-mail: rekhap@am.amrita.edu

H. S. Saini et al. (eds.), *Innovations in Computer Science and Engineering*,
Lecture Notes in Networks and Systems 103,
https://doi.org/10.1007/978-981-15-2043-3_62

approach. Implementation of complex cryptographic algorithms cannot be performed due to storage and processing limitations of IoT system. Conventional access control mechanisms are based on server-side access control. The data is exposed and is not encrypted. A data-centric mechanism of access control needs to be developed. Since the introduction of blockchain in 2008, it has played an integral part in the building of distributed applications and systems. Blockchain in layman's language is a simple chain which grows continuously. Each block of the chain is a collection of three different types of data: a hash function (cryptographic) of the previous block, the trusted time stamp of the data generated and the hash function of the current block of data which is usually represented as the root hash of the Merkle tree. It is an open and distributed collection of data which is used for recording details of transaction between two parties, which can be verified and cannot be modified. With these inherent properties of blockchain, it can be used for storing the access control policies of an IoT system or healthcare IoT system.

2 Related Works

In the work [6], the study produced a IoT server platform that is secured by blockchain. The proposed system was based on dynamic log chunking and is able to save the network bandwidth by 13–19% compared to the existing model. Also, there is a factor of reduction in cost. However, it lacked a secure data transaction. In the paper [7], the main focus is on a system called verifiable auditing of access to confidential data. This system facilitates user to check and verify if there are any illegitimate access to their personal information. It also helps data auditors in auditing by helping them in the detection of any policy violations to access individual information. In the work [8], authors propose a new platform for IoT servers, based on the concept of the blockchain which is different from the traditional Mobius-based IoT server platform. The main research goal of the paper [9] is to understand whether the blockchain-based network, in general peer-to-peer network structure, can be incorporated into the IoT design so as to maintain the privacy of the user data and hence if the IoT data storage can be decentralized. In the paper [10], the focus is on the attacks prone to different block chain platforms. In the paper [11], there is a comparison between Ethereum and Hyperledger fabric block chain platforms based on the energy-performance trade-offs between the two platforms.

3 Blockchain

Blockchain technology has made transaction histories more transparent. This is because blockchain is a sort of distributed ledger where all the participants of the network share the same documentation and not different individual copies. The shared documentation version can be updated only through consensus. In order to change a

single record of transaction, it would require the alteration of the entire subsequent records in the chain and also the collusion of the complete network. It can be stated that data on a blockchain is more consistent, transparent and accurate in comparison with the transactions involving paper works and physical processes. Transactions taking place in the blockchain network must be agreed upon by all the participants prior to the process of recording. Once a transaction is approved by the network peers, it undergoes encryption and is then linked to the prior transaction. This, along with the fact that information is stored across a distributed network of devices/computers rather than a single server, makes it closely impossible and difficult for the hackers to hack the protected and confidential data.

4 Proposed Architecture

Generally, to access a database of critical and private information, access requests need to be sent from the needing party of the data to the authorization server for accessing the data. However, if the authorization server is attacked or hacked, the resource or the data server can be easily hacked, and the entire critical data can be compromised due to the centralized architecture of the authorization database. It is therefore important to store the access control policies in a repository or server which is not prone to single point of failure or attack. The best way to tackle this issue is to store the access control policies in a distributed database. One of the most secure distributed databases which can be used for this purpose is based on the distributed ledger technology, i.e., the blockchain.

Blockchain can be used to store the access control policies to any database. In our case, we store the access control policies to access a patient's data by a third party (the doctor or the healthcare person) in the blockchain. The inherent security features of the blockchain help in elevating the security of the access control policies. Every transaction that takes place between the third party and the database is recorded inside the blockchain. So, when a new access request comes, the previous transactions are first verified to see whether a similar request had taken place previously. If yes, the request is granted. If not, the request is redirected to the owner or the patient of the data to confirm the legitimacy of the requester. If the patient finds it as an illegitimate request, she will reject it. However, if the request is legitimate, the user can add the policy and the access to the database will be granted.

As shown in Fig. 1, a third party (a doctor or a healthcare person) will request for the access to a preferred medical record. The request is forwarded to the access control policy (ACP) repository to check whether the requester is having access to the requested record. This is achieved by verifying the previous transactions that had taken place. If a similar request and transaction are found, then the current request will be approved. However, if the transaction is new, the request will be forwarded to the patient whose data is the subject of access. If the patient wants to approve the access request, a new policy is added in the repository. But, if the patient finds

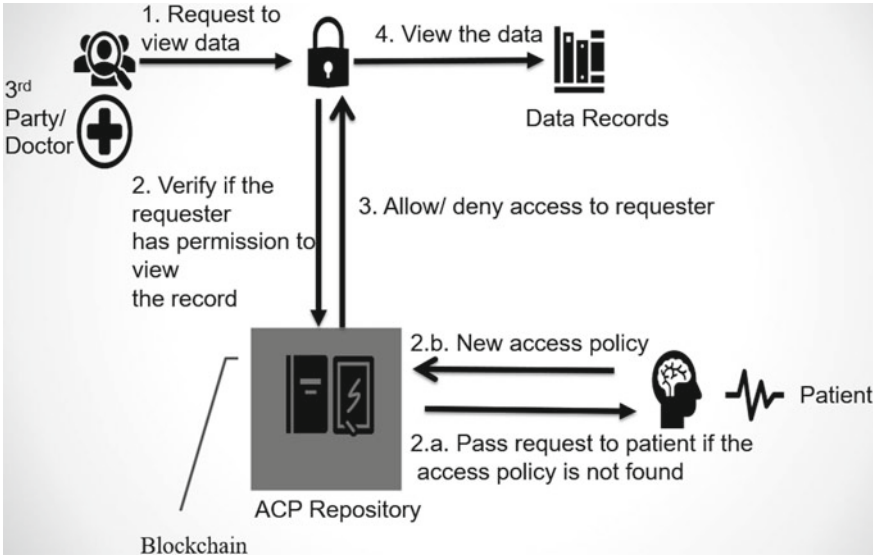


Fig. 1 Proposed model

a request fishy, the request is completely rejected. Here, the access control policies and the transactions henceforth are stored in the blockchain.

The process flow in the repository is shown in Fig. 2. If a new policy needs to be added to the block, then the requesting peer would request the network to give the latest block. The hash of the latest block should be the previous hash of the created block. If the block is valid, it is added to the chain and then broadcasted to the network. If the requirement for the hash value is not met, then the index of the newly created block is compared with the index of the latest block. If the index is greater, then it is verified if the newly created block is part of a chain which is longer and valid. Then, the existing chain will be replaced with the new chain. However, if the index value of the newly created block is smaller than the current block, then the block is considered to be an invalid block and the block is rejected.

The simulation work has been done in the online IDE called the Remix. It is Web browser-based IDE which allows users to code their smart contracts, then deploy them to the EVM, run and debug the results. Figure 3 shows the ownership setting. The network consists of two functions "setOwner" and "getOwner." The first function, setOwner, helps the user in setting the owner of the current transaction, and the getOwner function helps in retrieving the address of the current user. This function helps us to understand whether the setting of owner is done properly or not.

Figure 4 shows the data storage in the blockchain. Here, the access control rules can be stored within the blockchain. The rules for the patient data access and authentication of the user can be stored within the blocks. The functions used here are "get" and "set." The set function helps the user to set the rules and threshold values in the

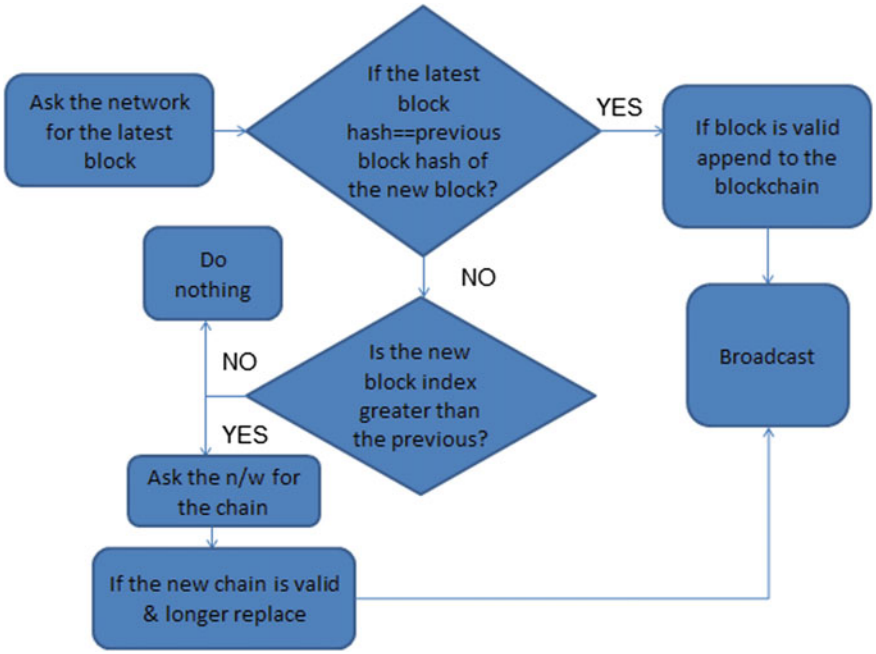


Fig. 2 ACR policy inclusion [12]

contract. Get function helps the user in verifying if the value and the rules set by the user are correct or not.

Figure 5 shows the role assignment to doctors for a particular record, addition of roles to doctors and patients (full access generally), role revoking, verification of roles added. The functions used are "addDoctor," "addRole," "removeDoctor," "hasRole" and "roles." The function addDoctor adds a user as a doctor with the privileges. The addRoles function adds a role. The function removeDoctor removes a doctor from the privileges assigned to him. The other two functions hasRole and roles check if a user has a given role or not and the roles given, respectively.

5 Conclusion

The storing of access control policies of a patient database in a blockchain has the ability and scope of involving millions of people (patients), doctors, medical researchers, healthcare institutions like hospitals or laboratories to share a mammoth amount of a various information on health care involving environmental, diet and genetics with an assurance that the individuals/patient's personal data is not compromised, leaked, reverted or corrupted. Hence, there is a sense of security and privacy. This will also help people to shift toward the digitized healthcare world. Doctors can

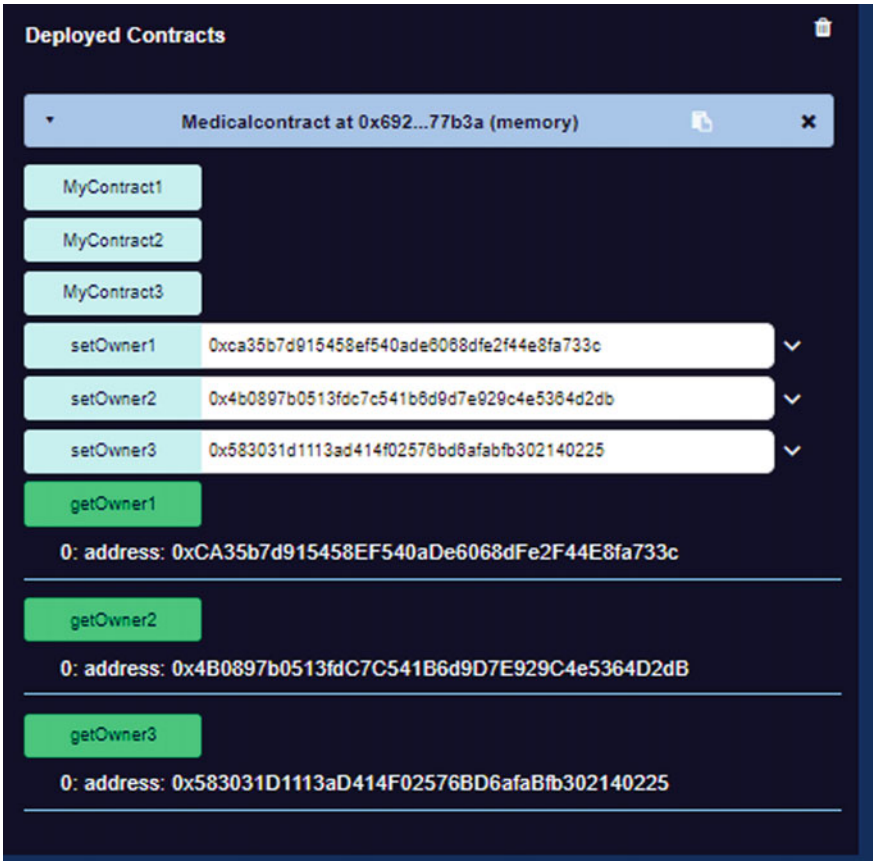


Fig. 3 Ownership setting output

prescribe medicines, view reports, scans and so on, digitally. The patient can share the critical medical information related to his/her health without any hesitation as the blockchain framework is secured and tamperproof and cannot be reverted back.

The project concentrated mainly on storing the access control policies to a patient record database in a decentralized manner using the blockchain unlike the traditional centralized storage approach. The simulation results are shown in Remix IDE with Ethereum framework. Smart contracts were written in solidity language. The project can be further extended by analyzing the transactions using hardware such as the Raspberry Pi.

Fig. 4 Output for the data storage

Fig. 5 Output for the role assignment

References

1. Prabha R, Sinitambirivoutin E, Passelaigue F, Ramesh MV (2018) Design and development of an IoT based smart irrigation and fertilization system for chilli farming. In: 2018 international conference on wireless communications, signal processing and networking (WiSPNET), Chennai, pp 1–7
2. Rekha P, Rangan VP, Ramesh MV, Nibi KV, High yield groundnut agronomy: an IoT based precision farming framework. In: 2017 IEEE global humanitarian technology conference (GHTC), San Jose, CA, 2017, pp 1–5
3. Pathinarupothi RK, Alangot B, Ramesh MV, Achuthan K, Rangan PV (2016) H-plane: intelligent data management for mobile healthcare applications. In: Younas M, Awan I, Kryvinska N, Strauss C, Thanh D (eds) Mobile web and intelligent information systems. MobiWIS 2016. Lecture notes in computer science, vol 9847. Springer, Cham
4. Dilraj N, Rakesh K, Krishnan R, Ramesh MV (2015) A low cost remote cardiac monitoring framework for rural regions. In: Proceedings of the 5th EAI international conference on wireless mobile communication and healthcare, pp 231–236
5. Kokkonis G, Psannis KE, Roumeliotis M et al (2017) J Supercomput 73:1044. https://doi.org/10.1007/s11227-016-1769-9
6. Ramesh MV, Achuthan K, Pathinarupothi RK, Alangot B, Rangan PV (2016) H-plane: intelligent data management for mobile healthcare applications. In: International conference on mobile web and information systems, pp 1195–1199
7. Al-Bassam M, Meiklejohn S, Murdoch SJ, Hicks A, Mavroudis V (2018) VAMS: verifiable auditing of access to confidential data, pp 1909–1914
8. Kim J-H, Jeon JH, Kim K-H (2018) Block chain based data security enhanced IoT server platform. In: International conference on information networking (ICOIN)
9. Vetrò A, Conoscenti M, De Martin JC (2016) Blockchain for the internet of things: a systematic literature review. In: IEEE/ACS 13th international conference of computer systems and applications
10. Maroun C, Moubarak J, Filiol E (2018) On blockchain security and relevant attacks. In: 2018 IEEE Middle East and North Africa communications conference (MENACOMM)
11. Sankaran S, Achuthan K, Sanju S (2017) Energy comparison of blockchain platforms. In: IEEE/ACS 13th international conference of computer systems and applications
12. Blockchain (Online). Available from: https://blockchaindemo.io/

Detection of Disease in Mango Trees Using Color Features of Leaves

Jibrael Jos and K. A. Venkatesh

Abstract The goal has been to detect disease in mango trees. This paper compares different approaches to extract color features and check the accuracy and applicability for mango trees. The paper proposes variations which helped in increasing the accuracy of features extracted for mango trees: firstly, a customized method of splitting leaf into layers while doing K-means clustering, and secondly, segmenting the region of interest to blocks to help in applying statistical functions more accurately over a region.

Keywords Disease detection · Mango trees · Color analysis · Feature extraction · Segmenting · Region of interest · Neural network

1 Introduction

The aim of this research has been to detect disease using image processing techniques. Author has been studying the problem mango farmers face in the Kolar region of southern India. Image analysis-based methods to detect disease are a feasible option as the orchard managers have access to smartphone. But the margin they have on their produce is not large enough to do chemical or spectral analysis on a regular basis.

This paper aims to study different methods used across the world on different plants. Apply the same on mango trees, and compare the effectiveness of these methods. This is a study of how effective can color analysis be for mango disease detection. Identify the gap and find strategies to overcome the challenges. The end result is identifying whether a given leaf is healthy or not.

J. Jos (✉)
Christ University, Hosur Road, Bengaluru, India
e-mail: jibrael.jos@res.christuniversity.in

K. A. Venkatesh
Myanmar Institute of Information Technology, Chanmyathazi, Myanmar
e-mail: ka_venkatesh@miit.edu.mm

H. S. Saini et al. (eds.), *Innovations in Computer Science and Engineering*,
Lecture Notes in Networks and Systems 103,
https://doi.org/10.1007/978-981-15-2043-3_63

Features extracted using this approach along with textures and edge features have been used to identify different mango diseases.

1.1 Literature Survey

Three papers have been used as a basis to do color analysis of mango leaves to quantify symptoms in plant leaves.

Pagola et al. [1] highlighted a method for barley leaves to check for nitrogen deficiency using RGB space.

Camargo–Smith [2] proposed a way to identify lesions using color transformation to HSV and I1I2I3.

Contreras-Medina et al. [3] suggested a system to check for chlorosis, necrosis, leaf deformation, white spot and venation identification.

Some other researches done in similar areas have been listed in Table 1 to understand the breadth of work undertaken in the disease detection using color analysis, and Table 2 lists out research done for thresholding. A broader understanding can also be found in the literature survey papers of Barbedo [4] and Hamuda et al. [5].

Diseases in plants can be caused by pathogens and physiological factors. Infectious disease in mangoes could be caused by include fungi, bacteria, algae. Mango trees also have to face further challenges in the form of insects, mites, vertebrate or other pests that affect plant health by consumption of plant tissues.

Physiological plant disorders include:

Table 1 Quantification based on color analysis

Papers	Plant
Boese et al. [8]	Eelgrass
Contreras-Medina et al. [3]	Pumpkin, pepper, bean
Pagola et al. [1]	Barley
Pugoy and Mariano [9]	Rice
Wiwart et al. [10]	Faba beans, pea, yellow lupine

Table 2 Quantification based on thresholding

Papers	Plant
Camargo and Smith [11]	Multiple
Lloret et al. [12]	Grapes
Ferentinos [13]	Multiple
Macedo-Cruz et al. [14]	Oat
Patil and Bodhe [15]	Sugarcane
Škaloudová et al. [16]	Bean
Weizheng et al. [17]	Soy

Natural: Drought, frost damage, breakage by snow and hail, flooding and poor drainage, nutrient deficiency, salt deposition, wind, lightning and wildfire.
Man-made: Soil state, air pollution, soil pollution, herbicide over-application, poor education and untrained to work with trees.

An early disease detection system will help in decreasing loss caused by plant diseases. This can further prevent the spread of diseases. After the onset of disease symptoms, the presence of disease in plants can be verified using image processing and artificial intelligence techniques.

This paper concentrates on imaging techniques and researcher as farmers in Karnataka, India, currently cannot afford to go for serological or molecular methods as they will not be cost effective.

Some of the earlier methods captured the images using a camera. The identification of the diseased regions was done by a simple thresholding.

For accurate disease identification, extraction of characteristic features of diseased region would be required. Wang et al. [6] used PCA and neural networks to study wheat and grape diseases. The powdery mildew they studied is also a common problem from mango trees in India. They used more than 20 color and texture features and a few shape features.

The current proposal aims to use the opportunities created in this era of smartphones. Process generally followed is to segment diseased region and extract statistical texture features like: mean, variance, entropy, correlation, inverse difference moment, variance, sum entropy.

1.2 Study

Study started in 2016 January. Trees have been studied over the months in the orchard.

Image Dataset
Leaves were collected at four different times of the year. Hence, disease and infections may be found at different stages. The leaves were collected from three different locations in Karnataka. But the research is primarily been done in the farms of Srinivaspur region of Kolar District.

Different farms add up to more than 1200 trees under the supervision of one mango orchard owner. Thirty-six different trees were selected for this study. Leaves were collected and scanned using a flatbed scanner. Each leaf was scanned individually in an upright position with stem facing down. The background was white/black to avoid noisy background. For the current study of comparing color analysis methods for mango leaves, 500 leaf scans have been used. The leaves are numbered, and leaf numbers mentioned in images are based on indexing of this dataset.

Classification was done as follows:

Colors: Yellow, gray, brown, black, red, white
Type: Spot, patch, growth

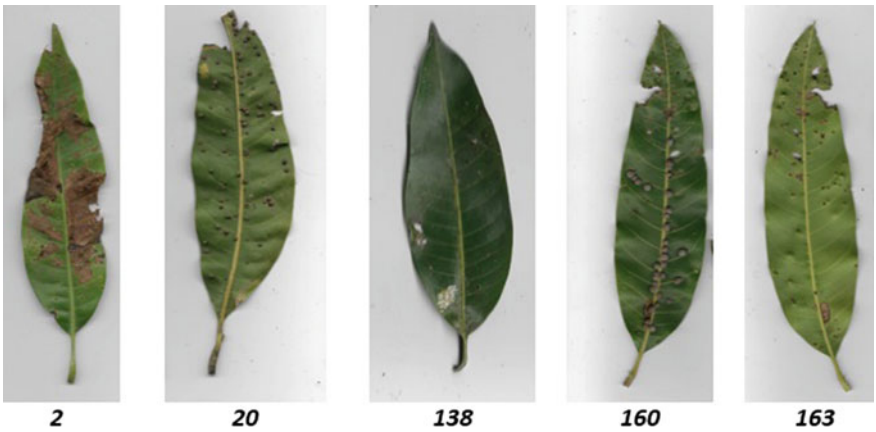


Fig. 1 Symptoms of disease on mango leaves

State: Dried, deformed, eaten, holes, healthy
Age: Young and developed.

Some of the issues faced by the trees have been shown in Fig. 1.

For mangoes, the following diseases were observed when leaves were scanned. The observation is not just based on state of leaf, but observing the leaf, bark, fruit, pest, soil, etc.

Following disease symptoms were visually observed:

Anthracnose, Fruit Fly (Harvest Time), Mango Hopper, Dried Leaves.

Mealy Bugs, Scales, Zinc Deficiency, Leaf Deformations, Weevil.

Disease symptoms need to be studied on leaf, bark, fruit, soil, pests to make it more comprehensive. This paper's scope was to see what all features can be extracted based on color from mango leaves which can help ascertaining the health of the mango tree.

2 Methodology

The color feature system (built using MATLAB and C#) has the following steps (Fig. 2):

1. Preprocessing and background identification
2. Clustering to separate region of interest
3. Segmenting the leaf into smaller block
4. Vein identification and color analysis
5. Color analysis on non-vein, leaf area
6. Neural network-based classification.

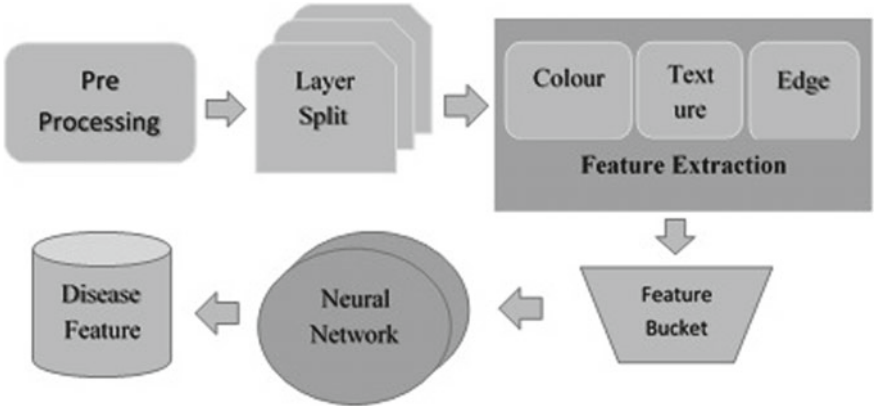


Fig. 2 Process flow which generates features like yellow spot and brown patch for each leaf. Multiple neural network models have been made for each disease feature. Disease features are later fed into disease detection neural network

Step 1: To identify background initially it was assumed the color would be white because scan was done with a white background but because leaf may also contain white patches or scales. The area surrounding the leaf was marked as non-leaf. To achieve this, all the green outer edges were considered as interest points. To identify outer edge, canny edge operator was used. While working with application, the uninterested area was marked in blue as shown in Fig. 3. The leaf is 2.jpg from the mango disease set. First image shows the original one; image 'b' shows the background which is detected. Image 'c' is after a split is done based on hue for color analysis.

Step 2: To identify the regions which are not healthy. A K-means clustering was done using the hue of each pixel. The three diagrams in Fig. 4 show how leaf no 2 was split into three layers. Zhang used K-means super-clustering with a variation to identify and to locate region of interest more accurately [7]. In our approach, K-means clustering had to be done twice once using hue and once using intensity in the HSI model.

Step 4: Healthy portions of the leaves are shades of green but when the disease on leaves is yellow, then it becomes difficult to identify whether it is the vein or the diseased segment of the leaf. A simple color analysis seems to give a higher quantification of disease on leaves.

Initially, it was tried to identify yellow which is not lying in the vein section by first identifying the veins on the leaf and checking for yellow spots or patches which are surrounded by green. But there are cases where yellow patches line in close proximity to the vein. The solution currently applied uses an approach where a healthy leaf is used as a criterion to ascertain the green leaf versus vein ratio.

Step 5: To analyze color, Pagola et al. [1] proposed RGB space. Initially, RGB was split based on red channel to identify non-leaf space. It works well for a system to

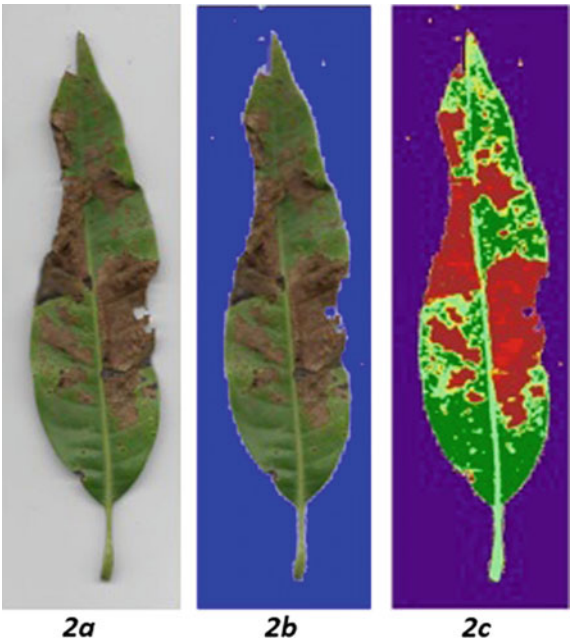


Fig. 3 Preprocessing stage

Fig. 4 Splitting leaf into layers, first image has the background, then the green layer

check for single color but when we are working on identifying different colors for different diseases it was found an HSV model was more efficient to separate different diseases into different categories. Another challenge is that the green color of the healthy leaf may change based on the age of the leaf.

Camargo–Smith [2] proposed an HSV and 1I2I3 to identify lesions. HSV means hue, saturation and value. The value of hue gives the colors of rainbow (VIBGYOR) in reverse order. So, zero has red, 120 has green and 250 has violet but since it is based on a cylindrical model the higher values will further roll around to red.

One challenge which was faced in sifting through issues challenging in mango trees was identifying white, brown and black colors on leaves using this model. If the V value is 0, then it is black irrespective of H value. If V is not zero and S is zero, then it is shades of gray. White is a high value on V with a low value of S. For white, another option was to use the HSL model and use lightness value to identify white.

One peculiar problem faced was the hue-based color detection due to shadow of edges when leaf was scanned. In the image below, the edges had to be cleared to ensure that percentage impact is accurate (Fig. 5).

One was to identify leaf based on green color and eliminate the shadow simply based on edge color. But in certain leaves, the discoloration may be found at the edge as shown in Fig. 6. The colors of shadow are in the hue range of darker shades.

The figure is based on leaf 226 from the Mango Leaves Scanned Dataset.

262a: Hue-based split, this split first classifies white, black and gray. Then, the function splits the hue.
262b: Original leaf scan.
262c: Intensity split (inset shows a section zoomed). This is especially useful if the discoloration is rough or rises above leaf level like a growth.

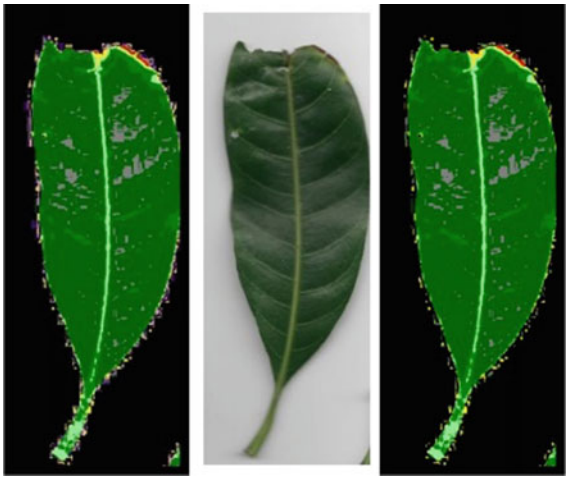


Fig. 5 Shadow interference while detecting gray color

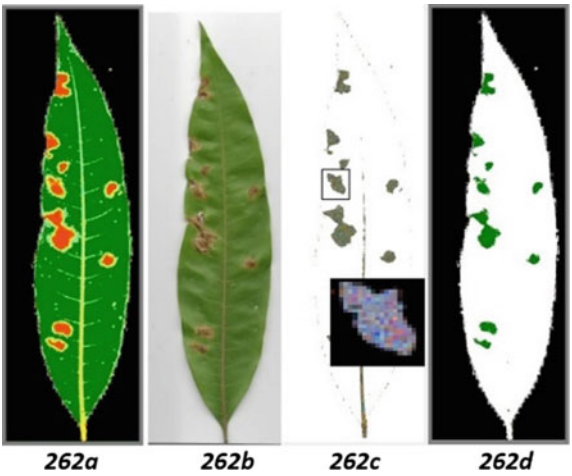


Fig. 6 Challenges of handling discoloration similar to hue of veins

262d: Hue split for red–brown shades. Vein is removed but along with it the outer regions of brown patches have also been removed. This is similar to hue split but additionally splits each color into two based on saturation values.

Contreras-Medina et al. [3] proposed a methodology which is the general strategy used by the system which has been made. White spot, leaf deformation and venation are similar to the challenges faced by mango trees too.

Step 6: Color features identified were used to train a neural network model to classify leaves as having brown spot or not, and white scales or not. Multiple networks were first modeled for each feature. Later along with texture and edge features, one model was created.

3 Results

The color features extracted using the process were fed into a neural network with a batch size of 500. Since each leaf has multiple layers stored in different images, there are around 1500 (500 * 3) leaf images in total. The preprocessing and feature extraction on the computer took a lot of processing time as each function took input as an image and the output being the extracted feature. Neural network is relatively very fast as it had to deal with only numerical values rather than the image itself.

The larger application uses 12 color features, 8 texture features, 14 edge features; in this paper, we have discussed the color feature and its variation which helped us getting this accuracy.

The results have been given in Table 3, as it can be seen the accuracy of detecting the healthy leaves was around 90%.

Table 3 Results

Symptom	Training NN	Testing	Accuracy (%)
Brown spots	100 in 200	50/50	94
White scales	80 in 200	30/30	91
Yellow spots versus veins	80 in 200	30/30	65
Young leaves	60 in 150	30/30	90

It is clear that ***just*** color analysis cannot be used to classify plant diseases. The attempt of this paper was to study different color-based approaches proposed and create a set of features. To handle yellow spots when the shade of yellow matches the veins, a different approach had to be used in the preprocessing stage and additional texture and edge features. Currently, the accuracy is above 90% for yellow spots too. Similarly for different diseases which are having shades of brown, we have had to use texture features to differentiate both of them.

Color features created for disease detection are as follows:

Block-wise (n pixel by n pixel)

- Average hue bucket
- Dominant hue bucket
- Range of a color (deviation)
- Colors in the block (pixel count)
- Blob-wise area
- Hue variance
- Intensity variance
- Contains background (percentage).

Block is compared with 8 neighbors and variance with other based on above features (Fig. 7).

Finally, all the blocks which are considered non-healthy are used in feature matrix to identify possible infection and diseases on the leaf.

Blocking (Step 6) also allowed identifying multiple problems in the same leaf. Many times, neural network detects a disease but it is not clear which feature combination triggered the same. But knowing the block in which the feature was detected helps in identifying the root cause.

4 Conclusion

The challenges of extracting the color features are not specific to mango trees alone, and the method can be used for other plants and trees too. Using the RGB channels along with K-means clustering helped in splitting into layers. Bucketing the hue in the

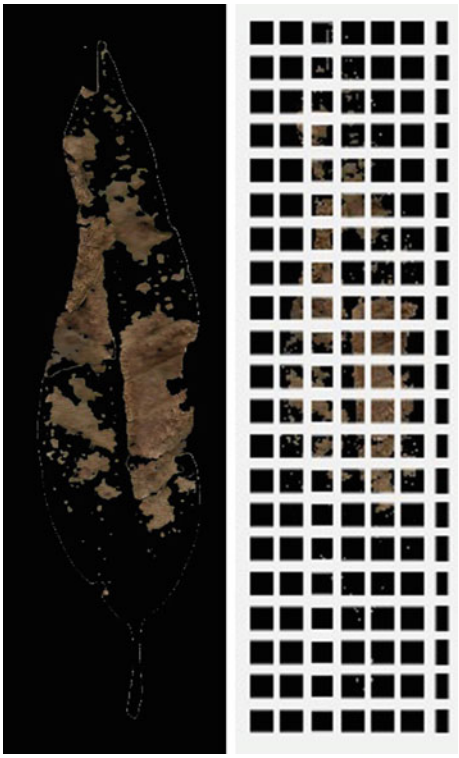


Fig. 7 Splitting region of interest layer into smaller blocks

HSV model along with extreme values of saturation and value helped in identifying colors as humans normally see. The color identification worked well except in cases of black, white or dark-colored patches. A lot of experimentation lead to getting the color features right for these colors. Some of the innovations included splitting the layers using a customized algorithm. Segmenting the region of interest also improved accuracy in statistical function used. The accuracy was improved by increasing the number of features and with enhanced preprocessing. For effective disease detection, the color features is one of the key steps. Neural network model currently created uses a mixed approach of color, texture and region of interest edge features for mango leaves.

4.1 Future Work

Currently, the dataset consists of scanned images, and system does not work well for pictures clicked in different light conditions. Texture features have to be made more accurate by eliminating healthy part in region of interest and handle shadow in

cases of growth on leaf. There are certain features which need more work, like green growth on leaf and gray patches on edges of leaves.

Acknowledgements Access to mango orchards over the years was granted thanks to the owner Mr. Venkatesha Rao S. R. He has an in-depth scientific understanding of challenges orchard owners face in these drought-stricken areas. In the fieldwork phase, authors were assisted by the farm manager Mr. Rajanna.

References

1. Pagola M et al (2009) New method to assess barley nitrogen nutrition status based on image colour analysis: comparison with SPAD-502. Comput Electron Agric 65(2):213–218
2. Camargo A, Smith JS (2009) An image-processing based algorithm to automatically identify plant disease visual symptoms. Biosyst Eng 102(1):9–21
3. Contreras-Medina LM et al (2012) Smart sensor for real-time quantification of common symptoms present in unhealthy plants. Sensors 12(1):784–805
4. Barbedo JGA (2013) Digital image processing techniques for detecting, quantifying and classifying plant diseases. SpringerPlus 2(1):660
5. Hamuda E, Glavin M, Jones E (2016) A survey of image processing techniques for plant extraction and segmentation in the field. Comput Electron Agric 125:184–199
6. Wang H et al (2012) Image recognition of plant diseases based on principal component analysis and neural networks. In: 2012 8th international conference on natural computation. IEEE
7. Zhang S et al (2018) Plant diseased leaf segmentation and recognition by fusion of superpixel, K-means and PHOG. Optik 157:866–872
8. Boese BL et al (2009) Recolonization of intertidal *Zostera marina* L. (eelgrass) following experimental shoot removal. J Exp Mar Biol Ecol 374(1):69–77
9. Pugoy RADL, Mariano VY (2011) Automated rice leaf disease detection using color image analysis. In: Third international conference on digital image processing (ICDIP 2011), vol 8009. International Society for Optics and Photonics
10. Wiwart M et al (2009) Early diagnostics of macronutrient deficiencies in three legume species by color image analysis. Comput Electron Agric 65(1):125–132
11. Camargo A, Smith JS (2009) Image pattern classification for the identification of disease causing agents in plants. Comput Electron Agric 66(2):121–125
12. Lloret J et al (2011) A wireless sensor network for vineyard monitoring that uses image processing. Sensors 11(6):6165–6196
13. Ferentinos KP (2018) Deep learning models for plant disease detection and diagnosis. Comput Electron Agric 145:311–318
14. Macedo-Cruz A et al (2011) Digital image sensor-based assessment of the status of oat (*Avena sativa* L.) crops after frost damage. Sensors 11(6):6015–6036
15. Patil SB, Bodhe SK (2011) Leaf disease severity measurement using image processing. Int J Eng Technol 3(5):297–301
16. Škaloudová B, Křivan V, Zemek R (2006) Computer-assisted estimation of leaf damage caused by spider mites. Comput Electron Agric 53(2):81–91
17. Weizheng S et al (2008) Grading method of leaf spot disease based on image processing. In: 2008 international conference on computer science and software engineering, vol 6. IEEE

Weather Categorization Using Foreground Subtraction and Deep Transfer Learning

Sri Venkata Divya Madhuri Challa and Hemendra Kumar Vaishnav

Abstract We propose a novel foreground subtraction algorithm to extract the Sky pixels and use transfer learning on these processed images using pre-trained ResNet-50 and DenseNet-161 models to classify them. For this study, the Image2Weather's 2 category weather dataset having 1500 images, is used. By using transfer learning and training, only the last layer by freezing rest of the layers, we have found that the proposed ResNet-50 and DenseNet-161 architectures achieved the classification accuracies of 94.3% and 92.68%, respectively, on the test images and outperformed the state-of-art methods. These results are extremely good as there is a significant improvement of 6–8% in accuracy over the existing models due to foreground subtraction. The proposed method can be implemented in real-time applications to help farmers plan their cropping cycle and for efficient weather forecast activities.

Keywords Convolutional neural networks · Foreground subtraction · Weather classification · Image classification · Transfer learning

1 Introduction

Weather classification strongly influences important areas like weather forecasting, disaster prediction, outdoor video surveillance and autonomous driving systems. In the recent years, weather prediction became an area of immense research due to extreme devastation caused by natural disasters like cyclone and hurricane. But the task of weather categorization into cloudy or sunny climates always remained a task which needs human supervision. Such manual classification of a huge number of weather images is tedious and time consuming. And the lack of trained human workforce limits the efficiency of weather prediction. All these factors demand a novel computer vision tool that can solve this problem.

S. V. D. M. Challa (✉)
University of Texas at Dallas, Texas, USA

H. K. Vaishnav
Barefoot Lightning India Pvt Ltd, Jaipur, India

H. S. Saini et al. (eds.), *Innovations in Computer Science and Engineering*,
Lecture Notes in Networks and Systems 103,
https://doi.org/10.1007/978-981-15-2043-3_64

The convolutional neural networks (CNNs) are the most viable techniques that are applied to several areas of computer vision, namely autonomous driving, medical image analysis, sales forecasting, etc. The end-to-end structure of CNN architectures enables them to learn high-level features from the data [1]. Earlier methods like deformable part models [2], histogram of oriented gradients [3] and scale invariant feature transform [4] revolved around using handcrafted features. But nowadays, convolutional neural networks have replaced the need for handcrafted features and fulfilled the demand for robustness in computer vision applications. They do not require any feature engineering. Instead, they follow non-linear operations and have a loss function which is to be minimized for optimization.

2 Related Works

Very few studies have been done to classify weather using outdoor images [5–8]. Most of these techniques can be categorized into three basic steps [6–8]. Extracting the regions of interest (ROIs) in a weather image, for example, sky region and ground region extraction, is the first step which is followed by representing these ROIs using a set of histogram descriptors and finally, classifiers like Adaboost and support vector machine (SVM) are used to categorize these images. Though these approaches work excellently for images taken from environments containing these weather cues, they fail for weather images taken in densely vegetated areas that hardly contain sky portion. In order to surpass these challenges, recently, Lu et al. [5] proposed a complex collaborative learning framework to analyze multitude of weather cues instead of just focusing on sky pixels. This method comprises many pre-processing techniques, like the image segmentation, sky, haze and boundary detection, which makes the model's performance largely dependent on the performance of above-mentioned techniques.

The above studies present interesting solutions for weather classification, but they are not quite engaging as far as the performance is concerned. The best normalized classification accuracy is achieved by these approaches in the very challenging weather image dataset (consisting of 10K images), is only 53.1% but the regular accuracy is 76.5%) [5].

3 Proposed Method

For a given outdoor image, our goal is to predict the type of weather associated with the image. For this, first, the image is subjected to foreground subtraction using a simple OpenCv thresholding and a modified grab-cut algorithm. In this step, the foreground will be removed and the image will consists only the background, i.e. the sky. These foreground subtracted images are then given to the CNN as input images for training. Therefore, the proposed method is divided into two main parts:

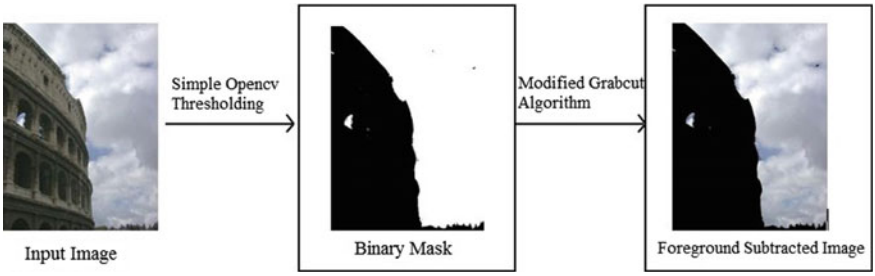


Fig. 1 Block diagram showing the foreground extraction process

Foreground subtraction and deep transfer learning using the pre-trained ResNet-50 and DenseNet-161 CNN architectures.

3.1 Foreground Subtraction

The dataset used has a diversity of things present in foreground which are not needed for weather prediction. As the sky forms the main weather clue, we need to extract only the sky pixels using foreground extraction. This is achieved using two basic steps as Fig. 1.

1. **Creating a Binary Image**: A simple OpenCv-based thresholding is used to obtain the binary mask of the input image. The thresholding function cv.THRESH_BINARY is used to mark the pixels below a given threshold value to black color and set rest of all pixels to white color.
2. **Foreground Subtraction**: The grab-cut algorithm which is commonly used to extract foreground from an image is modified to extract only the background. This modified grab-cut algorithm takes in the binary mask and uses it to perform foreground subtraction on the original image.

3.2 Classification Using Deep Transfer Learning

In this study, the pre-trained ResNet-50 and DenseNet-161 models are trained on the processed weather images, using transfer learning and used to classify the images into sunny and cloudy weathers.

ResNet-50: He et al. [10] developed the residual neural networks (ResNet). By developing a 152 layer deep CNN model that has an error rate of 3.57%, the authors secured the first position in ImageNet Large Scale Visual Recognition Challenge (ILSVRC 2015). In order to avoid loss of information during training of deep networks, the ResNet architecture put forth the concept of skip connections. This way the gained

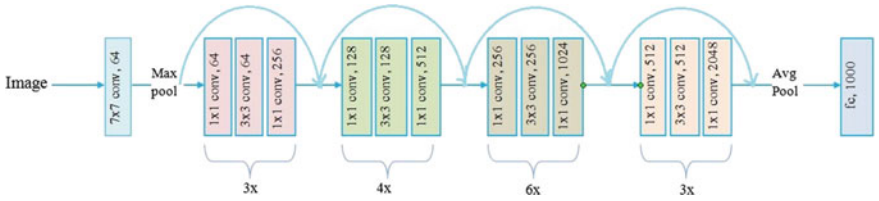


Fig. 2 Schematic diagram of pre-trained ResNet-50 model used in our study

knowledge is preserved and the training time is speeded up which in turn boosts the model's performance. ResNet-50 is a 50 layer deep residual network having four stages of CNN layers.

These stages have (3, 4, 6, 3) blocks, respectively, with each block having three convolution layers. The ResNet-50 has over 23 million trainable parameters. Figure 2 shows a schematic diagram of the pre-trained ResNet-50 model used in our study.

DenseNet-161: Huang, Liu and Maaten [11] developed the dense convolutional networks (DenseNet) which attained the best classification performance on huge datasets such as ImageNet and CIFAR-10 in 2017. The ResNets learn redundant feature maps and have a large number of parameters which makes the training difficult. The DenseNet instead has very narrow layers and learns a small set of feature maps. Since each layer has direct access to the gradients from the loss function and the original input image, there is greater information flow, the training of the network becomes more efficient, overfitting is reduced and the model's performance is increased. DenseNet-161 has four dense blocks with (6, 12, 36, 24) sub-blocks, respectively. Each sub-block has two convolution layers giving rise to a total of 156 layers (in dense block) + five convolution layers with a growth rate of $k = 48$. A block diagram of DenseNet-161 used in our study is as shown in Fig. 3.

Training large architectures like ResNet-50 and DenseNet-161 requires a huge amount of data and faster processors (GPUs). Using random weights initialization approach, such training with millions of parameters can take weeks. To surpass these problems, the transfer learning technique has been used in this study. Using this method, a CNN model that is already trained on a huge dataset transfers its learned

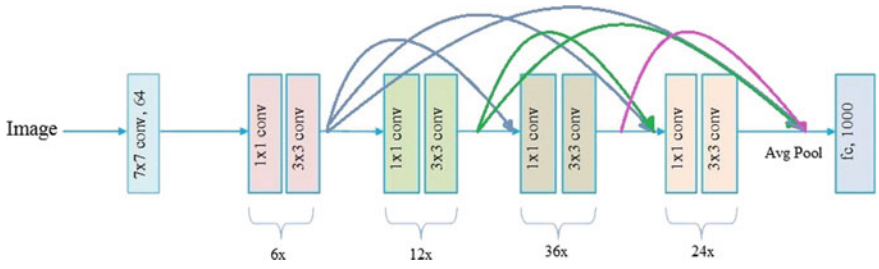


Fig. 3 A block diagram of pre-trained DenseNet-161 model used in this study

features to the new model that we have. This saves computing resources by training only the last few fully connected layers instead of training the whole network.

4 Classification Results

In this study, the transfer learning technique is employed by attaching seven extra layers to both the ResNet-50 and DenseNet-161 pre-trained models. The convolution layers of these pre-trained models are freezed to retain the features that are learnt from earlier dataset. The seven layers consist of two each of batch normalization, dropout and fully connected layers and a single softmax layer at the end to classify into two categories. The dropout layer prevents overfitting and the batch norm layers prevent training of the freezed network. Finally, training of the fully connected layers is performed on our processed weather dataset. Figure 4 shows a block diagram of customized CNN using transfer learning approach.

The batch normalization values are chosen as 1e-5 for epsilon and 0.1 for momentum. To regularize the models, the dropout ratios are set to 0.2 and 0.5, respectively. The learning rate is randomly set to 1e-3. RMSprop also called as stochastic gradient descent (SGD) with momentum, is used during training for the optimization of the parameters of the network. The 1500 processed weather images are split into train and validation sets in the ratio 80:20.

The attached layers of the DenseNet-161 and ResNet-50 models are trained on the train set in an end-to-end fashion for about 50 epochs. Figure 5 shows the train and validation loss plots of the above-trained custom CNN (using transfer learning).

ResNet-50 outperforms the DenseNet-161 in terms of classification accuracy. Table 1 shows the accuracy comparison of our proposed method with the previous baseline systems. ResNet-50 has less number of layers than DenseNet-161. And even though, both DenseNet-161 and ResNet-50 use shortcut connections between the network layers, the ResNet-50 pre-trained model outperformed the DenseNet-161 in classifying the processed weather images.

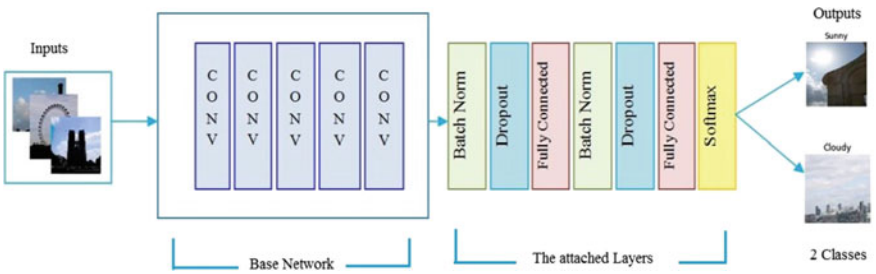


Fig. 4 Block diagram of custom CNN using transfer learning used in this study

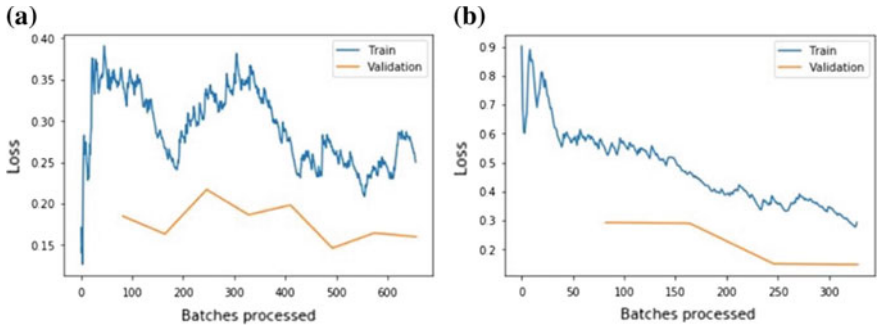


Fig. 5 Train and validation loss graphs for **a** ResNet-50 and **b** DenseNet-161

Table 1 Accuracy comparison of the proposed method versus the baseline systems

Method	Accuracy
GIST [9] + SVM	55.7 ± 1.0
HOG [3] + SVM	69.3 ± 1.2
Combined feature [5] + SVM2	70.6 ± 1.1
Yan et al. [7][2]	63.1 ± 1.2
Roser et al. [6][2]	76.6 ± 1.1
Ours (with ResNet-50)	**94.3 ± 1.0**
Ours (with DenseNet-161)	**92.68 ± 1.1**

The (2) in here shows the accuracy attained by the method of using HOG and SVM for Human Detection of 69.3% as demonstrated in the paper [3]. This result is used to show that our system with 94.3% accuracy has outperformed the method (2) in here

5 Conclusion and Future Work

The automated analysis of weather classes from outdoor images has significant importance in early disaster prediction and planning of cropping patterns. This study puts forward a novel foreground subtraction method is used to extract only the background pixels of an image and DenseNet-161 and ResNet-50 pre-trained models are used to classify the processed weather images into two classes. The classification performance, i.e. accuracy of the proposed method is compared to the baseline models. The proposed ResNet-50 and DenseNet-161 models tested on the final test images attained the best classification accuracies of 94.3% and 92.68%, respectively, and outperformed the state-of-art methods. In the future, the classification performance can be increased using ensemble learning methods.

References

1. LeCun Y, Bengio Y, Hinton G (2015) Deep learning. Nature 521(7553):436
2. Felzenszwalb P, McAllester D, Ramaman D (2008) A discriminatively trained, multiscale, deformable part model. In: Proceedings of the IEEE CVPR
3. Dalal N, Triggs B (2005) Histograms of oriented gradients for human detection. In: Proceedings of the IEEE CVPR
4. Lowe DG (2004) Distinctive image features from scale-invariant keypoints. Int J Comput Vis
5. Lu C, Lin D, Jia J, Tang C-K (2014) Two-class weather classification. In: IEEE conference on computer vision and pattern recognition (CVPR), pp. 3718–3725
6. Roser M, Moosmann F (2008) Classification of weather situations on single color images. In: IEEE intelligent vehicles symposium, pp 798–803
7. Yan X, Luo Y, Zheng X (2009) Weather recognition based on images captured by vision system in vehicle. In: Advances in neural networks, pp 390–398
8. Chen Z, Yang F, Lindner A, Barrenetxea G, Vetterli M (2012) How is the weather: automatic inference from images. In: IEEE international conference on image processing (ICIP), pp 1853–1856
9. Oliva A, Torralba A (2001) Modeling the shape of the scene: a holistic representation of the spatial envelope. Int J Comput Vision 42(3):145–175
10. He K, Zhang X, Ren S, Sun J (2016) Deep residual learning for image recognition. In: Proceedings of IEEE conference on computer vision and pattern recognition
11. Huang G, Liu Z, Van Der Maaten L, Weinberger KQ (2017) Densely connected convolutional networks. In: Proceedings of the IEEE conference on computer vision and pattern recognition, pp 4700–4708

A Subspace Similarity-Based Data Clustering by Delaunay Triangulation

Ebinezar, S. Subashini, D. Stalin Alex and P. Subramanian

Abstract Grouping data suffers from the curse of dimensionality and similarity functions that use all input features with equal relevance may not be effective and the features should be common to complete data. In this paper, Delaunay triangulation method is used to discover and cluster the subspace similarity-based data and finds the closest neighbors by similarity measures, and the triangulation drawing can be done repetitively over the space and cluster. This method avoids the risk of loss of information in any assumed distributed model, and it is a geometric model finds empty circles without any points, only the corner points of the triangles having related points.

Keywords Clustering · Nearest neighbor · Subspace data · Delaunay triangulation method

1 Introduction

Image processing is one of the important fields for the various advancements in context of various aspects of images. Although, all the advances in image capturing, storage, and internet technologies have made vast amounts of image data are available [1]. Image information systems are becoming increasingly important with the advancements in broadband networks, high powered workstations, etc. However, digital images can be formed by a variety of devices like digital scanners,

Ebinezar
TCS, Edison, NJ, USA

S. Subashini
Sethu Institute of Technology, Madurai, Tamil Nadu, India

D. Stalin Alex (✉)
Guru Nanak Institute of Technology, Hyderabad, Telangana, India

P. Subramanian
Sri Indu College of Engineering, Hyderabad, Telangana, India

H. S. Saini et al. (eds.), *Innovations in Computer Science and Engineering*,
Lecture Notes in Networks and Systems 103,
https://doi.org/10.1007/978-981-15-2043-3_65

cameras, coordinate measuring machines, digital video recorders, digital synthesizers, and airborne radars [2]. In this paper [3], the common method for grouping the similarity-based data set in a huge set of data. The proposed method is applied for a huge set of data, where the complete data is divided into sectors in a circle. Circle represents the complete data; the sector represents the subgroup from the data. Given a set of distinct points

$$P = \{p_1, p_2, p_3, \ldots, p_n\}$$

in a plane and all the points are spread on the plane in random positions. A Delaunay triangulation DT(Pt) of P is defined that the circumscribed circle $C_{\mathrm{DT}(pt)}$ of any triangle $P_i P_j P_k$ in DT(P) contains no point from P in its interior and the points $P_i P_j$ and P_k from P on its circumference [3–5]. Within a circle limit, the data points are clustered. If we use the procedure described in [6], DT(Pt) is unique even if we have more than three points on such circumscribing circles for the triangles in DT(P). It is also well known [4] that all two points A and B from P that can be circumscribed by a circle with no points from P in its interior are an edge AB in DT(P). When using this property, always consider such circles $\mathrm{SC}_{\mathrm{AB}}$ that contain A and B on its boundary and have AB as its diameter, i.e., the littlest delimit circle for the points A and B. Triangulated models shown in Fig. 1, rather using a Delaunay triangulation, are imperative in many manufacturing applications from interactive games to map-making and approximating the volume of gas and oil alternative deposits. One of us has made a Delaunay triangulated model for the seabed to compute the waves for an investigational wave power plant [7]. There are four levels where Level-0 and Level-1 specified below are novel in the intelligence that they have to the best of our knowledge never before been explicitly stated or published in any textbook or paper [4, 5] and were also not mentioned in the Delaunay article on Wikipedia [8]. Level-2 and Level-3 are undisputedly new. Nowadays, content-based information retrieval is badly needed in data mining. The CBIR can be used for image mining, information mining, etc. and some of the document formalizations for text clustering are applied

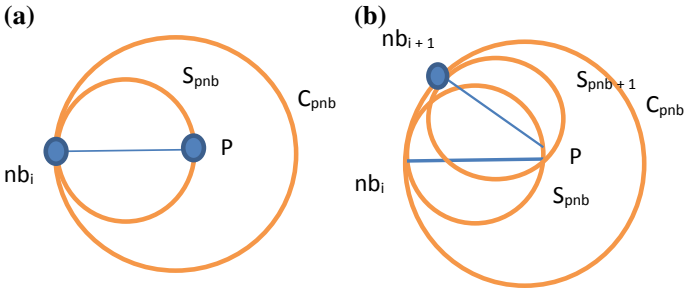


Fig. 1 **a** The circle C_{pnb} with no interior points and pn_b as radius totally contains the circle S_{pnb} with pn_b as its diameter. **b** The circle *Cpb* with no interior points and $pnbi = pnbi + 1$ as radius totally including the circles *Spb* with *pbi* and $pbi + 1$ as their diameters

with graph-based feature extraction method [9]. In this paper [10], the author says that feature-based and similarity-based opinion mining approach is effective for document retrieval. Until recently, some researchers have tried to adopt a lot of precise machine learning models so as to extend the opinion mining efficaciousness. One typical work is Opinion Miner [11]. In [12] is clear that when the scale of data set increases the complexity of preprocessing is also increases, it is difficult to reduce noise and outlier of data set. A soft subspace clustering of data proposed in [13]. The intersection of two subspaces obtained by hypercorrelation derived from the triplets due to the complementarily of multiple constraints [14]. The clustering labels of the training samples are learned by representation-based subspace clustering, and features that can well preserve the cluster labels are selected [15].

2 Proposed Approach

In this paper, the proposed approach of the Delaunay triangle method is proved in four levels. In the Level-0, it is presumed that it receipts all the points $p_i$and has its own unique closet neighbor nb_i. In the second level, we remove the assumption applied and formulate a general Level-1, where it is allowed more than one closest neighbor to a point. Lastly, it is expressed and showed Level-2 which considers the Kth closest neighbor to a point P_i, and it has Level-0 and Level-1 as the special cases.

Level-0: Let assume P as set of all P_i, and P_i in P, and the nb_i in P is the unique closest neighbor to *pi*, the line segment p_inb_i is an edge in the DT(P_t).

The nearest point nb_i to pi defines a circle Cp_inb_i with pi as its center, p_inb_i as its radius, and nb_i on its perimeter and no point from P in its interior. The subcircle Sp_inb_i with p_inb_i as its diameter it contained in that circle Cp_inb_i and since Sp_inb_i contains no other point from P in its interior, then p_inb_i is an edge of a triangle in DT(P_t) is shown in Fig. 1. In the field of computational geometry and Mathematics, a method of Delaunay triangulation for a set points P_t in a plane will be covered by a triangulation $DT(P_t)$ such that no point in P_t is inside the circumcircle of any triangle in $DT(P_t)$. This DT method maximizes the minimum angle of each angle of all the triangles in the triangulation drawn on the plane, where it is used to eliminate the skinny triangles. Delaunay triangulations have variety of attention-grabbing properties that are consequences of the structure of the Voronoi diagram. It is impracticable to draw a group of points lie on a similar line. Some of the points spread within a circle- or square-shaped area can be obtained by DT method. In view of constrained spheres, the view of DT spreads to three and higher dimensions.

Level-1: Let P_t be a set of points in the d dimension based on Euclidean space, a **DT** is a triangulation $DT(P_t)$ such that no point in P_t is inside the circum-hypersphere of any simplex in $DT(P_t)$. It is known that there occurs a distinctive DT for P_t; if P_t is a set of points in *over-all position*, there exists no k-flat containing $k + 2$ points

nor a k-sphere containing $k + 3$ points, for $1 \leq k \leq d - 1$. For example, for a set of points in $\mathbb{R}^3$, no three points are on a line, no four on a plane, no four are on a circle, and no five on a sphere.

The tricky of discovery the DT of a set of points P_t in d-dimensional Euclidean space can be transformed to the problematic of discovery the curved structure of a set of points in $(d + 1)$ dimensional space, by providing each point P_t an extra coordinate equal to $|Pt|^2$, taking the bottom side of the curved structure, and representing back to d dimensional space by deleting the last coordinate. As the curved structure is unique, so is the triangulation, assuming all facets of the curved structure are simplices. Non-simplicial surfaces only occur when $d+2$ of the original points lie on the same $d-$ hypersphere, i.e., the points are not in general position. This DT(Pt) can be proved by the theorem of nearest neighbor.

Level-2: Let us assume, a set of point p_t has a unique nearest neighbor n_b. The assumptions are avoided and formulated a complete general theorem, where it allows more than one nearest neighbor to a point.

A set of point $P_t = \{p_1, p_2, p_3, \ldots. p_n\}$, where all p_i in P_t, and n_b is the unique nearest neighbor to p_i, the line segment pn_b is an edge of the DT(pt). The nearest neighbor n_b to pi defines a circle Cpn_b with pi as its center, pn_b as its radius, n_b on its perimeter and no point from P in its interior. By definition, the circle Spn_b with pn_b as its diameter is contained in that circle Cpn_b and since Spn_b contains no other point from P in its interior, then pn_b is an edge of a triangle in DT(P_t) as depicted in Fig. 2.

Level-3: The distance between the closest point n_{bi} defines a circle Cpn_b with pi as its center and pn_{b1} (= pn_{b2}, …) as its radius, this circle has no point from P in its interior. By the definition, the Spn_{bi} with pinb1, pinb2, … as their diameters, have all p_i on their boundaries. These circles are all contained in the circle Cpn_b. Since the point n_{bi} are all distinct, they are all different points on the perimeter of circle Cpn_b. These circles Spn_{bi} then contain no points from P, nor any of the other point n_{bi} in their interior. Then all the line segments pin_{bi}, pin_{bi+1} are edges in the Delaunay triangulation of P.

This process can be generalized for a set M nearest neighbor nbi(i = 1, 2, 3, …, M) of any point pi and find a sufficient constraint for any of these M nearest neighbors to pi forming a DT edge pn_{bi}. The p_in_{bi} is an edge in the DT(P_t) of P if none of the nearest neighboring points n_{bj} (j = 1, …, i − 1) is included in the circle Sp_in_{bi} with p_in_{bi} as its diameter. The circle Sp_in_{bi} with p_in_{bi} as its diameter is contained in the circle Cp_in_{bi} with p_in_{bi} as its radius, then the points n_{bj} ($j = i - 1, i - 2, \ldots 1$) are the only points from P included in Cp_in_{bi} because they are nearer to pi than n_{bi}. They are the only candidates from P to be included in Sp_in_{bi}. If we find that none of them are included in Sp_in_{bi}, we have found an empty circle Sp_in_{bi} that contains pi and n_{bi} on its circumference. Then p_in_{bi} is an edge in DT(P).

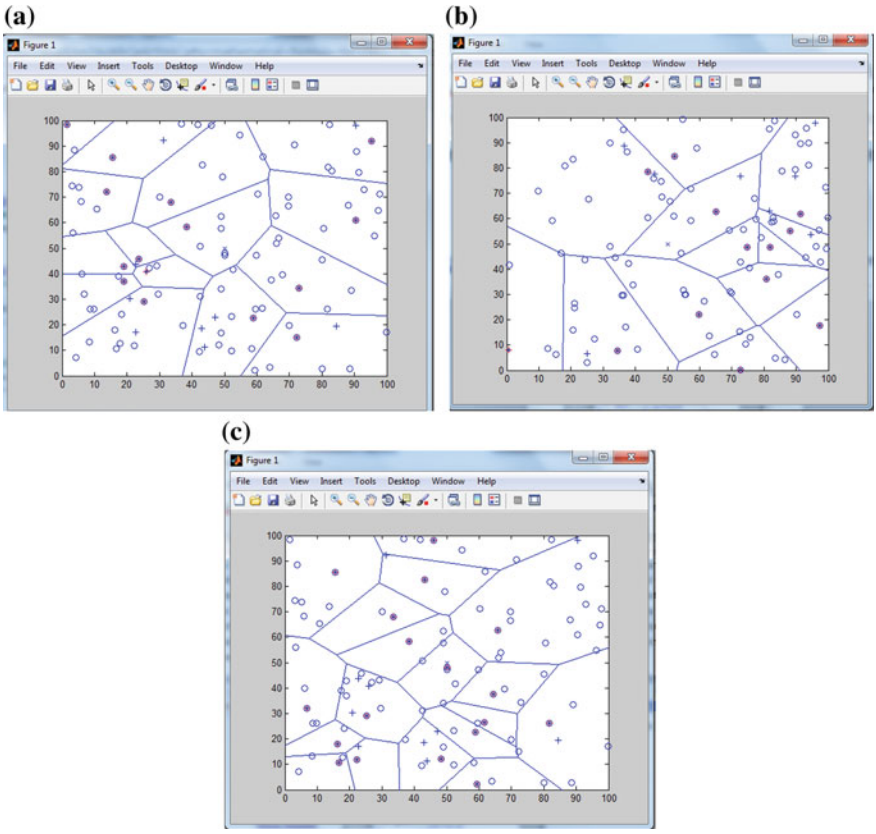


Fig. 2 DT (P_t) finding the nearest neighbors. **a**: at time $T = 5$, **b**: at time $T = 10$, **c**: at time $T = 15$

Algorithm

1. Set of data P, placed in a circle form randomly.
2. Find the center point C of the circle and pick Pi in cornet.
3. Draw an edge C-Pi, and get θ as an angle from center point clockwise and draw another edge C-Pi + 1 where C-Pi $> \theta < C - Pi + 1$.
4. Connect Pi and Pi + 1, get a triangle.
5. Retrieve all the points within the corner C, Pi, Pi + 1 and find the similarity distance and cluster the same points.
6. Replace tmp = C-Pi; C-Pi = C-Pi + 1; repeat from step 3.
7. Until comparing all the data points within the circle.

From the above algorithm, it is clear that by drawing the DT repeatedly with the help of the center of the circle and the corner points on the circumference of the circle and cluster and classify the data. The simulated result is shown and discussed in the following sections.

3 Results and Discussion

This proposed approach is experimented using the benchmark of hockey data of 10 years from 2002 to 2012. The hockey data is collection of scores and the time period, for team-based. All the time, team number, place, and score are represented as columns in a data file. In this paper, the team-based score data is taken for finding the similarity-based data and grouping. And, the proposed approach gathers all the data and splits the data into small groups, then applying the DT(Pt) to find the groups. Those groups are nothing but the similar data in value-wise or in range-wise. Each subgroup is sorted and arranged for further data retrieval. The result of the proposed approach may be in ascending ordered and range-wise data.

The complete MATLAB simulation runs for a time interval or it takes certain time to process the complete data. Since the process takes a time interval, the result is analyzed at a particular time interval, like at the time of 5, how the data and how the data looks like and how much data is getting processed can be shown.

At the time of 5 s, the data is clustered according to the similarity and classified in different symbols. There are 15 DT is drawn in the total data, and each triangle consists of more are less equal number of data under same category.

After 10 s, the data is clustered according to the similarity and classified in different symbols by the DT. The proposed approach changes the size of the triangle and location of the triangle within the region of the complete data points are located. After the DT(Pt) function, the data is taken from each subgroup and they are arranged in an order for more look and feel to draw the graph in such a manner.

Within a time interval, the Delaunay triangulation procedure is clustering the data points repetitively, so the clustering position and the number points under a measure are getting changed in some period of time is shown in Fig. 2.

There are huge set of hockey data is assumed as points in a subspace and it is simulated in MATLAB software, where the N number of points are deployed randomly on the plane, and the procedural of DT steps as step0, step1, step2, and step4 applied and the data points are clustered and placed inside the triangles and are in different shapes as circle, start, etc., and it is depicted clearly in Fig. 1a–c, where it says that the clustering and triangle drawing function is applied for a period of time. According to Level-0, 1, 2 and Level-3, the results are produced for each kind of data.

The mass of data is arranged in such a manner using DT and shown in a different color in Fig. 3a.

From the mass of data, only one group of data clustered in a particular range is taken out and shown in Fig. 3b. The data is saved in column-wise. Each column has different number of data that may be in integer format or in float format. The DT initially arranges the data in ascending order and finds the similarity. The range of the total data is from 0 to 10.

The hockey data is taken, and according to the similarity using DT, the data is clustered and classified as shown in Fig. 2a, b, c, respectively, before and after DT applied.

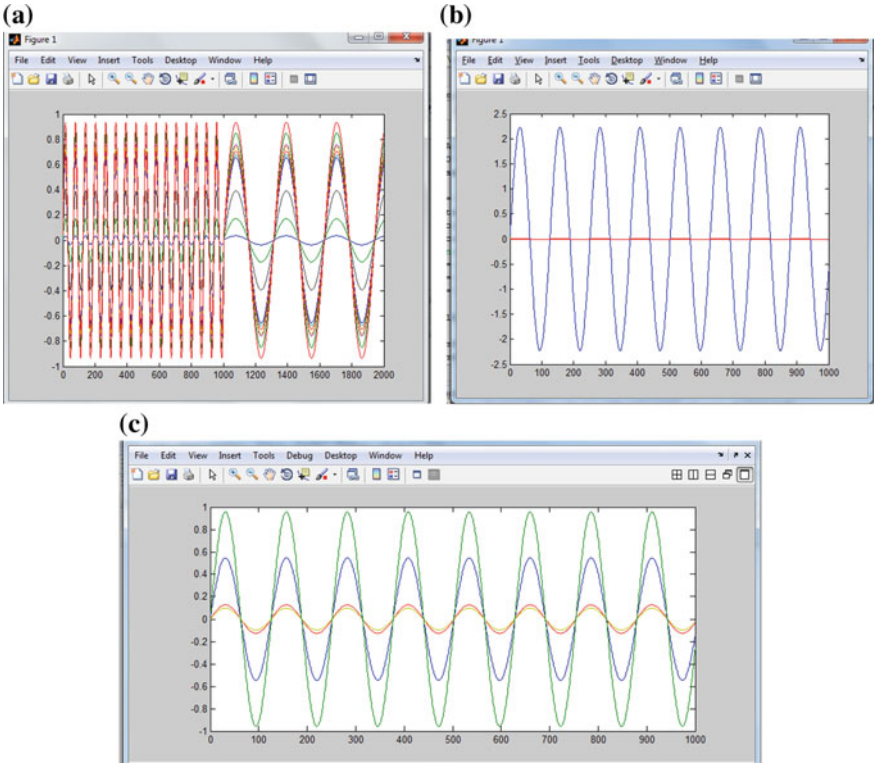


Fig. 3 **a** Original data, **b** single data AC, **c** multi data AC*. **AC* After Clustering*

4 Conclusion and Future Work

In this paper, an easy and dimensionality reduction, no loss of data information with clustering can be obtained by simple triangulation method in this paper and it is effective due to time and cost. This method saves the time also. And, this approach can also be applied for mass of data in any dimensions.

Since the DT method is efficient in terms of time, it is cost-effective. The same method can be applied for various kinds of data and the performance can be verified.

References

1. Park SB, Lee JW, Kim SK (2004) Content-based image classification uses a neural network, vol 25, Issue 3, pp 287–300. Elsevier
2. Zhang W, Mao L, Xu W (2009) Automatic image classification using the classification ant colony algorithm. 10.1109/ESIAT.2009.280

3. Delaunay B, Sur la sph_ere vide, Izvestia Akademia Nauk SSSR (1934) VII Seria, Otdelenie Matematicheskii i Estestvennyka Nauk, vol 7, pp 793–800
4. De Berg M, Cheong O, van Kreveld M, Overmars M (2008) Computational geometry: algorithms and applications. Springer, Berlin. ISBN 978-3-540-77. http://www.cs.uu.nl/geobook/interpolation.pdf
5. Hjelle Y, D_hlen M (2006) Triangulations and applications. Mathematics and visualization. Springer, Berlin. ISBN:978-3-540-33260-2
6. Dyken, Floater (2006) Preferred directions for resolving the non-uniqueness of delaunay triangulations. CGTA: Comput Geom Theory Appl 34(2):96–101
7. Maus Arne (1984) Delaunay triangulation and the convex hull of n points in expected linear time. BIT 24:151–163
8. Wikipedia: Delaunay triangulation http://wikipedia:org=wiki=Delaunaytriangulation
9. Jiang C, Coenen F, Sanderson R, Zito M (2008) Text classification using graph mining-based feature extraction
10. Xu R, Kit C (2010) Incorporating feature-based and similarity-based opinion mining CTL in NTCIR-8 MOAT. In: Proceedings of NTCIR-8 workshop meeting, June 15–18, Tokyo, Japan
11. Jin W, Ho H, Srihari R (2009) Opinion miner: a novel machine learning system for web opinion mining and extraction. In: Proceedings of the 15th ACM SIGKDD international conference on knowledge discovery and data mining, pp. 1195–1204. ACM
12. Dhasal P, Shrivastava SS (2012 Sept) An optimized feature selection for image classification based on SVMACO. IJACR 2(3) Issue-5. ISSN (online): 2277-7970)
13. Jia H, Cheung Y-M (2018) Subspace clustering of categorical and numerical data with an unknown number of clusters. IEEE Trans Neural Netw Learn Syst 29(8):3308–3325
14. Yang J, Liang J, Wang K, Yang Y-L, Cheng M-M (2018) Automatic model selection in subspace clustering via triplet relationships. In: Proceedings of AAAI, pp. 4358–4365
15. Zhu P, Zhu W, Hu Q, Zhang C, Zuo W (2017 June) Subspace clustering guided unsupervised feature selection. In: Pattern Recognition, vol. 66, pp. 364–374. Elsevier

A Brief Literature on Optimization Techniques and Their Applications

Alok Kumar and Anoj Kumar

Abstract Meta-heuristics optimization algorithm is becoming identically popular from the last two decades, and a lot of proposed work has been employed in this field to solve large number of engineering problems, real-world problems, and all other such kinds of problems those are not easy to solve in deterministic amount of time. Such types of problems are known to be NP-hard, and corresponding constraint variables of objective functions contain continuous values. To solve that kind of problem, randomize algorithms (optimization algorithms) come into account that begin with random solutions. This work gives a brief idea about swarm intelligence optimization algorithm, evolutionary algorithms, physical algorithms, and biologically inspired optimization algorithms with their applications. The outcome of these algorithms is prominent in many applications, data set and engineering problems. Some are described in this article out of them.

Keywords PSO · GA · GWO · ACO · CS · WSN · Image segmentation · Image annotation

1 Introduction

Optimization is a technique, method, or an approach to compute optimum or near optimum (optimal) solution out of feasible solution. Optimization problems are such problem for which finding the best solution or optimal solution (near optimum) from all possible feasible solutions [1]. The process of minimizing or maximizing the objective value in objective space from pareto optimal solution for a given objective function from random solution space is the goal of optimization technique. Typically, deterministic and randomize are two types of algorithm to solve the real-life

A. Kumar (✉) · A. Kumar
Computer Science and Engineering Department, Motilal Nehru National Institute of Technology Allahabad, Allahabad, India
e-mail: alokkumar@mnnit.ac.in

A. Kumar
e-mail: anojk@mnnit.ac.in

H. S. Saini et al. (eds.), *Innovations in Computer Science and Engineering*,
Lecture Notes in Networks and Systems 103,
https://doi.org/10.1007/978-981-15-2043-3_66

and other mathematical problems. Surprisingly, deterministic algorithm takes finite amount of time to solve such problems and comes under P problems. In contrast, some problems could not be solved in finite time and need some random solution to fulfill the query which is known as randomize algorithm or optimization algorithm, and these problems come under NP-hard problems. Typically, computer works with discrete values but large-scale real-life problems that are continuous in nature. Therefore, optimization techniques help in order to solve such types of problems. Single objective as well as multi-objective types of problem solve by optimization techniques. Only one objective function is employed in single objective; two or more objective functions which are opposite with each other are known as multi-objective functions.

In the last two decades, the techniques of meta-heuristics in optimization have become very democratic. Hence, various natures inspired and social intelligence meta-heuristics techniques have been nominated like, particle swarm optimization (PSO) [2] and their applications [3, 4], ant colony optimization (ACO) [5], grey wolf optimizer (GWO) [6–10], cuckoo search [11], bat algorithm [12], etc. Genetic algorithm (GA) [13–15] and their applications [16, 17], evolutionary search [18] and PBIL [19] come into evolutionary algorithms. No free lunch theorem [20] states that there is no such meta-heuristic algorithm that solves and best suited all types of optimization algorithms.

A prestigious literature review and conclusion organized in the rest part of the paper.

2 Literature Review

The present section of this article describes the many optimizations approach and fourthly their corresponding application in which optimization approach has been applied.

Particle swarm optimization (PSO) [2] is proposed and designed by Kennedy and Eberhart in 1995. A large group of homogeneous particles is known as swarm and such optimization algorithms inspired by the swarm are known as swarm-based optimization algorithms. Swarm based optimization algorithm is based on social behavior or social intelligence [3] of species such as fish schooling (in biological vocabulary, any group of fishes that halt together for untidily reason known as shoaling; further, if the group of fishes swims in same direction for hunting in unified manner, that is known as schooling and shown in Fig. 1a, b) and bird flocking (an assembly of group of similar types of animals in order to travel, pasturage, or jaunt with one another, that is known as flocking and shown in Fig. 1c, d). PSO is implemented with only two paradigms, particle best or personal best (PBEST) and global best (GBEST). Individual best solution of any particle during any course of generation is called personal best solution; subsequently, best out of all personal best solution is known as global best. The velocity and position vectors simulate the mathematical model

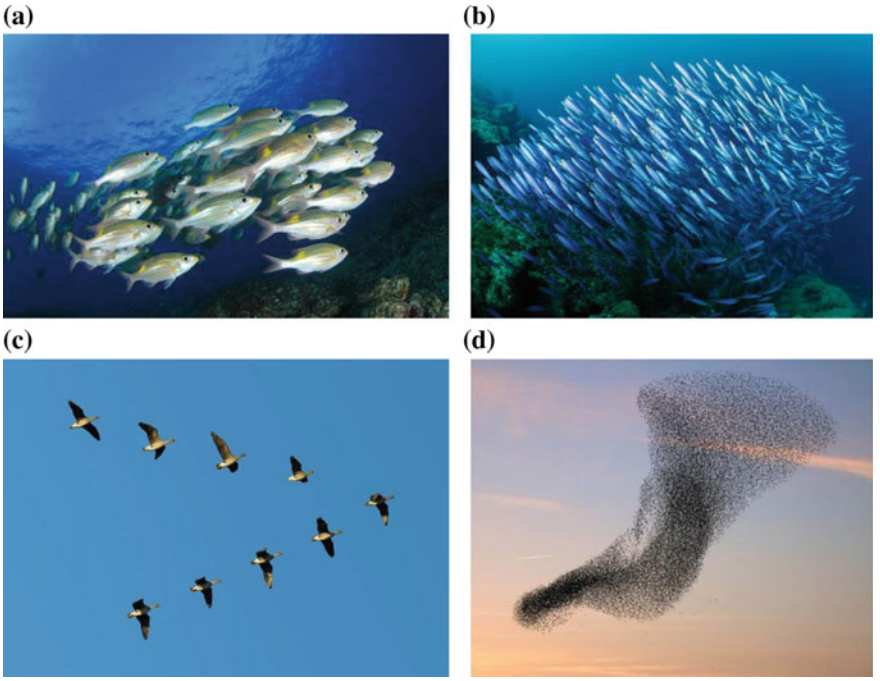


Fig. 1 **a**, **b** Fish schooling, **c**, **d** bird flocking

to generate optimal results. An application of particle swarm optimization algorithm to train the neural network is proposed by Kennedy and Eberhart in [4].

Priyadharshini and John Grasias [21] proposed optimization technique for implementing the process of image segmentation to detect the brain tumor. Image segmentation is the process of dividing the image into constituent pieces to extract the fruitful information from complex image. The proposed technique begins with image enhancement for sharpening and smoothness of input image by applying the median filter at that image. The median filter detects and corrects the error bit from the input image which contains salt and pepper noise. Fundamentally, that noise is also known as impulse noise as well as Gaussian noise. Image transmission and analog-to-digital conversion are the reasons of salt and pepper noise that degrade the quality of image. In the next step, particle swarm optimization (PSO) and other swarm-based ant colony optimization (ACO) techniques perform the process of image segmentation. Rand index (RI) parameter, variations of information (VOI), parameter of boundary displacement error (BDE), and parameter of global consistency error (GCE) are the performance metric to test and comprise the performance of PSO and ACO on a set of 20 brain images. Successfully, the detection of tumor from brain image with low complexity and computational time are the advantage of the proposed approach. Table 1 concludes this technique.

Table 1 Conclusion [21]

Author	Data set	Comparison	Pros	Cons	Experimental tool
Priyadharshini, and Grasias	20 brain images	Between PSO and ACO	Low computational time as well as complexity	Experiment evaluation only of 20 brain image	MATLAB

Patel and Kumar [22] review some image segmentation techniques and discuss some evaluation metrics about the performance regarding segmented image. The discussion starts with introduction about image segmentation which is a process of segregation of desired pixels from the input image or query image as per the objective criteria. In next phase of simulation, implement many segmentation techniques like, Thresholding, Edge base segmentation, Region base segmentation, and Clustering. Thresholding technique based on threshold value decides by administrator. Gradient base and gray histogram are the methods of edge-based segmentation. Roberts, Sobel, Canny, Prewitt, and log operators are used for gradient-based method. Region growing methods as well as split and merge methods come under region-based segmentation adhere to seed pixels. Fuzzy c-means clustering and k-means clustering are the methods of clustering-based segmentation. In the last phase of description, rand index (RI) parameter, variation of information (VOI) metrics, parameter of global consistency error (GCE), boundary displacement error (BDE) parameter, mean absolute error (MAE) metrics, and parameter of peak signal to noise ratio (PSNR) are used to evaluate the performance of segmented image.

Genetic algorithm (GA) [13] is based on theory of natural selection and evolution and was developed by Holland in 1960. Survival of fittest is basic fundamental of Darwins's theory of evolution that the inspiration of proposed approach. To simulate this sequential approach, start with a random selection of population and get more fittest new generation than the previous generation by applying crossover and mutation operator. Best individual has large probability to participate in generation of new population. Exploration and exploitation performed by crossover and mutation operator to avoid the stagnation in local optima.

Sukhija et al. [17] proposed a face recognition technique that is based on the fundamental of genetic algorithm. The face recognition is a promising technique of image processing, neural networks, computer vision, psychology, and pattern recognition. There exist many applications of face recognition in several fields like public security, criminal identification, law enforcement and commerce, credit card verification, etc. The absence or presence of structural components, pose, image orientation, age, emotions and facial expression, and many more are the challenges which are associated with face recognition technique. The proposed approach begins with selection process in which appropriate database is selected to train the data set. Eigenvector is evaluated for query image and compared with UMIST, ORL, and Indbase data sets which are considered as benchmarked data sets. In the final phase,

Table 2 Conclusion [17]

Author	Data set	Comparison	Experimental tool
Pratibha Sukhija, Sunny Behal, and Pritpal Singh	ORL, UMIST, and Indbase	GA better than LDA and PCA	MATLAB

recognition rate has been computed for the proposed approach. Recognition rate is used to compare the performance of proposed approach with other face recognition approaches. The experimental results demonstrate that recognition rate of genetic algorithm is better than linear discriminate analysis (LDA) and principal component analysis (PCA). The concluded parameters of this article are described in Table 2.

Maihami et al. [16] proposed a prototype model for image annotation which is automatic in nature. Comments, words, and keywords are produced for query image that is known as image annotation process. The term image annotation and tagging will be used interchangeably with the same meaning in this proposed paper. The proposed approach begins with a training data set which may contain useless image with noisy or redundant image. A genetic-based prototype selection method is used to remove these superfluous images from training data set and obtained an optimal prototype. The prototype selection used to reduce the running time by the means of optimal neighbor selection. The nearest neighbor-based voting algorithm is applied on optimal prototype for a given query image to produce image annotation. Corel5k, IAPR TC12, and MIR Flikr are three data sets for the training set and test set with different sizes. To evaluate the scalability of the proposed method, MIR Flikr is a good benchmark. Average precision, F-score, and average recall are the three measures to analyze the performance of the proposed method. F-score used to calculate the fitness value of objective function of optimal prototype. Experimental result shows that the performance of prototyping method is reduced slightly, but running time reduced about 90%. To analyse the improvement in performance, comparison of proposed method with other annotation models like, CMRM, CMR, NPDE, MIL, and RFC-PSO. Performance result of Corel5k, IAPR TC12 and MIR Flikr data set with nearest-neighbor-based algorithm (like Joint Equal Contribution (JEC), Social tag relevance by neighbor voting (TagRel), and Tag Propagation method (TagProp)) and proposed prototype with above three measures. Table 3 concludes the important parameters of the proposed technique.

Grey Wolf Optimizer (GWO) is a fresh meta-heuristic optimization algorithm developed and mathematically formulated by Mirjalili et al. [6]. Canis lupus is the scientific name of grey wolves that is the inspiration of the proposed algorithm. Grey wolves follow the leadership hierarchy eke hunting behavior in nature which has been mimicked by proposed algorithm. There are employed four different types of grey wolves participated in leadership hierarchy and three main steps imposed of hunting. The proposed algorithm tested on 29 fairly well-known benchmarked functions [23] and compared the result with particle swarm optimization, differential evolution, evolution strategy, gravitational search algorithm, and evolutionary

Table 3 Conclusion [16]

Author	Data set	Comparison with	Pros	Cons	Experimental tool
Maihami and Yaghmaee	Corel5k, IAPR TC12, and MIR Flikr	CMRM, CMR, NPDE, MIL, and RFC-PSO	Running time with prototype model reduced approximately 90%	Performance of prototyping method reduced slightly	MATLAB

programming with average and standard deviation as comparing parameters. The outcome of the proposed algorithm reveals competitive result with above long-familiar meta-heuristics optimization algorithm. The proposed algorithm considers three different types of classical engineering problems to solve like, design problem of welded beam with optimum variables [height of bar (t) constraint variable, thickness of weld (h) constraint variable, thickness of bar (b), and length of attach part of bar (l)] and optimal cost, design problem of compression/tension spring with optimum variables [wire diameter (d) measure, number of active coils (N) constraint variable, and mean coil diameter (D) constraint variable] and optimum weight, and design problem of pressure vessel with optimum variables [thickness of head (T_h), length of cylindrical section without considering head (L), thickness of shell (T_s), and inner radius (R)] and optimal cost considers as comparison parameters between other meta-heuristics optimization algorithms. The innovated proposed GWO algorithm considers optical buffer design as real application of optical engineering. The development of multi-objective and binary version of grey wolf optimizer algorithm comes under future work. The concluded parameters of this article are described in Table 4.

Table 4 Conclusion [6]

Author	Total benchmark function (TBF)	23 classical function out of TBF	Composite benchmark functions	Run each benchmark function	Application
Mirjalili et al.	29	F_1–F_7 (uni-model) F_8–F_{13} (multi-model) F_{14}-F_{23} (Fixed-dimension multi-model)	Six from CEC 2005 [24]	30 times	Three classical engineering problems (welded beam, compression/tension spring, pressure vessel design), optical buffer design as real application of optical engineering

Table 5 Conclusion [7]

Author	27 Classical function benchmark function	Application	Compared with	Compared parameters
Mittal et al.	F_1–F_7 (uni-model) F_8–F_{13} (multi-model) F_{14}–F_{23} (fixed-dimension multi-model) F_{24}–F_{27} (composite benchmark functions)	Cluster head (CH) selection problem in the research domain of wireless sensor networks (WSNs)	GA, PSO, BA [12], CS [11], GWO	Optimal cost, mean and standard deviation

Mittal et al. [7] proposed a variant of grey wolf optimizer, namely modified grey wolf optimizer (mGWO) by exponential function instead of linear function for the decay of a during elapsed number of iterations to exploration (70%) and exploitation (30%) in mathematical model. 27 benchmark functions reveal the statistical results for comparison. The selection of cluster head (CH) is employed by mGWO that belongs to real-world type of problem in the research domain of wireless sensor networks (WSNs). Table 5 concludes the parameters of this technique.

Modified mean grey wolf (MGWO) optimization is a modified variant of GWO which has been developed by Singh and Singh [8]. A mean operator variable (μ) obliges the wolves to encircling and attacking prey by modifying their equations. 23 classical, well-known benchmark functions [uni-model (F_1–F_7), multi-model (F_8–F_{13}), and fixed-dimension multi-model (F_{14}–F_{23})] employee to test the performance of the proposed variant. High level of accuracy and avoidance of local optima (stagnation problem) assert obtained result of five real-life data set problems (XOR data set, balloon data set, breast cancer data set, iris data set, and heart data set). The proposed variant reveals either competitive or better results with other meta-heuristic optimization algorithms like standard GWO, PSO, GA, ACO, ES, and PBIL. A binary GWO is proposed by Emary et al. [10] for the purpose of feature selection. The concluded parameters of this article are described in Table 6.

One more modified variant of GWO (MVGWO) proposed by Singh [9] through enhancing the leadership hierarchy of gray wolves by adding one more gamma (γ) level of wolves (hierarchical level: alpha, beta, gamma, delta, and omega) simulated in hunting behavior and mean operator variable (μ) obliges the wolves to encircling and attacking prey to assist update their positions by modifying corresponding equations. 23 classical testing well-known benchmark functions [uni-model (F_1–F_7), multi-model (F_8–F_{13}), and fixed-dimension multi-model (F_{14}–F_{23})] employee to check the performance of proposed variant. The proposed variant applies on sine data set and cantilever beam design function. The competitive results of proposed variant

Table 6 Conclusion [8]

Author	23 classical function benchmark function	Environment tool	Application	Compared with	Compared parameters
Singh, N., and Singh, S. B.	F_1–F_7 (uni-model) F_8–F_{13} (multi-model) F_{14}–F_{23} (fixed-dimension multi-model)	MATLAB R2013a	Five real-life data set problems (XOR, balloon, breast cancer, iris, and heart)	Standard GWO, PSO, GA, ACO, ES [18], and PBIL [19]	Mean squared error (MSE) and classification rate

Table 7 Conclusion [9]

Author	23 classical function benchmark function	Environment tool	Application	Compared with	Compared parameters
Singh, N.	F_1–F_7 (uni-model) F_8–F_{13} (multi-model) F_{14}–F_{23} (fixed-dimension multi-model)	MATLAB R2013a	Sine data set and cantilever beam design function	CONLIN, MMA, SOS, CS, GCA-I, and GCA-II	Mean and standard deviation

with other related algorithms like Convex Linearization method (CONLIN), Method of Moving Asymptotes (MMA), Symbiotic Organisms Search (SOS), Cuckoo Search (CS), and Grid based clustering algorithm—I and II (GCA-I and GCA-II) to find optimal solution. Table 7 concludes the parameters of the proposed technique.

3 Conclusion

The shortcoming of genetic algorithm is that the performance getting slowdown at higher dimension, low convergence rate, and best result at local optima but not at global optima. PSO is very fast in searching of optimal solution, but if parameters are not properly tuned in this algorithm, therefore, may converge into a local optimum. GWO mimicked the social level of leadership hierarchy and participated in hunting behavior of gray wolves and check the performance on standard limitations of any optimization algorithm in terms of spread of exploration, achievement of exploitation, avoidance of local optima, and convergence of obtained results. Results of unimodal functions demonstrate the exploitation performance and multimodal functions

described the exploration performance. The demonstrations of results of the composite functions achieve the high level of avoidance of local optima in search space and convergence analysis confirmed the convergence of the proposed algorithm.

Optimization with meta-heuristics approach has been employed in large applications of engineering, environmental application, image processing, medical and bioinformatics, and networking to provide better solutions. The main objective is to minimize the cost and maximizes the effort of a large number of multi-objective problems. Various optimization algorithms have been proposed related to several fields of applications and working sincerely to produce optimum or near optimum solution. No free lunch theorems state the reason behind the story.

References

1. Chong EK, Zak SH (2013) An introduction to optimization, vol 76. Wiley
2. Eberhart R, Kennedy J (1995 Nov) Particle swarm optimization. In: Proceedings of the IEEE international conference on neural networks, vol 4, pp 1942–1948
3. Beni G, Wang J (1993) Swarm intelligence in cellular robotic systems. In: Robots and biological systems: towards a new bionics?, pp 703–712. Springer, Berlin
4. Kennedy J, Eberhart R (1995) Particle swarm optimization. In: Proceedings, IEEE international conference on neural networks, 1995, pp 1942–1948
5. Dorigo M, Socha K (2006) An introduction to ant colony optimization, vol 194(6). Universit de Libre de Bruxelles, CP
6. Mirjalili S, Mirjalili SM, Lewis A (2014) Grey wolf optimizer. Adv Eng Softw 69:46–61
7. Mittal N, Singh U, Sohi BS (2016) Modified grey wolf optimizer for global engineering optimization. Appl Comput Intell Soft Comput 2016:8
8. Singh N, Singh SB (2017) A modified mean Gray Wolf optimization approach for benchmark and biomedical problems. Evolut Bioinf 13:1176934317729413
9. Singh N (2018) A modified variant of grey wolf optimizer. Int J Sci Technol Sci Iran. http://scientiairanica.sharif.edu
10. Emary E, Zawbaa HM, Hassanien AE (2016) Binary grey wolf optimization approaches for feature selection. Neurocomputing 172:371–381
11. Yang XS, Deb S (2010) Engineering optimisation by cuckoo search. arXiv preprint arXiv:1005.2908
12. Yang XS, Hossein Gandomi A (2012) Bat algorithm: a novel approach for global engineering optimization. Eng Comput 29(5):464–483
13. Holland JH (1992) Genetic algorithms. Sci Am 267(1):66–73
14. Davis L (1991) Handbook of genetic algorithms
15. Goldberg DE (1989) Genetic algorithms in search, optimization, and machine learning. Addison-Wesley
16. Maihami V, Yaghmaee F (2018) A genetic-based prototyping for automatic image annotation. Comput Electr Eng 70:400–412
17. Sukhija P, Behal S, Singh P (2016) Face recognition system using genetic algorithm. Proc Comput Sci 85:410–417
18. Back T, Hoffmeister F, Schwefel HP (1991 July) A survey of evolution strategies. In: Proceedings of the fourth international conference on genetic algorithms, vol 2, No. 9. Morgan Kaufmann Publishers San Mateo, CA
19. Baluja S (1994) Population-based incremental learning. A method for integrating genetic search based function optimization and competitive learning (No. CMU-CS-94-163). Carnegie-Mellon Univ Pittsburgh Pa Dept. of Computer Science

20. Wolpert DH, Macready WG (1997) No free lunch theorems for optimization. IEEE Trans Evol Comput 1(1):67–82
21. Priyadharshini SP, John Grasias S (2016) Image segmentation with optimization techniques. IJAR 2(8), 284–287
22. Patel N, Kumar R (2014) Image segmentation & performance evaluation parameters. Image 4(10)
23. Molga M, Smutnicki C (2005) Test functions for optimization needs. Test functions for optimization needs
24. Suganthan PN, Hansen N, Liang JJ, Deb K, Chen YP, Auger A, Tiwari S (2005) Problem definitions and evaluation criteria for the CEC 2005 special session on real-parameter optimization. KanGAL report 2005005:2005

A Futuristic Development in the Sanatorium Domain to Enhance Human Life in Secure and Safeguarded Technique with the Aid of IoT

Bhavan Kumar Basavaraju, K. R. Bhargav, Revanth Voleti, Chintakani Sai Gireesh and B. L. S. R. K. Vishal

Abstract A medical error is a preventable effect caused due to an improper or incomplete diagnosis of the patient. According to the survey conducted by the Institute of Medicine (IOM) on an average, 97,000 deaths occur annually found in the report for preventable medical error. Hospitals are searching for methods to diminish these errors caused, and adding to its enhancing the analysis of the patient, also the prior data of diagnosis so to ease the examination process and to minimize the cost in the same time. When we go on to analyze the root cause for these toils faced, we observe a lack of medical staff available to each and every patient for their assistance in any instance, which is assuredly impossible. Thus, we go on to update a piece of the present-day equipment available in hospitals that is ECG scanners; these ECG scanners give an outline of the heart rate of the patient through lines of peaks and dips. In this pulse monitor, we give incorporation of emergency message dispatcher to the respective medical personnel for immediate help and also 24-h data synchronizer for future purposes. The major elements in this upgradation are also very easily available and at a modest price. The government can preferably go on with this proposed idea as recruitment of medical staff can be brought down due to the altering of the number of personnel required for each patient and organizing the whole hospital, which benefits the government not only economically but also socially.

Keywords Medical error · Institute of Medicine (IOM) · ECG scanners · Data synchronizer

1 Introduction

The life of the patient is the most significant for any of the medical or health centers. These organizations give their priority only for the life of the patient as they get paid accordingly, but the major issue arises here is about the lack of providence of 24/7 surveillance to every independent patient. This type of surveillance is to be provided as an instinctual condition of the patient, and the extremity of the situation

B. K. Basavaraju (✉) · K. R. Bhargav · R. Voleti · C. S. Gireesh · B. L. S. R. K. Vishal
Computer Science and Engineering, Panimalar Engineering College, Chennai 600123, India

H. S. Saini et al. (eds.), *Innovations in Computer Science and Engineering*,
Lecture Notes in Networks and Systems 103,
https://doi.org/10.1007/978-981-15-2043-3_67

can never be pre-assessed by any of the medical professionals or doctors. Sometimes this can lead to the death of the patient which definitely makes it a medical error or inefficiency. Thus, medical organizations started to think of an optimal solution to just control the medical errors, provide safe health care and also an assurance of 24/7 surveillance. The method stated here is about using the Internet of Things in much coherent manner just to replace ECG scanners in the medical hospitals which are used to continuous monitoring of pulse rate of the patient. The present-day ideology of ECG is an embedded system technology which will be much more efficient through replacing it by an IoT device. The device is much more similar to the available ECG scanner in its outer design, but coming into the internal structure, it consists of an Arduino board which acts as the central unit for monitoring the diagnosis of the patient and also the message passing during any emergency situations for the medical staff who will be handling the patient. The continuous pulse rate analysis of the patient helps in providing a proper medical or diagnosis report about the patient which makes the work of doctor much more facile to analyze the problem or condition. The data processing for each patient can be done through storing the data in the database which an individual organization must handle or maintain. The system explained is much more beneficial for patients who are undergone major surgeries, etc., who need surveillance for every instant due to their inconsistent health behavior. Thus, through this addition of the proposed system, we can avail a high-quality health diagnosis, and organizations can procure these machines in a very low cost due to only the difference in internal or technological upgradation not the outlook of the ECG scanners. The idea presented will become advancement in the medical era, which has already flourished with different technologies.

1.1 Related Works

In the stated paper, the system proposed is the replacement of the present-day ECG machines with the latest technological update of IoT mechanism. In the proposed system, only the components of the machine are altered rather than its hardware structure. The paper [1] suggests us the method of examination of the patient from the distant and also provides a much cheaper or low-cost way, due to the distant monitoring of ECG; this system cannot be used as a medical error rectifier system in the hospital area. In [2], it has been given of using IoT-based technology for sensing the ECG monitoring but could not provide a full-fledged idea of implementation of IoT concept in the ECG machines. The author [3] in this concept concentrates majorly on the development of the system for the sensing of heart rate but does not go on with the concept of IoT rather choosing embedded over it. This paper helps us to understand the model in which an embedded system is used to develop a heart rate sensing machine. The paper [4] replicates the ideology of paper one in which the low-cost way of sensing the heartbeat of distant persons is found. In this, they added a feature of multiple patients which provide or make difference between the already stated paper and the contemporary paper. In [5], the complete idea of components and

also the concepts involved in IoT are explained through real-time application data through which understanding has been keen on making the development toil free and much more facile. Kamal [6] provides information about the embedded technology by the author which makes the building of the equipment much more facile. From [7], the author starts himself to state the usage of IoT concept in the health monitoring but still lacks in the implementation level where there showcases an enlightening of an error or misguide of the problems faced in the health organizations. The stated papers either not yet proposed the system similar to the mentioned one or rather been an under constraints through they become inefficient or less efficient compared to the stated system.

2 Proposed Method

The method stated in this paper is to provide an efficient medical service to the patients through 24-h surveillance of their health condition using IoT technology. This proposed system is an advancement of the present-day ECG (electrocardiogram) in which we make use of IoT pieces of equipment to ensure that the heart rate of the particular person is monitored. The system comes to use when there is any sudden alter of the patient's health condition due to any abnormal situations as this immediately alarms the respective medical staff in charge just to ensure that he reaches in time. This method also gives an advantage in providing the doctor with a detailed report of the patient's pulse rate, which can portray a clear idea about the condition of the person to the doctor so that he can diagnose the patient with accuracy. The systems not only provide an efficient outcome but also avail itself in a very lower cost compared to the present-day systems. The major aspect which varies the stated method with the contemporary ideas is the replacement of embedded system technology with the IoT which pushes or enhances the health providence in a greater manner. The methodical approach in this paper makes it an innovative method in the field of health services. The adaptation of the stated system could happen bringing up a drastic change in the life of health providers and also the patients who tend to procure good health care.

2.1 Advantages

- Immediate message passing during emergency.
- Cheaply availed than the present-day systems.
- Better than the present-day usage systems.
- Provides complete pulse rate diagnosis report.

Major modules involved are:

1. Monitoring of pulse rate or heart rate

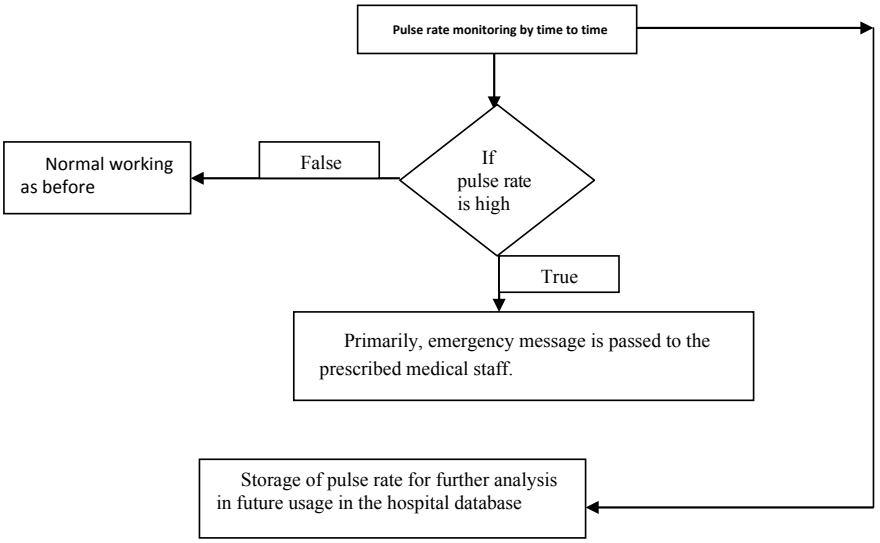


Fig. 1 Flow chart of cycle of phases

2. Checking the constraints
3. Act as per violation or satisfaction of constraints
4. Storage of the data of patient in database as per the requirement (Fig. 1).

The above flow showcases the path in which each module is being executed to surveillance the patient for 24 h during the connection of patient with the device. Each box represents each action taken part in the device during unavoidable circumstances and also during the normal activities.

Figure 2 is the diagrammatical representation of the flow lines. This displays how the medical staff responds during emergencies, and at other duration of time, the pulse is analyzed and stored in the IoT cloud database. This also provides an interface between the user, that is, the doctor and the database.

3 Conclusions

The technology has been developing in day-to-day life; the technology made the life of human facile to live, but this development is still lacking in the major areas such as infirmaries. The problem stated here is about the medical errors committed by the medical personnel due to the miscue of the available mechanisms in the hospitals. Every patient in the hospital cannot be kept under 24-h surveillance; as such during emergencies, this may lead to a critical condition of a patient, even to death. These can be furnished with different solutions incorporating different technology stacks.

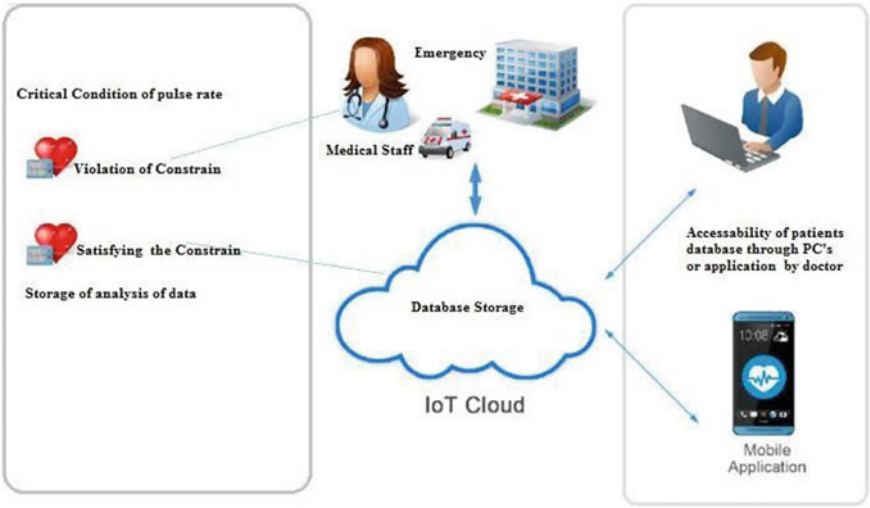


Fig. 2 Pictorial representation of the flow of modules

The solution we propose is based on the major part of the examination in hospitals which is pulse rate monitoring. The pulse rate monitoring is a key aspect through which the condition of the patient can be easily determined.

References

1. Singh P, Jasuja A (2017 May) IoT based low-cost distant patient ECG monitoring system. In: ICCCA
2. Djelouat H, Baali H, Amira A, Bensaali F (2017 June) IoT based compressive sensing for ECG monitoring
3. Sutar RG, Kothari AG, Keskar AG (2013 Sept) Development of an embedded system for real time heart rate variability analysis. In: ISCIT
4. Nurdin MRF, Hadiyoso S, Rizal A (2017 Sept) A low-cost Internet of Things (IoT) system for multi-patient ECG's monitoring. In: ICCEREC
5. Sharma V, Tiwari R (2016 Feb) A review paper on "IoT" and it's smart applications. Int J Sci Eng Technol 5(2)
6. Kamal R (2003 Jan) Embedded systems: architecture, programming and design. McGraw-Hill
7. Saha HN, Auddy S, Pal S, Kumar S (2017 Mar) Health monitoring using Internet of Things (IoT). In: Annual industrial automation and electromechanical conference

Improved Privacy Preserving Score-Based Location K-Anonymity in LBS

Lakshmi Prasanna Yeluri and E. Madhusudhana Reddy

Abstract The extensive use of the location-based services in today's communication world has created tremendous interest. Considering the importance of these services, the demand for applications using location-based services is also growing rapidly. While working with the applications of these services, there are many threats related to the issue of security. Security to the user's data is to be provided from the unauthorized parties in the network. The main idea lies in preserving the privacy of the user using anonymization techniques. In this paper, a method for improving the location privacy of the user is proposed by the popular K-anonymity technique, and the implementation algorithm is also discussed.

Keywords Location privacy · Location-based services · Location K-anonymity · Cloaking · Anonymizer

1 Introduction

The increase in the interest for LBS is posing a serious threat related to the privacy of users. The area to focus is that there are certain situations to be described where the user's identity is to be hidden. By using anonymization techniques, identification of the information related to the users is projected as collective information rather than individually [1]. This enables the user to hide sensitive data by using anonymization techniques. This technique aims in providing privacy to the user data with the help of a trusted third-party server known as an anonymizer. This is the major area which provides a security breach related to the privacy of the user. When the users are working with the services of the location-based services via an anonymizer, security measures are to be taken properly related to the user and the server too. Using this approach if a request is issued by the user, then the location information is also shared along with the requested data. Malicious or unauthorized nodes existing in

L. P. Yeluri (✉)
Department of CSE, JNTUH, Hyderabad, India

E. Madhusudhana Reddy
Department of CSE, GuruNanak Institutions Technical Campus, Hyderabad, India

H. S. Saini et al. (eds.), *Innovations in Computer Science and Engineering*,
Lecture Notes in Networks and Systems 103,
https://doi.org/10.1007/978-981-15-2043-3_68

the network create a major problem to the user data if the trusted third-party server is not secure [2]. This topic of interest which deals with the leakage of sensitive information of the user's location is defined as location privacy. Location privacy deals with the facility to prevent other users from learning one's current or past location. Location-based services based on location privacy are classified as follows [3]:

1. Services that operate completely anonymously.
2. Services that work with user identity.
3. Services that use PIR technique.

A lot of research is being carried out for addressing the issue of location privacy where user anonymity is important [4]. This paper aims in minimizing the divulgence of location information to third parties where the identity of users is also to be taken into consideration.

2 Related Work

Several methods are being proposed for preserving privacy in location-based services such as anonymization-based, cryptographic-based, obfuscation-based, IP hiding, access control and architecture-based [5, 6]. Among all the techniques, services that operate completely anonymously have gained popularity. Anonymization is the state of performing certain activities without revealing the individuality of the user by making the query request issued by the user identical among a group of users where there is a chance of attack. It is also known as the technique of hiding the user identity. Sweeney et al. proposed a traditional anonymization technique for protecting privacy known as K-anonymity [7]. Generalization and suppression techniques are the methods used in K-anonymity for hiding the user data. The level of anonymity is determined by grouping a set of identifiers known as quasi identifiers. But with this traditional technique, the accuracy of the location information is not guaranteed, and the chance of data leakage is more. Several techniques are being proposed to address the data leakage problem, but still the problem lies with the privacy of the user [8].

Another important point of consideration which impacts user anonymity is the capability of devices. The location-based services operate on the user nodes which are smaller devices with low power, storage and bandwidth, and these are the factors to be considered affecting the privacy of the location information.

Location-based K-anonymity K-anonymity is a technique defined as that the user's location information sent to the location provider is made indistinguishable among $k - 1$ users by defining a set of quasi identifiers. To achieve privacy using K-anonymity, a trusted server is to be incorporated. It can also be known as anonymizer [9].

An anonymizer is a trusted third-party server which is trustworthy for the transfer of information between the client and server, removing the user identities and selecting a cloaked region (Fig. 1).

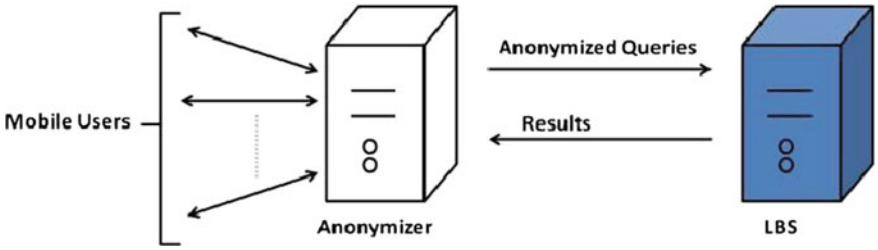


Fig. 1 Location anonymizer

But the main limitation with this approach is to maintain the accuracy of location information. In this paper, the authors have proposed an improved method using K-anonymity to solve the problem of accuracy in the location information which aims at generating minimized cloaked regions. Cloaking is a process where a spatial cloak or a region is constructed around the exact location of the user [10]. Location cloaking blurs the user's location into a cloaking region (CR) which satisfies the privacy metric specified by the user at the time of issuing query. Here, the query issuer is fixed; whereas, the user devices or nodes are non-fixed [11].

3 Proposed Location-Based K-Anonymity

To address the user privacy issue, a location-based K-anonymity technique is proposed. This method can generate minimized cloaked regions by choosing the nearest neighbors using a score function and can also protect the location and path of the query issuer. Using these smaller cloaked regions, energy consumption will be reduced, and delay time between the user and the query issuer can also be minimized. Energy and node connectivity are the parameters used while deploying the nodes in the network. Initially, all the nodes are allocated an initial energy, and this energy will be changed accordingly with their energy consumption and the respective change of location in their positions within the cloaked region. The query issuer transmits a message to the nearest neighbors in the cloaked region wherein at that time there is a chance of information leakage in the query issuer and the nearest neighbor nodes that results in the form of energy drop out. In this method, the minimized cloaked regions are computed by considering the quality (energy) of the average locations reported by the user nodes. The lesser the area, the better the accuracy of the aggregate location information is retained. The area between the two nodes is computed based on the weighted Euclidean distance:

$$d_{x,y} = \sqrt{\sum_{i=1}^{n} w_i (x_i - y_i)^2} \tag{1}$$

After calculating the distance, the best cloaked region is analyzed by using a score function as follows:

$$\text{score} = w_{i1}E + w_{i2}C + w_{i3}I \tag{2}$$

Here, E is the residual energy, C is the node connectivity, and I is the node identifier. w_{i1}, w_{i2} and w_{i3} are the weights of the node at ith iteration. The best score value after subsequent iterations is the optimum value and thus finds the nearest node and transmits the message. Hence, the location-based K-anonymity technique calculates the best cloaked region using a score function which is calculated in relation to the energy level of the nodes, node connectivity between the number of nodes and the query issued and node identifier value.

4 System Architecture of the Proposed Problem

The proposed location-based K-anonymity technique solves the problem of accuracy in the location information by generating minimized cloaked regions based on the score value obtained for two different paths with the same distance. In this process, the query issuer is fixed, and the receivers are non-fixed. According to the anonymity level chosen, the query issuer finds the shortest path based on the distance. Thus, the proposed approach is given in the following steps:

Algorithm: Score-Based Location K-Anonymity

Step 1: User's C_N requests the query to the LBS in communication with the anonymization server.
Step 2: Anonymization server selects the node from the node list as a fixed node which is known as query issuer Cq and a K-anonymity value.
Step 3: Query issuer Cq selects the shortest path by calculating the distance between two nodes (query issuer and the nearest node) as follows:

$$d_{x,y} = \sqrt{\sum_{i=1}^{n} w_i (x_i - y_i)^2}$$

Step 4: Score function at each iteration calculates the minimal CR as follows:

$$\text{score} = w_{i1}E + w_{i2}C + w_{i3}I$$

Step 5: K-anonymity value is now updated based on the result of the score function.
Step 6: The query issuer Cq starts data transmission in the time period ***t*** to the authorized node in sorted order.
Step 7: Cq updates the location by performing a rotation about an angle of 45° at the time period ***(t + 1)*** and then starts the data transmission.

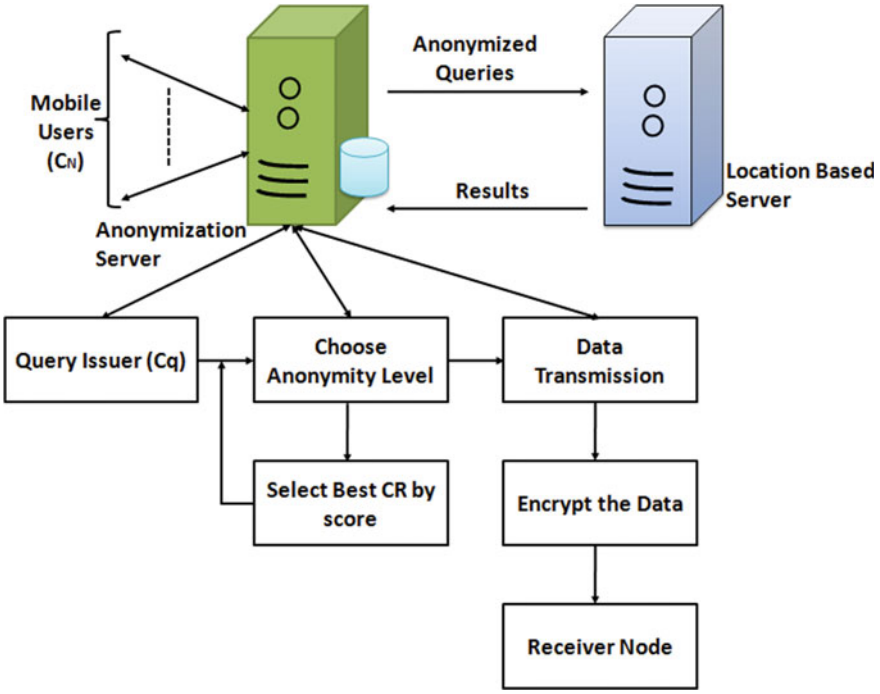


Fig. 2 Proposed score-based location K-anonymity

The above said algorithmic approach is as given in Fig. 2. The anonymizer in communication with the user nodes and the location-based server facilitates the process of query request and response mechanism. Anonymizer chooses the query issuer node among the user nodes in the cloaked region and finds out the anonymity value by using the proposed score function. Once the anonymity level is chosen, then it starts the data transmission with the neighboring nodes in the cloaked region.

5 Conclusion

In this paper, an approach to protect the user locations is presented using a location-based K-anonymity technique. For each and every iteration, the location information is analyzed in collaboration with the anonymizer which contains the list of all the mobile user nodes participating in the cloaked region. Factors such as energy and connectivity between the mobile nodes are also taken as measures which help in protecting the user location. But this technique may be vulnerable to query tracking attacks, where the malicious node can infer the query issuer. The future work concentrates on optimizing the identified malicious node in the CR, thus improving the performance of the system.

References

1. El Emam K, Dankar FK (2008 Sept–Oct) Protecting privacy using k-anonymity. J Am Med Inf Assoc 15(5)
2. Pan X, Jianliang X, Meng X (2012) Protecting location privacy against location-dependent attacks in mobile services. J IEEE Trans Knowl Data Eng 24(8):1506–1519
3. Tyagi AK, Sreenath N (2015 July) A comparative study on privacy preserving techniques for location based services. Br J Math Comput Sci 10(Issue 4):1–25. ISSN:2231-0851
4. Vu K, Zheng R, Gao J (2012) Efficient algorithms for K-anonymous location privacy in participatory sensing. In: Proceedings in IEEE INFOCOM
5. Wang D, Cheng H, Wang P (2016) On the challenges in designing identity-based privacy-preserving authentication schemes for mobile devices. IEEE Syst J
6. Kido H, Yanagisawa Y, Satoh T (2005 Apr 05–08) Protection of location privacy using dummies for location-based services. In: ICDEW'05, proceedings of the 21st international conference on data engineering workshops, 12–48
7. Zhang W, Song B, Bai E (2016) A trusted real time scheduling model for wireless sensor networks. J Sens 2016:1–19. https://doi.org/10.1155/2016/8958170
8. Priya Iyer KB, Shanthi V (2013 May) Study on privacy aware location based service. J Sci Ind Res 72:294–299
9. Niu B, Li Q, Zhu X, Cao G, Li H (2014) Achieving k-anonymity in privacy-aware location-based services. Proc IEEE INFOCOM. https://doi.org/10.1109/infocom.2014.6848002
10. Wang Y, Xu D, He X, Zhang C, Li F, Xu B (2012) L2P2: location-aware location privacy protection for location-based services. In: Proceedings in IEEE INFOCOM
11. Song D, Park K (2016) A privacy-preserving location based system for continuous spatial queries. Mob Inf Syst 2016:1–8. https://doi.org/10.1155/2016/6182769

Relation Extraction and Visualization Using Natural Language Processing

B. K. Uday, Kailash Gogineni, Akhil Chitreddy and P. Natarajan

Abstract This paper discusses relationship extraction among actors/nodes in the text provided. Given a text data, relationships are extracted using natural language processing and shown in a graph. Proper identification of "Nouns" and "Pronouns" can help to identify the actors/characters in the given text. Any relation usually would be between/among the nouns, so this paper first aims to extract "Nouns" and "Pronouns" in the given text and discusses how relation is extracted between/among them. Paper discusses step by step procedure of finding relation among actors/characters in the given plot/text. There are two prominent phases; one is, extracting "Nouns" and "Pronouns," and the other is the relation among the characters/actors. This methodology is applied on movie story plot and tested. The above said methodology is applied on movie "Baahubali," as it contains many characters and relations.

Keywords Text mining · Relation extraction · Data visualization · Term analysis · Natural language processing

1 Introduction

Natural language processing, NLP, is a part of artificial intelligence domain. Simply put, NLP deals with interaction between humans and computer systems with human's language. NLP highly relies on machine learning. Lot of machine learning stuff involves making NLP shine.

Extracting knowledge from raw text is very helpful. It reduces lot of effort. As an example, "Baahubali" [1] an Indian movie whose story/plot is taken and all the relations are extracted; finally a graph is drawn showing the relations of all the characters. Paper discusses and applies the main methodology on "Baahubali" [1]

B. K. Uday (✉) · K. Gogineni · A. Chitreddy · P. Natarajan
School of Computer Science and Engineering, Vellore Institute of Technology, Vellore, Tamil Nadu, India

P. Natarajan
e-mail: pnatarajan@vit.ac.in

H. S. Saini et al. (eds.), *Innovations in Computer Science and Engineering*,
Lecture Notes in Networks and Systems 103,
https://doi.org/10.1007/978-981-15-2043-3_69

movie plot and continues its discussion on "Baahubali" [1] story till the end. This paper also discusses how dataset is collected, cleaned and preprocessed.

The main step in any data science project is to collect meaningful data which suits the purpose. The dataset, which suits for this paper, is hardly found. A Python crawler is implemented to crawl and get the data. Wikipedia has enough amount of information. So, Wikipedia pages are crawled to get the information regarding all the movies released between years 2000 and 2018, in "Telugu" language. Information about 5000 movies is obtained and stored in a text file. The same crawler is made to run on each movie title [*which are extracted in above step*] to extract "story/plot" of the respective movie. The extracted movie plot data is stored in a text file. Crawler is coded in Python language. "Requests," [2] "Beautiful Soup" [3], and "urllib" [4] libraries are used to download, refine, and parse the downloaded html content, respectively. Many Web sites are explored, and finally "Wikipedia" suited the best. Crawler took 18 min to fetch the respective movie's main story line. The main purpose of getting movie's storyline is to train and test the methodology.

The downloaded content is very raw. So, the next step is data preprocessing. Data preprocessing involves the removal of stop words [5], stemming [5], and tokenizing [5]. After performing all the steps, data is clean up to the point. Now, the data is almost ready to identify the named entity recognition [NER] [6]. After identifying different parts of speech, "Nouns" and "Pronouns" are concentrated. Usually, relations will be among/between characters/actors. So, identifying "Nouns" and "Pronouns" will do the job. Data visualization is done with the help of D3 network package from R programming language. By using the Stanford Parser, dependency relations are obtained among entities in text. After that, *source–destination* adjacency list is prepared. *D3 network* is an awesome package for creating interactive graphs. Each node of the graph represents an actor/character in text fed to the system.

The distribution of the paper in different sections is as follows. Section 2 deals with the literature survey. In Sect. 3, the crawler which is used to extract the information is discussed. In Sect. 4, description of various steps in data preprocessing is provided. Section 5 deals with the technology used. Section 6 deals with methodology. Section 7 deals with process design. Section 8 deals with snapshots. Section 9 deals with conclusions. Section 10 deals with references.

2 Literature Survey

Vijayarani et al. [5] proposed that after gaining the text documents from different sources to gain the most important and required information, the data has to undergo a process called as the preprocessing, which is the first step to be followed in text mining or data mining as there will be noise in the data and some unrequired words or articles called as the stop words, which makes the data or text looks heavy, but does not require for mining the information. So, before getting into natural language processing, first step the data preprocessing is done and followed by some other steps like extraction, stop words removal, stemming, and stop list.

Brin et al. [7] proposed that World Wide Web consists of a lot of information in which some of the information is required, and the other information is not required. Web crawlers are used to gain the information, which is required. Web crawlers are the code robots, which get the required information from the URL, which is provided to the crawler. Like this, the required information with unnecessary extra data is gained.

Manning et al. [8] proposed that after the preprocessing is done the natural language processing comes into the picture. The data is refined, but it is still a text, the machine must process the text, and this can be done with the help of natural language processing. Under NLP, the text undergoes a series of steps in which the text is converted into tokens, and this process is called as tokenization and few other processes such as sentence splitting, part-of-speech tagging, morphological analysis, named entity recognition, syntactic parsing, conference resolution, and other annotators.

Culotta et al. [9] proposed that relation extraction can be considered as the last process under NLP as the tokenization and others are done. This process understands some key words such as brother, father, and some related words, which are present in the package in the NLP. Under the process of tokenization, extraction of the words in the text is done. It divides the whole text into a tabular form with an entity described at the top of the field which remains the same but the values change. Like this, the relation is also stored in separate columns. Semantic relations occur usually between entities like Person or Organisation. With the help of Named Entity Recognition, entities can be mapped to extract the relationship between them.

Tan et al. [10] proposed that text mining or text data mining is getting useful information from the knowledge databases or the information databases. Even though they are knowledge bases, for any instance of time only some information is required, but not all. So, using different techniques and processes the right information, which is required at that particular instance, is generated. So, many processes such as text segmentation, text analysis, relation extraction, NLP and some other techniques come under text mining.

3 Crawler

A web crawler is implemented in Python with "Requests" and "Beautiful Soup" libraries. This is used to download our favorite content from the World Wide Web. A URL will be provided to the crawler. Crawler sends an "httprequest" to that page and downloads the content of that html webpage. The crawler is highly sophisticated that provides the required tag of html to download, and crawler can download only that content from HTML. Tags of HTML like *paragraph (<p>), header (ex : <h1>), anchor (<a>)* etc can be provided as input to crawler and it gets content only from that tag. Many other options are also implemented such as "prettify," which prettifies the downloaded html content. Crawler also makes use of "Beautiful Soup" library, which is an HTML parser. It provides the facility to download any content in a page. Usually, a page is made of HTML. Beautiful Soup provides the facility to download

the required tag's content from the HTML. Beautiful Soup not only downloads the HTML content, but also prettifies the downloaded content.

A URL is fed to crawler. Crawler can now download any content in that page. On observation, any movie's data which contains "cast," "date of release," "producer," "director," and "title of movie" is within the *table* tag. With the help of "Requests" module, crawler sends an "httprequest" and with the help of "Beautiful Soup", table tag data is downloaded and collected in a text file. Till now, all the movie titles have been obtained.

The same crawler is just modified to download the "story/plot" of all the movies. As crawler already downloaded the movie titles, running a loop over the movie titles has to fetch the "story/content." On observation, "story/content" is present in *"paragraph*" tag. So, using Beautiful Soup, crawler downloads the "*p*" tag content. Crawler took on an average of 18 min to download over 5000 movie's prime story line. It downloads the "story/plot" of all the movies.

4 Data Preprocessing

The data obtained after crawling is raw data. Raw data is the data, which cannot be used directly. Raw data contains lot of useless information. Useless information may come while downloading the tag-based content. For example, if we download a tag say, "*table*" in html, Beautiful Soup downloads all the tables in that page. So, with our interested table, there are other tables, which get downloaded. Those unnecessary tables should be removed. Took human effort [manually removing] to remove the *raw unwanted downloaded* data [like html tags etc.]. After data cleansing, data preprocessing to be done. Data preprocessing is the main important step in mining process. This paper follows three primary data preprocessing methods.

Stop words removal: The useless words which are of no importance and do not affect the actual meaning of sentence are called stop words. Stop words are the general words that have been used in the daily life, like a, an, the, and in. They are mostly for grammatical purpose. While examining the plot of the movie, the parser will remove these stop words.
Stemming: It is a process which converts a word to its original form. For example, if "drinking" is the actual word, then "ing" is removed. That is, cutting of the stems of words. Stems refer here to "ing," etc.
Tokenization: It is a process of breaking a stream of words into tokens.

Ex: Friends, Rock, Mountain.
Output: Friends Rock Mountain.

5 Technology Used

Natural language processing and text mining are mainly used. Python is used for implementation. "NLTK" [11] [*Natural language toolkit*] is used for natural language processing. "Requests" module is used for "http requests" and "httpresponse". "Beautiful Soup" is used for parsing HTML content and getting required tag content. This paper mainly uses NLTK. NLTK is used for "named entity recognition" and "relation extraction". Data preprocessing and data cleaning use "Beautiful Soup" and "NLTK."

6 Methodology

This paper discusses how to extract relations between/among actors/characters. To proceed with, the dataset is utmost needed. Python crawler is applied on Wikipedia pages, and data is extracted. Over 5000 Telugu movie's data is extracted and stored in a text file. Data includes "movie's story," "cast," and "date of release." It took approximately 18 min for crawling the data. Then, data cleaning methods like "stop words removal," "stemming," and "tokenizing" are applied using NLTK. At each step of data cleaning, the text becomes more and more meaningful. Then, using NLTK, "named entity recognition" is done. In this step, "Nouns" and "Pronouns" are identified. Then, relations are extracted. The concept is any relationship will be between/among nouns/entities like "PERSONS" or "ORGANISATION." From the named entity recognition (NER) process, all entities could be obtained. Then, a graph is obtained, showing relations among the actors.

7 Designing the Process

See Fig. 1.

- The Python crawler starts to crawl the Wikipedia web pages.
- It collects the raw data and performs data cleaning and stores the refined data.
- Then through the refined data, the movie titles and movie plot will be extracted.
- Using NLTK inbuilt libraries, we will be able to remove the stop words in the text extracted.
- By the process of stemming, we can reduce the word to its original form.
- Then, tokenizing the sentences would remove unnecessary characters such as punctuations.
- We extract the named entities such as nouns and find the relation between them.
- We finally visualize the results and relations using R studio.

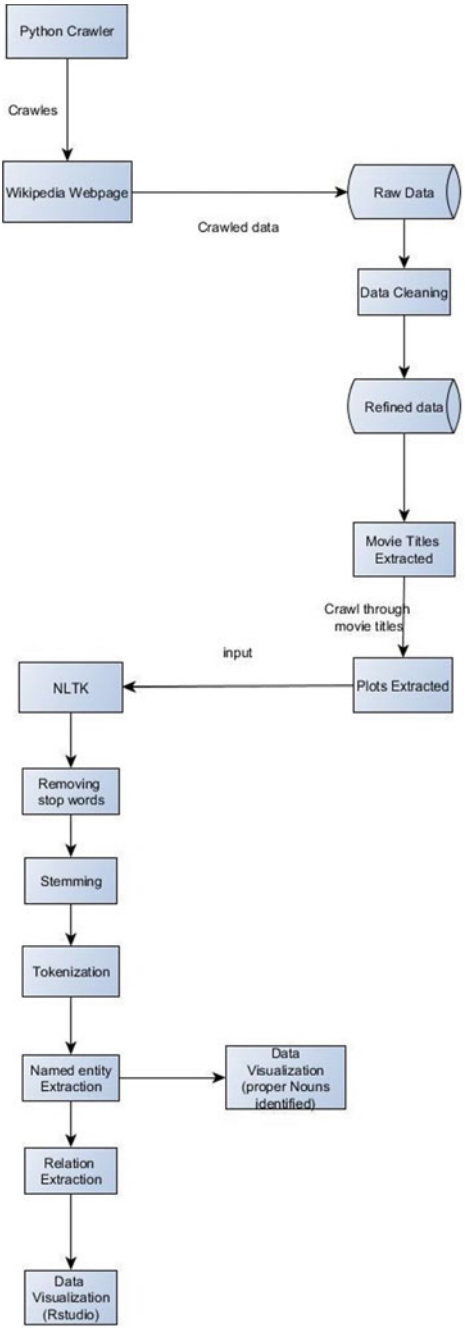


Fig. 1 Total process flow

Fig. 2 NLTK [11] classifying and recognizing named entities. "Harsha Vardhan" is identified as Noun [6]

Fig. 3 "Jagapati Babu" identified as Noun [6]

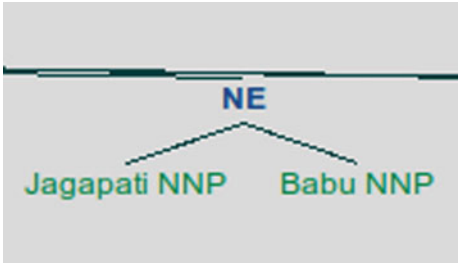


Fig. 4 "Prabhas," "Rana," and "Anushka" identified as persons [1, 12]

```
The/DT
film/NN
stars/NNS
(PERSON Prabhas/NNP)
,/,
(PERSON Rana/NNP Daggubati/NNP)
,/,
(PERSON Anushka/NNP Shetty/NNP)
```

8 Result Snapshots

See Figs. 2, 3, 4, and 5.

9 Conclusion

This paper hence extracts knowledge from the text by using "text mining" and "natural language processing." Characters' relation has been shown by displaying the graphical representation of the actors/characters from the text. This paper is implemented in Python by using various libraries such as "Requests," "Beautiful Soup," "NLTK," "Matplotlib," and R language for representing the final output in the graph. 3D representation of the graph has been successfully implemented by "networkD3" package. This paper can be further extended to include the "type of

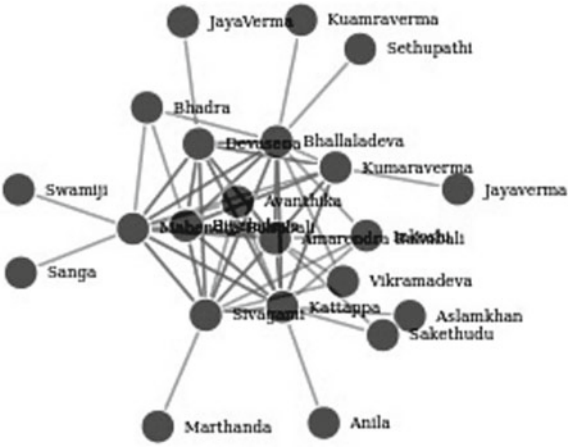


Fig. 5 Relations among characters in "Baahubali" [1] movie

relation" between characters/actors, as this paper limits its discussion in just identifying whether a relation exists between two nodes/actors. This paper can also be extended to the subject "social network analysis." Calculating the centrality measures to determine who is the main character of the given text.

References

1. https://en.wikipedia.org/wiki/Baahubali:_The_Beginning
2. http://docs.python-requests.org/en/master/
3. https://www.crummy.com/software/BeautifulSoup/bs4/doc/
4. https://urllib3.readthedocs.io/en/latest/
5. Vijayarani S, Ilamathi J, Nithya, Preprocessing techniques for text mining—an overview. Int J Comput Sci Commun Netw 5(1):7–16
6. Mohit B (2014) Named entity recognition. Springer, Berlin, 221–245
7. Brin S, Page L (1998) The anatomy of a large-scale hypertextual web search engine. Comput Netw ISDN Syst 30:107–117
8. Manning CD, Surdeanu M, Bauer J, Finkel J, Bethard SJ, McClosky D (2014) The Stanford CoreNLP natural language processing toolkit. stanford.edu/publications, StanfordCoreNlp
9. Culotta A, Sorensen J (2004) Dependency tree kernels for relation extraction. aclweb, anthology, P04-1054
10. Tan A-H (2000) Text mining: the state of the art and the challenges. semanticscholar
11. Loper E, Bird S (2002 May 17) NLTK: the natural language toolkit. arXiv:cs/0205028v1 [cs.CL]
12. Thomas JJ, Cook KA (eds) (2005) Illuminating the path: research and development agenda for visual analytics. IEEE Press
13. https://christophergandrud.github.io/networkD3/

Investigation on Aggregated Weighted Ensemble Framework for Data Stream Classification

Rishi Sayal, S. Jayanthi and N. Suresh Kumar

Abstract Ensemble-based data stream classification process is the most active research work in strengthening the efficacy of ensemble-based data stream classification process. This research is carried out in two different dimensions. First is focused on devising novel ensemble-based data stream classification algorithms to enrich data stream classification task. The second dimension is focused on formulating novel frameworks which propose the novel strategies to aggregate the results of the off-the-shelf classification algorithms. The proposed research work expounds a novel aggregated weighted ensemble framework that aggregates the results of off-the-shelf classification algorithms for data stream classification. The architecture and working principles of the proposed framework, and its role in confronting concept drifts in the data stream classification task are experimentally investigated. Theoretical justifications and empirical evaluation are made on the proposed framework, and accentuate the competency of the proposed framework in terms of accuracy.

Keywords Classification · Data mining · Ensemble classification · Data stream mining · Data stream classification

1 Introduction

The ensemble classification method is widely preferred because of its high accuracy, reliability, and robustness in achieving the classification task even in the presence of concept drifts and outliers [1–5]. These abilities attracted the attention of the data stream mining researchers toward ensemble classification for handling concept drifts in data stream classification. Ensemble classification methods can be classified

R. Sayal
Guru Nanak Institute of Technical Campus, Hyderabad, India
e-mail: ad.rs@gniindia.org

S. Jayanthi (✉)
Department of CSE, Guru Nanak Institute of Technology, Hyderabad, India

N. Suresh Kumar
Department of CSE, Galgotias University, Greater Noida, India

H. S. Saini et al. (eds.), *Innovations in Computer Science and Engineering*,
Lecture Notes in Networks and Systems 103,
https://doi.org/10.1007/978-981-15-2043-3_70

into two major taxonomies, namely horizontal ensemble classification and vertical ensemble classification [6–8].

Each ensemble classification method is distinct in the following dimensions:

- **Diversity of opinion**—Each classifier in the ensemble has private information to perform the classification task.
- **Independence**—Each classifier is independent in making the classification decision.
- **Decentralization**—Classifiers are able to specialize and draw conclusions based on local knowledge.
- **Aggregation**—Each classifier has some specific aggregation mechanism so as to entail its decision to the final classification.
- **Ensemble Size**—Number of classifiers constitute the ensemble.

The proposed approach is focused on devising a novel approach on aggregating the outputs of base classifiers.

1.1 Horizontal Ensemble Classification

Let us consider data streams containing an infinite sequence of data chunks D_i, where $i = 1 \ldots \infty$. Since data streams are infinite, they are segmented into several equivalent data chunks $D_1, D_2, \ldots, D_n$. If nth data chunk, D_n, is arriving at the current timestamp, then the buffered data chunks are denoted by $D_1, D_2, \ldots, D_n$.

Learning algorithm L having the knowledge on the data chunk D_n, $C_i = L(D_n)$, can be used as the base classifier to predict the instances of the upcoming data chunk, $D_n + 1$, by aggregating the predictions of the base classifiers C_i ($i = 1, 2, \ldots, N$) which are evaluated by adopting the weighted ensemble approach as shown in Eq. (1).

$$C_{\mathrm{HE}}(x) = (1/N) \sum_{(i=1..n)} C_i(x) \tag{1}$$

The horizontal ensemble also adds weight to the base classifiers of the ensemble based on their accuracy calculated over the recent data chunk, known as a weighted ensemble. In contrast to model averaging, weighted ensemble approach minimizes the error variance of the base classifiers on the recent chunk and then each classifier is assigned a weight that is inversely proportional to the error variance [7].

The advantage of adopting the weighted ensemble for horizontal ensemble is twofold [9, 10]:

- Horizontal ensemble framework exploits the classifiers trained on different data chunks to predict or to classify upcoming data chunks. This approach is efficient in handling recurrent and gradual concept drifts since the classifiers keep track of historical data chunks.

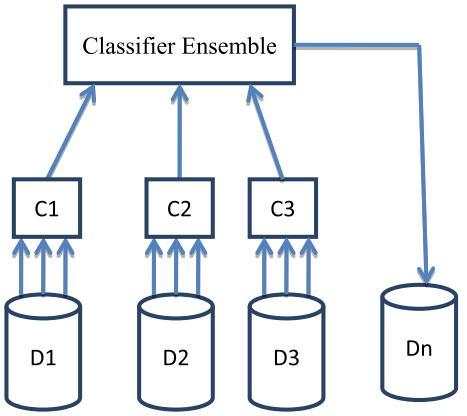


Fig. 1 Horizontal ensemble classification model

- They are also robust to noisy data streams because the final prediction decisions are based on the aggregating results obtained from the classifiers trained over different chunks.

In general, the efficacy of base classifiers is subject to the intensity of the noise and errors in the upcoming data streams. However, the horizontal ensemble can still provide stable prediction accuracy over upcoming data chunks with the weighted ensemble approach.

The disadvantage of adopting the horizontal ensemble framework is also twofold:

1. When sudden concept drift occurs, instances in the upcoming data chunk may swerve with the instances of historical data chunks. Hence, the prediction made by the horizontal ensemble framework becomes imprecise.
2. Moreover, tracking and processing such outdated historical data chunks also leads to high computational cost and makes the classification system ineffective.

The horizontal ensemble classification method is depicted in Fig. 1, in which different classifiers are trained over different data chunks and are collectively applied to predict the upcoming data chunks with weighted ensemble approach.

1.2 Vertical Ensemble Classification

Vertical ensemble classification model exploits m learning algorithms, L_j ($j = 1, 2, \ldots, m$), to learn the most recent data chunks D_n of data streams, $C_i = L_i(D_n)$, with the assumption that the recent data chunk is the most relevant and up-to-date. It combines the results of all the base classifiers through model averaging method as given in Eq. (2),

$$C_{\mathrm{HE}}(x) = (1/N) \sum_{(i=1\ldots n)} C_i(x) \tag{2}$$

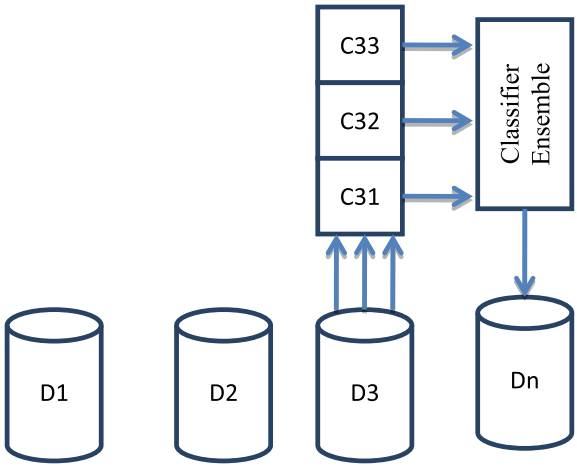


Fig. 2 Vertical ensemble classification model

In precise, vertical ensemble classification method trains multiple classifiers on the recent data chunk and disregards the historical data chunks with the assumption that they are outdated, obsolete and having no relevance with the upcoming future data chunks. The vertical ensemble method is depicted in Fig. 2.

A vertical ensemble classification method trains prudently chosen classifiers on the recent data chunk, i.e., it keeps track of multiple classifiers that are trained only on the most recent data chunk as they are more relevant to the yet-to-come data chunk in data streams.

Its merits are twofold.

- This approach sustains high efficacy in addressing sudden and gradual concept drifts.
- As it retains the classifiers trained on the recent data chunk, it needs less memory to perform its operations.

Despite its advantages, it suffers from the following demerits

- It entails flaw to achieve recurrent concept drift as since it does not keep track of any classifier trained on historical data chunks.
- It is known that the real-world data is subject to noise and errors. If the recent data chunk is corrupted with noise and errors, then this approach becomes a flawed one at predicting upcoming data chunks and leads to inefficiency in addressing sudden and gradual concept drifts.

1.3 Aggregate Ensemble Classification Model

Aggregate ensemble adopts the key strategies of both the horizontal and vertical ensemble frameworks so as to utilize the merits of both the approaches while leaving its demerits [11].

Aggregate ensemble classification model (AEM) exploits m learning algorithms, L_i $(i = 1, 2, \ldots, m)$ to build data stream classifiers on n buffered historical data chunks j $(j = 1, \ldots, n)$. Then, it trains m-by-n base classifiers $C_{ij} = L_i\,(D_j)$, where i represents the ith learning algorithm, and j represents the jth data chunk of data streams. Then, the aggregate ensemble classification model is formulated by combining the predicted results through the model averaging method as given Eq. (3).

$$C_{\mathrm{AE}} = (1/mn) \sum_{(i=1\ldots m)} \Sigma_{(j=1\ldots n)} C_{ij}(x) \tag{3}$$

This equation indicates that the aggregate ensemble model is the synergization of both the horizontal ensemble and vertical ensemble. Classification matrix constituting its base classifiers is given below in Eq. (4).

$$\text{Classification Matrix} = \begin{pmatrix} C_{11} & C_{12} & \ldots C_{1n} \\ C_{21} & C_{22} & \ldots C_{2n} \\ C_{m1} & C_{m2} & \ldots C_{mn} \end{pmatrix} \tag{4}$$

Each element of classification matrix represents a base classifier, C_{ij}, built by using a classification algorithm i on data chunk j of data streams. Since aggregate ensemble model is the synergization of both the vertical ensemble model and horizontal ensemble model to retain all the classifiers trained on the recent data chunk and all the classifiers trained on different data chunks, respectively.

This ensemble model upholds high accuracy in the presence of all kinds of concept drift. However, this model incurs high computational overhead since it uses $m * n$ classifiers to predict the upcoming data chunk. Aggregate ensemble classification model is illustrated in Fig. 3.

From Fig. 3, it is inferred that upon the occurrence of recurrent concept drift, classifiers trained on historical data chunk reduce the overhead of retraining the recurrent concepts in upcoming data chunks. When sudden and gradual concept drifts occur, classifiers trained on the recent data chunk work actively.

By this means, this model achieves the merits of both the horizontal and vertical ensemble model. However, it confronts overhead of maintaining $m * n$ classifiers where m is the number of data chunks and n is the number of classifiers used for learning in each data chunk. To alleviate its drawback and to uphold its merits, the novel aggregate weighted ensemble model has been proposed in this proposed research work.

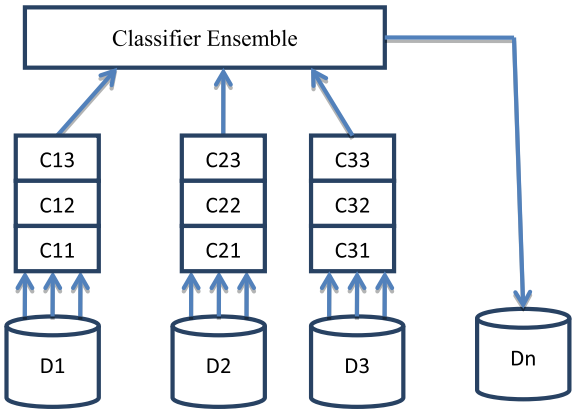


Fig. 3 Aggregate ensemble classification

2 Novel Aggregated Weighted Ensemble Model

The proposed aggregated weighted ensemble Model (AWEM) is devised to achieve all the merits of the aggregate ensemble classification model while leaving its demerits. In this model, data streams are segmented into several data chunks of fixed size, $D_1, D_2, \ldots, D_n$. Initially, each data chunk is scanned for pre-processing so as to produce cleansed and quality data for performing the classification task. The proposed aggregate weighted ensemble model (AWEM) is shown in Fig. 4.

Initially, when data chunk D1 arrives, multiple classifiers, C_{11}, C_{12}, $C_{13,}$ chosen for data stream classification are trained to learn over D_1. Upon the completion of

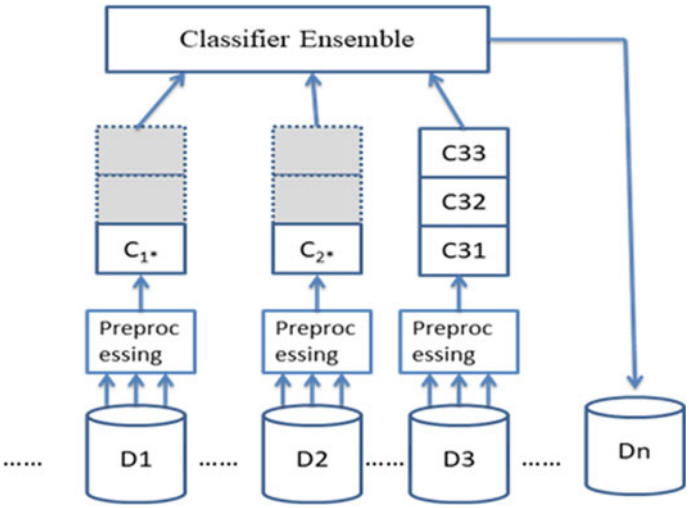


Fig. 4 The proposed aggregated weighted ensemble model

classification, the classifier C_{1*} which performed well in the classification of D_1 is retained using the majority voting method. When data chunk D_2 arrives, similar to the classification process of data chunk D_1, classifiers C_{21}, C_{22} and C_{23} are trained to learn the instances of the data chunk D_2 and the classifier C_{2*} which performed well in the classification of D_2 is retained.

It is notable that when data chunk D_3 arrives, all the classifiers C_{31}, C_{32}, $C_{33,}$ which are trained on the instances of the data chunk D, are retained with the assumption that the classifiers having the knowledge on recent data chunks are the most contemporary and accurate. In precise, classifiers which performed well on historical data chunks alone are retained instead of all the classifiers, so as to confront the recurrent concept drift in the upcoming data chunks with limited memory and computation along with high accuracy.

To classify the futuristic upcoming data chunks, the classifiers C_{1*}, $C_{2*,}$ and C_{3n}, are applied together. This ensemble framework needs to be updated only when the threshold level of the classifier is not met with the accuracy of the recent classification task. Indeed, it is evident that the AWEM can achieve high accuracy in predicting futuristic data chunks in data streams with reduced computational complexity.

In the above given aggregate weighted ensemble model framework, the ensemble is formulated with three base classifiers. At each time after the classification, the best classifier which performed well in the historical data chunk and all the base classifiers acted on the recent data chunk are retained as per the below given Eq. (4).

$$C_{\mathrm{AWM}(x)} = C_{1*}(x) + C_{2*}(x) + (1/m)\Sigma_{(i=1..3)}C_{33}(x) \tag{5}$$

Instead of using the Eq. (3) which retains $m * n$ classifiers, Eq. (5) retains fewer classifiers while achieving competent accuracy with less computational cost.

3 Experimental Environment

This section discusses the experimental setup, data streams used for the empirical investigation, and inferences made on the empirical results.

3.1 Experimental Setup

The proposed framework has been implemented in Java and deployed in a local area network equipped with 25 personal computers. Empirical investigations have been made with KDDcup1999 network intrusion detection dataset having 41 attributes, 494,020 instances and two class labels, namely anomaly and normal. When a significant change is found in any of the 41 attributes, such as, flag, Src_byte, protocol, etc., it is declared as concept drift, which emphasizes the intrusion or attack, otherwise,

Table 1 KDDcup1999 dataset for intrusion detection

S. No.	Duration	Protocol	Service	Flag	Src_byte	Class
1	0	TCP	HTTP	SF	267	Normal
2	0	TCP	HTTP	SF	327	Normal
3	0	TCP	HTTP	SF	234	Normal
4	0	TCP	HTTP	SF	54540	Anomaly
5	2079	TCP	HTTP	RSTR	72564	Anomaly
6	0	TCP	HTTP	SF	244	Normal
7	0	TCP	HTTP	REJ	0	Anomaly

it is considered as normal. A snapshot of the KDDcup1999 dataset is illustrated in Table 1.

Data streams are scanned by the proposed ensemble framework to classify whether target class is an intrusion attempt or normal. Investigations are also made by peppering the dataset with various drifts in the simulated environment, so as to accentuate the efficacy of the proposed model in detecting concept drifts.

3.2 Performance Evaluation

The proposed ensemble framework has been tested with the ensemble size of three having the base classifiers, such as decision tree, Naive Bayes classifiers, and support vector machine classifiers. Investigations in this proposed context is carried out in two phases:

- In the first phase, exhaustive analysis has been made in various sizes of data chunks to accentuate the competency of the proposed model.
- In the second phase, extensive analysis has been made by varying the order of base classifiers so to observe the fluctuations met in the average accuracy of the proposed model.

The experimental evaluation obtained in the first phase of this research work over various sizes of data chunks is illustrated in Fig. 5. Herein, the experiments have been carried out with the ensemble having the learning order of Naive Bayes, decision tree and support vector machine on data stream classification.

From the graphical plots obtained from the empirical results, it is evident that the proposed aggregate weighted ensemble model (AWEM) achieves high accuracy over other comparative approaches, namely hybrid ensemble (HE), vertical ensemble (VE), aggregate ensemble model (AEM) in terms of average accuracy obtained over various sizes of data chunks. Here, Naive Bayes, decision tree, and support vector machine have been chosen as the base classifiers and are deployed in the proposed approach the learning order of Naive Bayes, decision tree and support vector machine.

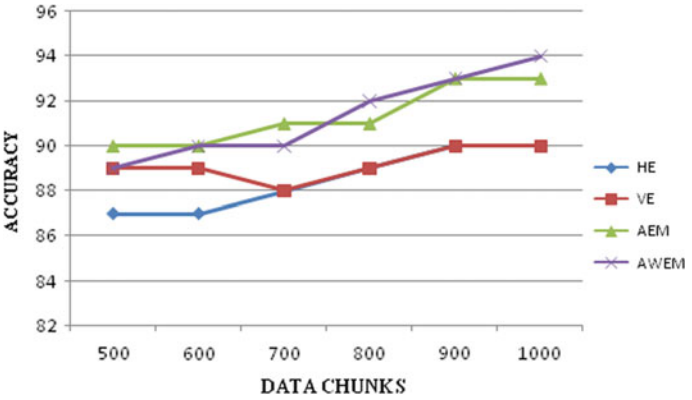


Fig. 5 Comparison of AWEM with HE, VE, and AEM in terms of accuracy over various sizes of data chunks (with the learning order of Naive Bayes, decision tree, and support vector machine in the ensemble)

Average accuracy performance report of AWEM (with the learning order of Naive Bayes, decision tree, and support vector machine in the ensemble) and other comparative algorithms are slated in Table 2.

The experimental evaluation obtained in the second phase of this research work over various sizes of data chunks is illustrated in Fig. 6. Herein, the experiments have been carried out with the ensemble having the learning order of decision tree, Naive Bayes, and support vector machine on data stream classification.

The respective average accuracy performance report of AWEM and other comparative algorithms are slated in Table 3.

The experimental results evince the competency of the proposed framework, aggregate weighted ensemble classification model is high over other comparative frameworks in terms of average accuracy obtained by varying the sizes of data chunks. Furthermore, the proposed model AWEM achieves better accuracy with less computational cost in confronting all kinds of concept drifts such as gradual, incremental, sudden, and recurrent concept drift.

Table 2 Average accuracy performance report of AWEM (with the learning order of Naive Bayes, decision tree, and support vector machine in the ensemble)

Data chunks	HE	VE	AEM	AWEM
500	87	89	90	89
600	87	89	90	90
700	88	88	91	90
800	89	89	91	92
900	90	90	93	93
1000	90	90	93	94

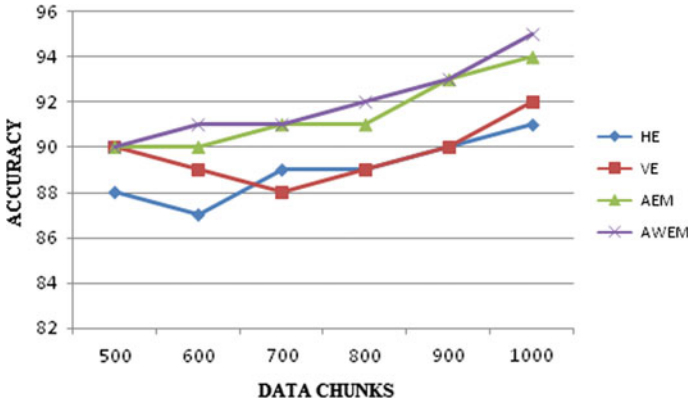


Fig. 6 Comparison of AWEM with HE, VE, and AEM in terms of accuracy over various sizes of data chunks (with the learning order of decision tree, Naive Bayes, and support vector machine in the ensemble)

Table 3 Average accuracy performance report of AWEM (with the learning order of decision tree, Naive Bayes, and support vector machine in the ensemble)

Data chunks	HE	VE	AEM	AWEM
500	88	90	90	90
600	87	89	90	91
700	89	88	91	91
800	89	89	91	92
900	90	90	93	93
1000	91	92	94	95

From the graphical plots Figs. 5 and 6, it is evident that the proposed aggregated weighted ensemble model (AWEM) achieves high accuracy over other comparative approaches, namely hybrid ensemble (HE), vertical ensemble (VE), aggregate ensemble model (AEM) in terms of average accuracy obtained over various sizes of data chunks.

It is notable that the changes in the learning order of Naive Bayes, decision tree, and support vector machine have an impact on accuracy fluctuations on the empirical results. However, learning order fluctuates the accuracy of the classification model, and the proposed framework sustains high accuracy in both the phases of the empirical experiment.

4 Conclusion

This section briefs the important aspects of this chapter:

- This chapter proposes a novel aggregate weighted ensemble model which is intended on promoting data stream classification process.
- Experiments have been conducted in two phases: first is focused on probing the efficacy of the proposed framework in achieving data stream classification task over various sizes of data chunks. Second is focused on assessing the efficacy the proposed framework by varying the learning order of the base classifiers of the ensemble.
- Investigations are carried out in both the phases; accentuate the competency of the proposed framework over other comparative aggregation ensemble model.
- However, the investigations on the proposed framework have been carried out with KDDCUP1999 dataset peppered with noises and concept drifts in a simulated environment.
- In future, it is planned to conduct an investigation on the proposed framework, with the ensemble of having increased number of base classifiers, in a real-time data streaming environment.
- The proposed framework shall be extended to ascertain its efficacy by adopting various ensemble aggregation methods, such as uniform voting, distribution summation, entropy weighting, density-based weighting, stacking, etc.

References

1. Ditzler G, Polikar R (2013) Incremental learning of concept drift from streaming imbalanced data. IEEE Trans Knowl Data Eng 25:1041–4347
2. Read J, Bifet A, Pfahringer B, Holmes G (2012) Batch-incremental versus instance-incremental learning in dynamic and evolving data. In: Proceeding IDA'12. Springer, Berlin, 313–323
3. Gama J, Rocha R, Medas P (2006) Accurate decision trees for mining high speed data streams. J Intell Data Anal 10(1):523–528
4. Minku LL, Yao X (2012) DDD: A new ensemble approach for dealing with concept drift. IEEE Trans Knowl Data Eng 24(4):619–633
5. Kosina P, Gama J (2012) Handling time changing data with adaptive very fast decision rules. In: Proceeding ECML PKDD, pp 827–842
6. Masud MM, Khan L, Han J, Thuraisingham B (2011) Classification and novel class detection in concept-drifting data streams under time constraints. IEEE Trans Knowl Data Eng 23(6):859–874
7. Zhang P, Zhou C, Wang P, Gao B, Zhu X, Guo L (2014) E-tree: an efficient indexing structure for ensemble models on data streams. IEEE Trans Knowl Data Eng 29:366–381
8. Nick Street W, Kim YS (2001) A streaming ensemble algorithm (SEA) for large scale classification. In: Proceedings of the seventh ACM SIGKDD, 377–382
9. Law Y-N, Zaniolo C (2005) An adaptive nearest neighbor classification algorithm for data streams. In: PKDD'05, 108–120. Springer, Berlin
10. Yang Y, Wu X, Zhu X (2006) Mining in anticipation for concept change: proactive-reactive prediction in data streams. Data Min Knowl Disc 13:261–289
11. Rokach L (2010) Ensemble-based classifiers. Artif Intell Rev 33:1–39

Author Index

H. S. Saini et al. (eds.), *Innovations in Computer Science and Engineering*,
Lecture Notes in Networks and Systems 103,
https://doi.org/10.1007/978-981-15-2043-3