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Blockchain cities: the futuristic cities driven by Blockchain, big data and internet of things

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Abstract Smart cities would depend on digital technologies that have the potential ahead where Blockchains would perform significantly. Blockchains has become popular because it offers adequate security than other solutions for a wide range of purpose. Blockchains can support the growth of smart cities due to their robust features like transparent, reliable, authenticate, and decentralized features. At present, big cities are utilizing sophisticated technologies with knowledge platforms to evaluate the quality of life of their residents. Society participation and dedication grow when humans are even more committed to responding with and being adaptable at some stage in their metropolis authorities and responding in an established way to personal problems. Big data, IoT, and Blockchain would accelerate and extend its government services, capacity, and even reduces costs and provides exciting opportunities like transportation services, exchanging services, healthcare services, etc. This study shows the reviews and importance of Blockchain in futuristic smart cities.

Keywords Blockchain · Smart cities · Internet of things · Urban development · Big data

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Introduction

The Internet's last 40 years to bring in emails, online forums, smartphone apps, online purchases, business intelligence, information sharing, cloud-based services, and the Internet of Things (IoT) (Qin et al., 2020). Information Technology is at the core of something today with a positive and negative impact. Due to transparency, privacy, and inclusion advancements, the network lacks a word: Trusts (Jessup et al., 2020). That is blockchain. Currently, smart cities are using advanced technologies to control and coordinate physical, social, and commercial enterprise systems to deliver quality services to their residents, even when guaranteeing the practical usage of available resources (Höjer & Wangel, 2015). The Blockchains technology allows for peer-to-peer exchanges as a public ledger that maintains records of the transaction, contract, agreement, and shipment without the third-parties mediators (Lu, 2019). If the information blockchain transactions have been released, users couldn't be altered to ensure absolute transparency and limitless recording; users could be delivered in any particular transaction without an intermediary; so, they are incredibly safe as they are authenticated (Gururaj et al., 2020). The Big Data and blockchain-based approach to data exchange in smart cities could help share resources across different, unauthenticated enterprises (Allam & Dhunny, 2019). It also allows an entity to efficiently use information collected from

various resources to engage in operational processes without requiring access to the data. Blockchains does not only try to do things differently, but it does transform them entirely. It rebuilt the financial structures, trading structures, communications, educational system, health management, and so on (Xu et al., 2018). The IoT in healthcare and the many aspects of IoT security, reliability, and privacy requirements are defined in the manuscript (Goyal et al., 2021). Without technical and controlled governance reforms, the city could not be considered a smart city (Khatoun & Zeadally, 2016). The smart city includes several integrated factors like connected infrastructure, more innovative security, advanced life, the intelligent usage of energy resources, intelligent people, and fundamentalism (Sun et al., 2016). Urban areas are now facing complicated burdens to raise the standard of living of their residents. Table 1 shows all the acronyms used in this article.

Backgrounds

In 2014, the World Urbanization Prospects report stated that around 50% of the world's population lives in cities. Also, another 2.5 billion will migrate to big cities by 2050 (United Nations, 2014). Blockchains could accelerate the growth of public services and improve the intensity of vital resources, capacity, sometimes reducing costs. Blockchains provide exciting applications from the delivery of public assistance to transmission, renewable energy, and health services (Xie et al., 2019). This work presents a review of blockchain cities using previous studies. Including people, technologies, and organizations also discuss several primary considerations which exchanging wealth makes the city efficient. The authors address the contribution to such concerns of evolving blockchains and their components that could enable smart cities to build service facilities. Such research investigates that technologies blockchain-enabled will apply to smart cities in a specified manner. Authors expect study or expertise in this field could be increased further and promote public discourse. Table 2 shows the related articles list.

The blockchains could build token activities to enhance changes in the behavior of the people (Ali et al., 2020). For example, SocialCoins has paved the path for blockchain technology that supports human life creatively and improves the lives environment (Muthukrishnan & Duraisamy, 2020). The SocialCoins aims at promoting revolutionary progress across a bonus system, in which customers get coins while doing righteous works. Artificial intelligence and blockchain, the convergence of both areas, offer plenty of opportunities with smart city systems to jointly work on machine learning and blockchain

Table 1 Acronyms used in this paper

Acronym	Definition
IoT	Internet of Things
DBS	Dubai Blockchain Strategy
PoW	Proof of Work
P2P	Peer-to-Peer
PoS	Proof of Stake
SDO	Smart Dubai Office
DFF	Dubai Future Foundation
G2C	Government to Consumers
G2G	Government to Government
SCGN	Smart Cities Global Networks
DFA	Dubai Future Accelerators
AI Lab	Artificial Intelligence Lab
IOTA	The Next Generation of Distributed Ledger Technology
IoTIFY	online cloud-based MQTT/HTTP network simulator
iExec	Blockchain-Based Decentralized Cloud Computing
Xage	blockchain cybersecurity system
SONM	Decentralized Fog Computing Platform

Table 2 Related articles

References	Topics	Year	Area
Qin et al. (2020), Dustdar et al. (2017)	Recent advances in Industrial Internet	2017–2020	Internet
Jessup et al., 2020)	Multi-method Approach Measuring Trust, Distrust, and Suspicion in Information Technology	2020	Trust
Höjer and Wangel (2015)	Smart, sustainable cities: definition and challenges	2015	Smart Cities
Lu (2019)	The blockchain: State-of-the-art and research challenges	2019	Blockchain
Gururaj et al. (2020)	Blockchain: A New Era of Technology	2020	Blockchain
Allam and Dhunny, (2019)	On big data, artificial intelligence, and smart cities	2019	Smart Cities
Xu et al. (2018)	A blockchain-based storage system for data analytics in the internet of things	2018	Blockchain and IoT
Khatoun and Zeadally (2016)	Smart cities: concepts, architectures, research opportunities	2016	Smart Cities
Sun et al. (2016)	Blockchain-based sharing services	2016	Blockchain
Xie et al. (2019)	A survey of blockchain technology applied to smart cities	2019	Blockchain for Smart Cities
Ali et al. (2020)	A Blockchain Model for Trustworthiness in the Internet of Things (IoT)-Based Smart-Cities	2020	Blockchain and IoT for Blockchain
Muthukrishnan and Duraisamy (2020)	Blockchain Technologies and Artificial Intelligence	2020	Blockchain
Kamran et al. (2020)	Blockchain and Internet of Things	2020	Blockchain and IoT
El Azzaoui et al. (2020)	Block5GIntell: Blockchain for AI-Enabled 5G Networks	2020	Blockchain
Sharma and Park (2018), El Bekkali et al. (2020)	Blockchain-based hybrid network architecture for the smart city	2018–2020	Blockchain for Smart Cities
Hvidt (2009)	The Dubai model: An outline of key development-process elements in Dubai	2009	City
Biswas and Muthukkumarasamy (2016), Aina (2017)	Securing smart cities using blockchain technology	2016–2017	Smart Cities
Ismagilova et al. (2019)	Smart cities of today and tomorrow	2019	Smart Cities
Murgante and Borruso (2015)	Smart cities in a smart world	2015	Smart Cities
Theodorou and Sklavos (2019)	Blockchain-Based security and privacy in smart cities	2019	Blockchain for Smart Cities
Chen et al. (2020)	Blockchain-Based Dynamic Provable Data Possession for Smart Cities	2020	Blockchain for Smart Cities
Perera et al. (2017), Tang et al. (2017)	Fog computing for sustainable smart cities	2017	Fog for smart cities
Wang et al. (2020)	Blockchain for the IoT and industrial IoT	2020	Blockchain and IoT

Table 2 continued

References	Topics	Year	Area
Brandão et al. (2018)	A smart city's model secured by the blockchain	2018	Blockchain for smart cities
Nasulea and Mic (2018)	Using blockchain as a platform for smart cities	2018	Blockchain for smart cities
Alam (2019a, 2019b), Das et al. (2019), Zoican et al. (2018), Arslan et al. (2020)	Blockchain and its Role in the Internet of Things	2018–2020	Blockchain and IoT
Kushch and Prieto-Castrillo (2019)	Blockchain for dynamic nodes in a smart city	2019	Blockchain for smart cities
Bhushan et al. (2020), Scekic et al. (2018), Nagel and Kranz (2020)	Blockchain for smart cities	2018–2020	Blockchain for smart cities
Atlam & Wills, 2019), Miraz (2020), Alladi et al. (2019), Liu et al. (2017), Lo et al. (2019), Hwang et al. (2017)	Blockchain and IoT	2017–2020	Blockchain and IoT
Qiu et al. (2019)	Cloud computing assisted blockchain-enabled Internet of Things	2019	Cloud and Blockchain
Aggarwal et al. (2019), Li (2018), Ghandour et al. (2019), Michelin et al. (2018)	Blockchain for smart communities	2019	Blockchain for smart cities
Ibba et al. (2017), Shaikh and Mohammad (2020), Dewan and Singh (2020)	Application of blockchain technology in smart city	2017–2020	Blockchain for smart cities
Elmaghraby and Losavio (2014)	Cybersecurity challenges in Smart Cities	2014	Challenges in Smart Cities
Sharma et al. (2017)	A distributed Blockchain-based vehicular network architecture in smart city	2017	Transportation in Smart cities
Lazaroiu and Roscia (2017)	Innovative district through IoT and blockchain	2017	Smart Cities with Blockchain and IoT
Singh et al. (2020), Chakrabarty and Engels (2016)	Blockchain technology for security and privacy in the Internet of things	2016–2020	Security and Privacy
Batty (2013), Mikalef et al. (2019), Mai (2016), Iqbal et al. (2020), Pramanik et al. (2017), Xiang and Fesenmaier (2017), Bradlow et al. (2017)	Big data, smart cities, and city planning	2013–2020	Big Data for Smart Cities
Lv (2019), Fang and Zhang (2016), Singh (2015), Al Hasani (2019), Smart Dubai (2021), Badran (2019), Khan et al. (2017) Efthymiopoulos (2016), Al-Azzawi (2019), Bishr (2019), Kaur and Maheshwari (2016), Sahib (2020), Dassani et al. (2015), Zakzak and Salem (2019), Dubai (2016), DubaiNow App (2020), DubaiCareer (2021), AI Lab (2021)	Blockchain City	2019–2020	Dubai: Blockchain city

technology (Kamran et al., 2020). Although blockchain technologies continue to expand amid popularity and have been adopted by organizations worldwide, the new Big Data developments have made data available from numerous perspectives, including analysis. Blockchains and Big data advancement played a significant role in advancing emerging technologies (El Azzaoui, et al., 2020). Would be the advanced techniques capable of supporting a secure system within the smart cities which are enormously trying to establish themselves? In

addition to ensuring only continuous improvement, consideration must be taken of different measures.

Current status of blockchain cities in the world

Currently, around ten smart cities worldwide are becoming blockchains cities (Sharma & Park, 2018). However, very few cities having a strong execution of blockchains usage a public ledger of all transactions. Dubai is prepared to become the first blockchain-enabled smart city by the end of 2020 (Hvidt, 2009). Blockchain would be a massive impact (Biswas & Muthukkumarasamy, 2016). Now, it can be connected almost entirely to digital currencies-bitcoin, Ethereum, and so on. Additionally, the potential of blockchain to shape the way people trade products online and reshape the support beyond and outside the cryptocurrencies speculation that is progressively becoming accepted. The development idea behind the concept would be incredible (Pelton & Singh, 2019). Smart cities like Toronto, Oslo, Milan, London, Santiago de Chile, and Stockholm are now establishing blockchain-based services. In contrast, Dubai has established the high-priority mission of becoming the first entirely blockchain-enabled city in the world by 2020 end. The policy changes are about to come (Murgante & Borruso, 2015). The blockchain is a series of blocks where each block is linked to the previous block. Each block should include a cryptographic hash passcode, a previous block key, and its data (Theodorou & Sklavos, 2019). Blockchain services are basic functions that have been developed to transfer data between connected devices (Chen, et al., 2020). All IoT devices begin to be various types of potential but communications devices with embedded sensors, cameras, networks, and the ability to communicate with several other IoT devices (Perera et al., 2017). The function of blockchain in IoT could be to provide a process for managing secured data transactions by IoT nodes. Blockchains tend to become a healthy products that can be used externally and internally (Xu et al., 2019). Blockchains exchanges could be tracked and transferred through anything processed to communicate in the IoT network. Blockchains may do well to improve communication threats (Alam, 2020a), (Alam, 2020b). IoT is rising rapidly over the years, intending to emerge Technologies, such as home automation and Smart Cities, e-education, mHealth, shared information, and so on (Goyal et al., 2021), (Wang et al., 2020). However, there are barriers to security and confidentiality. Prevention of transparency in communication around IoT gadgets received much more attention between 2017 and 2020 years. Previous research is dedicated to creating or improving the integration architecture; but, such research does not deliver the full IoT-Blockchains communication framework (Agrawal et al., 2018), (Brandão et al., 2018), (Al Barghuthi et al., 2018) and (Shen & Pena-Mora, 2018). Figure 1 shows the Blockchains use cases in organizations globally.

Motivation

The research study extends the analysis to and from expanding the communication of things that use cloud and blockchain network technologies (Ali, et al., 2018). Transmission of data from one device to another using communication technology was started in the form of radio network packets beginning in the year 1973 (Abramson, 1973). The computer was possible to connect to another computer with the same configuration. Many writers wrote many papers on blockchain and the Internet of Things during the 2017–2021 years.

Contribution

The following is contributed to this research work: (1) The fundamentals of blockchain technology are discussed. (2) Studied and discussed essential concerns for integrating IoT and blockchain technology with smart cities. (3) Studied and discussed essential concerns for integrating Bigdata and blockchain technology with smart cities. And (4) the case study of the first blockchain city, Dubai, is discussed.

Organization

The rest of the paper is organized as follows. Section Blockchain and IoT for Smart Cities represents the Blockchain and IoT for Smart Cities, section Blockchains and Big Data for Smart Cities represents the Blockchain and Big data for Smart Cities, Sect. Case Study of First Blockchain City, Dubai represents the case study of the first blockchain city, Dubai and Sect. 5 represents the conclusion.

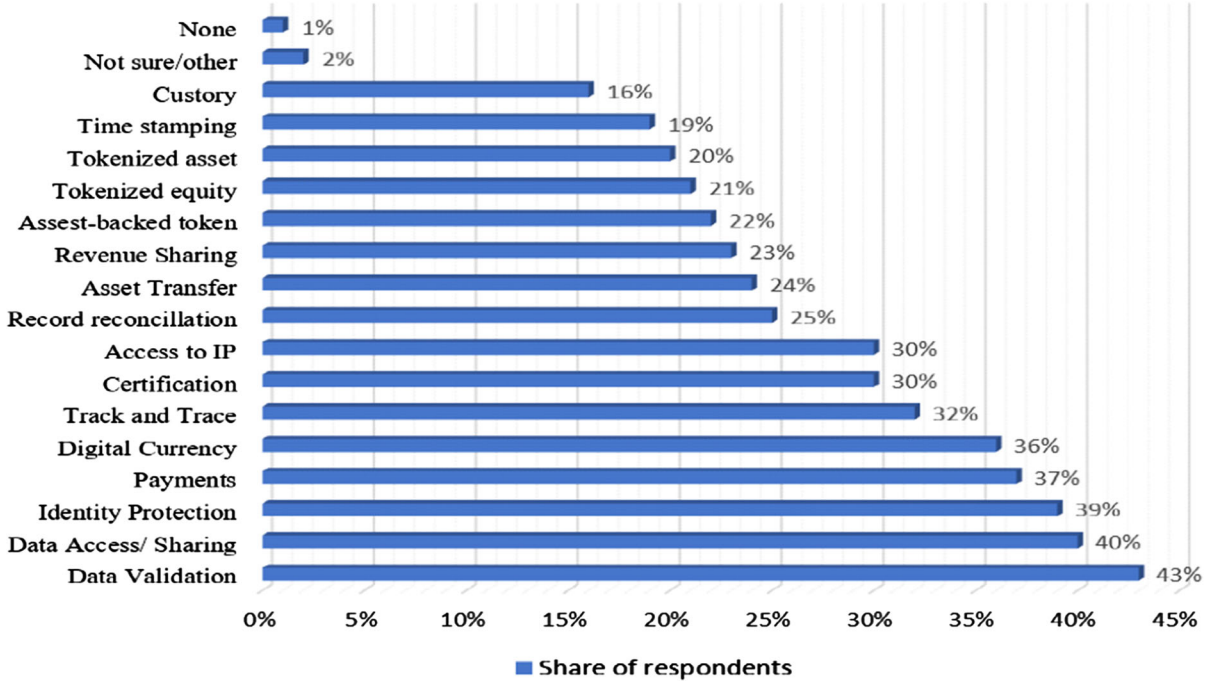

Fig. 1 Blockchains use cases in organizations globally (Statista, 2020)

Blockchain and IoT for Smart Cities

The Internet is represented as the global network of interactions among thousands of interlinked platforms and millions of devices (Choi, et al., 2006). The network itself, indeed, has grown into an irreplaceable global connectivity network. The internet is becoming an extremely desirable source for rumors or illegal practices such as fraudulent activity, malicious software, and spying (Nasulea & Mic, 2018). Activities that use a blockchain become secure, instantaneous, and without or a minimal charge. Urban areas that adopt this innovation and integrate this into the system of government would then build the groundwork for the futuristic digitized city (Al-Hader & Rodzi, 2009). The blockchain is a set of blocks, where every block is connected to its preceding block. Every block does have a cryptographic hash value, a previous hash block, and its metadata (Alam, 2019a). Exchanges in blockchains are the central core that transmits information among connected machines (Kushch & Prieto-Castrillo, 2019). Network devices are the kinds of objects with built-in sensors, actuators, software, and the ability to connect with other connected systems. Blockchain is a cryptographic shared database built along with a peer-to-peer infrastructure that could be publicly distributed by diverse users and providing an accurate digital ledger for each timestamp labeled and linked to previous blocks (Alam, 2021), (Bhushan, B., et al., 2021). Like almost any time a series of records being presented, the information has become another block throughout the series. As such, researchers may describe a Blockchain as a timestamped set of unalterable information stored attempting by a group of machines without being managed by a single entity (Atlam & Wills, 2019), (Miraz, 2020). Block Structure in Blockchains is represented in Fig. 2.

The blockchain is a distributed, open ledger that stores data about transactions with an incredible capability to build novel frameworks by efficiently establishing confidence among entities to many business intelligence (Alladi et al., 2019), (Liu et al., 2017). It is a leading technique, allowing for a distributed policy. Blockchain mainly attracted the research interest whenever it appeared as a framework for robust and reliable crypto exchanges like Bitcoins among random people on a distributed network (Lo et al., 2019). Currently, such technology builds tremendous interest from industry, finance, and insurance to healthcare, governance, enjoyment,

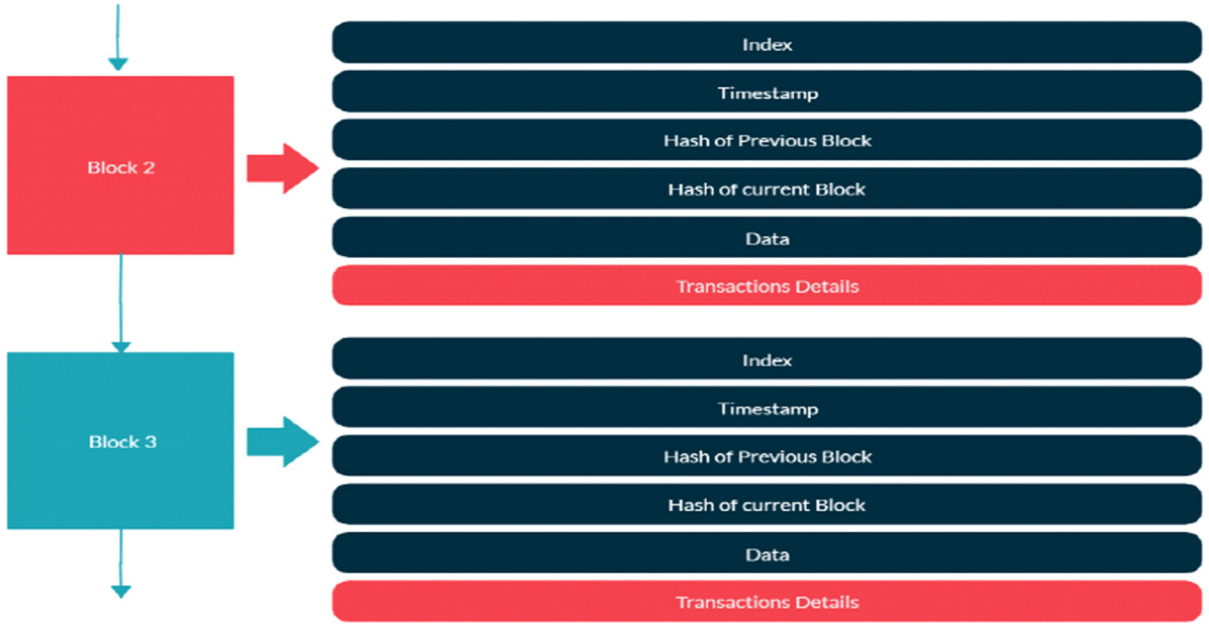

Fig. 2 Block structure in Blockchains

and development, for use in many areas of the economy (Hwang et al., 2017).

Blockchain elements

Below are the Blockchain elements.

1. Blocks: Blocks are data structures that used control the transactions list, which is transmitted to all entire networks.
2. Endpoints: endpoints are blockchain system devices or users.
3. Transaction: It is the least Blockchain system key component.
4. Miner: A Miner is a chosen entity in the Blockchain network which conducts the block validation.
5. Chain: This is the block series.
6. Consensus: this is a set of standards used throughout the transmission of a transaction to execute distributed ledger activities (Makridakis et al., 2018).

Block's transmission in IoT

Data packets are transferred to the data center using the Blockchains network. Every data packet is known as a block, as well. Each block does have its hash function, the prior hash code for the block, and the information (Lee & Pilkington, 2017). Each node does have a link to the sharing of data. Each data transfer link contains lots of blocks, including its prior hash code and information. Blockchains nodes are like connected devices in the data model. Therefore, users could assume the blockchain is a complex system of communication. Blocks become distributed in a distributed structure that used a point-to-point configuration. Once the latest block is generated, this travels to the network and reaches each linked device or confirms its authorization (Banerjee et al., 2018). Whether it is correct, this would interact with the blockchain, and its hash will be generated (Qi et al., 2017). Each newly founded block contains the hashing of the preceding block and links it to the sequence. Its performance can be assessed via several tests. Initially, the study aimed to develop hundreds of fixed-size blocks (Ferrag et al., 2018). Its developers also built an IoT network, linked to the cloud, and established fog and blockchains (Qiu, et al., 2019). fixed-size blocks (Rehman et al., 2020). Some IoT nodes are referred to as Miners in the network. They are typically used for the verification of blockchain operations (Alkhammash et al., 2020). Whether or not the exchanges are authenticated, these

are converted into blocks or agreed to connect to or transfer to the current Blockchains system (Teng et al., 2019).

The miners have a significant role in integrating the development of a new block in the blockchains system. Several tests have been done to assess the system (Aggarwal et al., 2019). The hashing technique is designed by using the Hyper Ledger IROHA method. The Hyperledger IROHA platform includes various tools such as distributed ledgers, Proof of Work (PoW) techniques, Peer—to—peer networks, etc. The Sumeragi is used in the Hyperledger IROHA approach in Blockchains. IROHA Android and iOS bundles require the blockchain service to connect with IoT nodes (Alam, 2019b). As per the Sumeragi method, IoT devices demanded transactions or performed the following steps involved:

1. *Transmission* IoT devices will confirm, arranges, or login transactions or transmit information to the network.
2. *Verification and signing* It confirms, demands, or registers the transactions or communicates to the approved IoT node of the peer-to-peer network.
3. *Commit* Commit to the registration.

In system failure, the automation process corresponds to a transition called the error detection technique. Also, this technique performs with the current server to detect inconsistency.

Blockchain for IoT

Blockchains on the Internet of Things is a modern innovation through a decentralized, distributed, public, and real-time ledger in storing IoT system activities (Li, 2018). Blockchains are a sequence of blocks, and to build a chain. Each block is connected to its corresponding block (Ghandour et al., 2019). Every block does have the cryptography hash value, the prior hash of the block, and its metadata. Blockchain transactions have become the main core in use for data transmission among IoT machines. Network devices are forms of physical objects, but connected devices with built-in sensors, actuators, programs, or other connected devices can communicate. The function of IoT is to have a mechanism for processing secure information transactions via connected systems (Das, et al., 2019). This is a secured technology that could be accessed freely or widely. Each linked device is a technology that enables communication security in a large system between the connected devices (Biswas et al., 2018). Blockchains activities can be tracked and accessed by someone authorized to interact inside the IoT network. Blockchains in IoT could improve overall security measures of information sharing (Yang et al., 2018). Blockchain significantly grows day after day with the target of smart cities, smart healthcare, smart transportation, etc. (Scekic, et al., 2018). This does have issues in terms of security and privacy, though. Embedded systems bind to each other in a decentralized system (Nagel & Kranz, 2020). However, its use in standard established communication protocols in information exchange between devices is complicated. This technology provides communication security between connected devices. It offers a shared ledger that is open, distributed, and fully available to preserve block data extracted and validated in an IoT system. Information contained throughout the shared database is continuously handled via the Peer-to-Peer system (Gharaibeh et al., 2017). Blockchains are a technique in which connected devices can fire the transaction records throughout the context of the blocks. Block is interconnected, but every gadget references its prior widget (Melhem et al., 2019). Blockchain collaborates on IoT and Cloud computing (Viriyasitavat et al., 2019a). This is a revolution in futuristic technologies.

The IoT system allows connected smart objects to access data within the complex system (Shaikh & Mohammad, 2020). The IoT system may be separated into those sections as follows.

Smart Objects: The IoT provides a unique Id throughout the communication system for every equipped object (Dewan & Singh, 2020). The IoT systems enable information to be processed with all other smart objects.

Access Points: access points are the tools that operate between the smart objects and the clouds to ensuring that its link is created and that the network system is equipped with authentication (El Bekkali et al., 2020).

Networks: It monitors information flow and creates the shortest path between the smart objects.Cloud: information is analyzed and processed through the cloud.

Blockchain is a sequence of verified and authenticated transactions owned by a computer linked to a

communication network (Alam & Benaida, 2020). Blocks records are saved in a publicly accessible, decentralized, and accessible public network. Blockchain provides a secure wireless sensor communications network. It may be a private, public, or variously operating consortium. Table 3 shows the types of blockchain.

Transaction in blockchain technology has capabilities including a distributed network topology, increased security, high open access, medium to moderate privacy, and exchangeable identities when in a central registry.

Platforms for developing IoT applications using Blockchain

The following platforms can be used to develop IoT applications using blockchains.

IOTA

It is the latest Blockchain and IoT platform called Next-Generation Blockchains. This platform enables strong information integrity, high exchange accuracy, and a communication range of blocks using fewer resources in the network. Also, it addresses the blockchain's shortcomings (IOTA, 2021).

IOTIFY

It offers a web-based approach to mitigate the drawbacks of blockchains in the context of software solutions (IOTIFY, 2021).

iExec

It is an open-access blockchain-based platform that is used to makes autonomous cloud benefits of blockchains more straightforward for the applications (iExec, 2021).

Xage

It is a decentralized public blockchain for IoT to maximize efficiency and security access privileges (Xage, 2021).

SONM

It is a distributed blockchain-based fog computing technology that offers cloud security support to consumers. The IoT and blockchains are rising competitive advantages and entering a new market where everything or everyone could interact with reliability, security, and privacy in a distributed system. Its convergence among these emerging innovations would then improve the entire future, in which machines could interact without humans in different phases. Its structure aims to obtain confidential information at the appropriate places, in the correct format, and real-time and availability. Blockchains could be used to monitor billions of Internet-linked objects, control such objects, and make communication possible (SONM, 2021).

Characteristics of Blockchain and the Internet of Things in Smart Cities

Decentralization

Blockchain and IoT innovations are connected, eliminating the central authority and offering a decentralized service solution. It increases the likelihood of failures and system performance efficiency.

Table 3 Blockchains type

Blockchains	Efficient	Decentralize	Growth of the Agreement	Immovability	Readability	Determination of
Private	Better	Not	always	May be	sometimes public	For one organization
Consortium	Best	May be	always	May be	sometimes public	Network Nodes
Public	worst	always	not	Not	public	For all miners

Secure

Blockchain offers inter-node authentication. To data transmission, it is a new concept. Blockchains offer a stable platform for IoT nodes to communicate (Elmaghraby & Losavio, 2014).

Identification

The IoT supports most smart objects which have a unique identification code. Through block in the blockchain is known individually, too. But blockchain is a reliable technique that enables distributed, unique identifier information stored in a shared database (Sharma et al., 2017).

Reliable

Blockchain and IoT integration can authorize the data that is allowed to pass in the systems. Information is collected since the miners check this before joining the blockchain network. Also confirmed blocks could also join the blockchain process (Michelin et al., 2018).

Autonomous

Blockchain supports all IoT devices that are free to connect with a decentralized system to any node in the network (Ibba et al., 2017).

Scalable

Blockchains support IoT nodes to interact in a high-availability, decentralized network system and communicate in real-time, sharing information with the destination address (Viriyasitavat, et al., 2019b).

Opportunities for Blockchain and the Internet of Things in Smart Cities

The Blockchain-IoT integration strategy has identified several impressive advantages. Blockchains-IoT opens new opportunities for both of them in different areas. Even so, several of the openings are listed as follows.

Establish trust among technologies

The Blockchain-IoT strategy will create trust among the multiple devices linked because of their authentication (Tekeoglu & Ahmed, 2019). Though all validated devices can be connected on the blockchain, each block of the transactions must first be reviewed by the miners and then inserted into the blockchains.

Reduce costs

Reduce costs, although it connects directly to the public without third-party providers (Lazaroiu & Roscia, 2017). It removes any third—parties node among IoT apps. This also offers a direct link.

Minimize the time

This can minimize time. It minimizes the time taken for transactions from days to moments (Zoican et al., 2018).

Privacy and security

It provides security and privacy to gadgets and moves data among devices (Arslan et al., 2020).

Public services

This approach offers public and social facilities to network devices. Each linked device can be connected and share data (Zhou et al., 2017).

Finance

This approach can securely transfer money without third-party service providers. It offers a rapid, stable, and private financial services network. This also decreased transaction time and cost too (Mohammadi & Al-Fuqaha, 2018).

Risk management

Essential factors are influenced in analyzing and lowering the impact of resource failure (Pan, et al., 2018).

Challenges of Blockchain and the Internet of Things in Smart Cities

The integrated approach may experience many issues, like financial level, collection, abilities, discovery, etc. Those are the issues affecting the embedded approach.

- Optimization

Blockchains can be hanged for their high overhead burden. Cryptocurrency capacity rose in 2019 by more than 197 GB of storage (Marsalek et al., 2019). As IoT combines with Blockchains, the workload would be more significant than blockchains alone (Farahat et al., 2019).

- Warehouse

Blockchain technology can be processed on any IoT computer (Yu et al., 2018). Moreover, as time goes, this will boost its storage capacity, which will be a difficult challenge and would become a massive burden on all compatible devices (Ejaz & Anpalagan, 2019).

- Absence of expertise

Blockchains are an advancement that is well known by several research teams but to less ordinary citizens (Singh et al., 2020).

- Investigation

Blockchains is not essentially constructed for IoT system (Marsal-Llacuna, 2018). It is difficult for smart objects to explore applications in integrated networks (Lopes & Rodrigues, 2020). The IoT devices will then explore it (Caganova, et al., 2019).

- Confidentiality

The distributed ledger is transmitted to all smart objects. Such machines could see ledger transactions dynamically. Confidentiality is a challenge in the integrated solution (Mohanta et al., 2019).

- Interconnection

Blockchains can be public or private, or consortium kinds (Paul et al., 2018).

The compatibility among public and private blockchains is also an issue for the integrated approach (Noh & Kwon, 2019).

- Laws and government intervention

The integrated approach must operate internationally and thus requires a range of laws and regulations to apply this specific strategy.

Blockchains and Big Data for Smart Cities

Blockchain cities are an ambitious concept seeking to ease the challenges created by the fast expansion of urban development in the regions. Policymakers are supporting smart city projects focusing on sustainable growth and improving the standard of living for both citizens and businesses to solve the concerns. Connection and IT is the smarting of such technological solutions (Hashem et al., 2016). The concept of smart cities has attracted worldwide interest from governments, companies, researchers, and organizations. Stakeholder groups have been seeking to understand and explain urban development from multiple viewpoints. Ideas and definitions of smart cities are still emerging, although there is currently no clear and consistent understanding among the numerous parties of sustainable development (Batty, 2013). To integrate and analyze smart cities to practice, the inclusive concept of the smart city must also be established. Figure 3 shows the roles of Big data in smart cities.

Role of Blockchains and Big Data for urban development

The invention in Smart Cities has provided people the potential to reduce and address the scale of urban development issues (Ok & Yoo, 2017). Support services have become more advanced and knowledge-based during the last two decades, although there was an uncertain increase in the living of the people community and environmental sustainability. Cities' services, culture, transportation, entertainment, and other aspects are being closely connected to sustainable development, or the system has become a significant element of daily lives for people (Anthopoulos, 2017a). The multiple accomplishments of digitizing the city's data not only provide everyday accessibility for the society (Anthopoulos, 2017b).

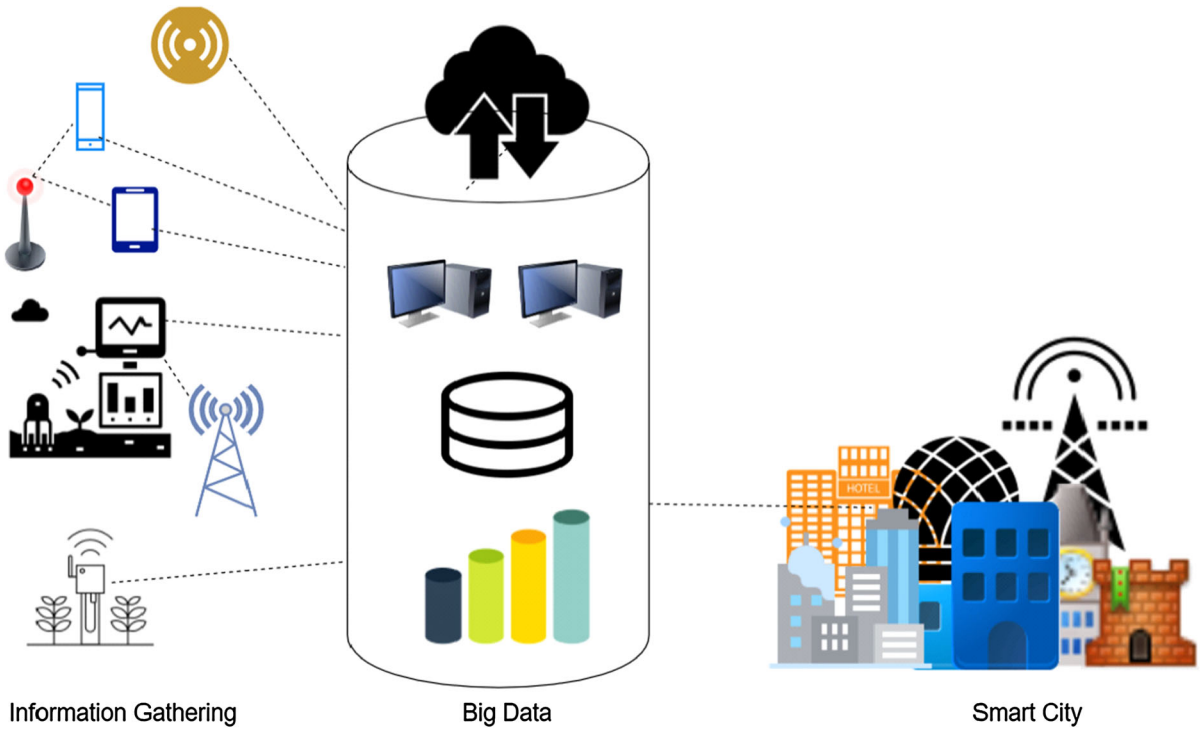

Fig. 3 Roles of big data in smart city

Effective urban development research has led to an appreciation of the technologies required to create a sustainable community (Thite, 2011). There seems to be a broad range of sustainable urban innovations throughout the studies due to the variety of thought proposed by different groups (Peris-Ortiz, et al., 2017). Several industrial placements were multidisciplinary innovations in energy-smart cities and enabled them to do so. A collection of innovative computer technology was widely shown in the smart city framework, involving cloud technology, machine learning, knowledge enhancement, IoT, and wireless networking.

Integrating the Big Data Analytics strategy is not as easy as the significant impact on the business. Throughout fact, so much research shows that the number of enterprises accomplishing measurable economic returns by big data analytics has been delayed by various viewpoints that have adopted big data analytics.Some different obstacles make it hard to take advantage of the possibilities provided by big data services.

The issue with big data analytics will be the instantaneous amount of information obtained. According to the International data corporation, the amount of data on multiple servers would be rising annually. These databases are assumed to store 175 zettabytes of digital information through the 2025 years. Big data analytics software must be ready to execute effectively if people want to prove the business impact. smart cities offer an opportunity to link people and things using new techniques to enable urban development (Yin, et al., 2015). Urban areas leverage technology to improve public services and people's living environment (Dos Santos, 2016). Municipalities use IoT systems, networks, and applications to gather relevant data, such as traffic, electricity use, and global warming. Technological approaches could use such knowledge to improve urban areas, including utilities, transportation, and essential services (Silva, et al., 2018). Figure 4 shows the Big data applications in smart cities (Quasim et al., 2021).

Developing communications innovations play an essential role in smart cities by providing knowledge collected through digital technology (Ahvenniemi et al., 2017). Big data operates by communicating with connected devices while transmitting the data to

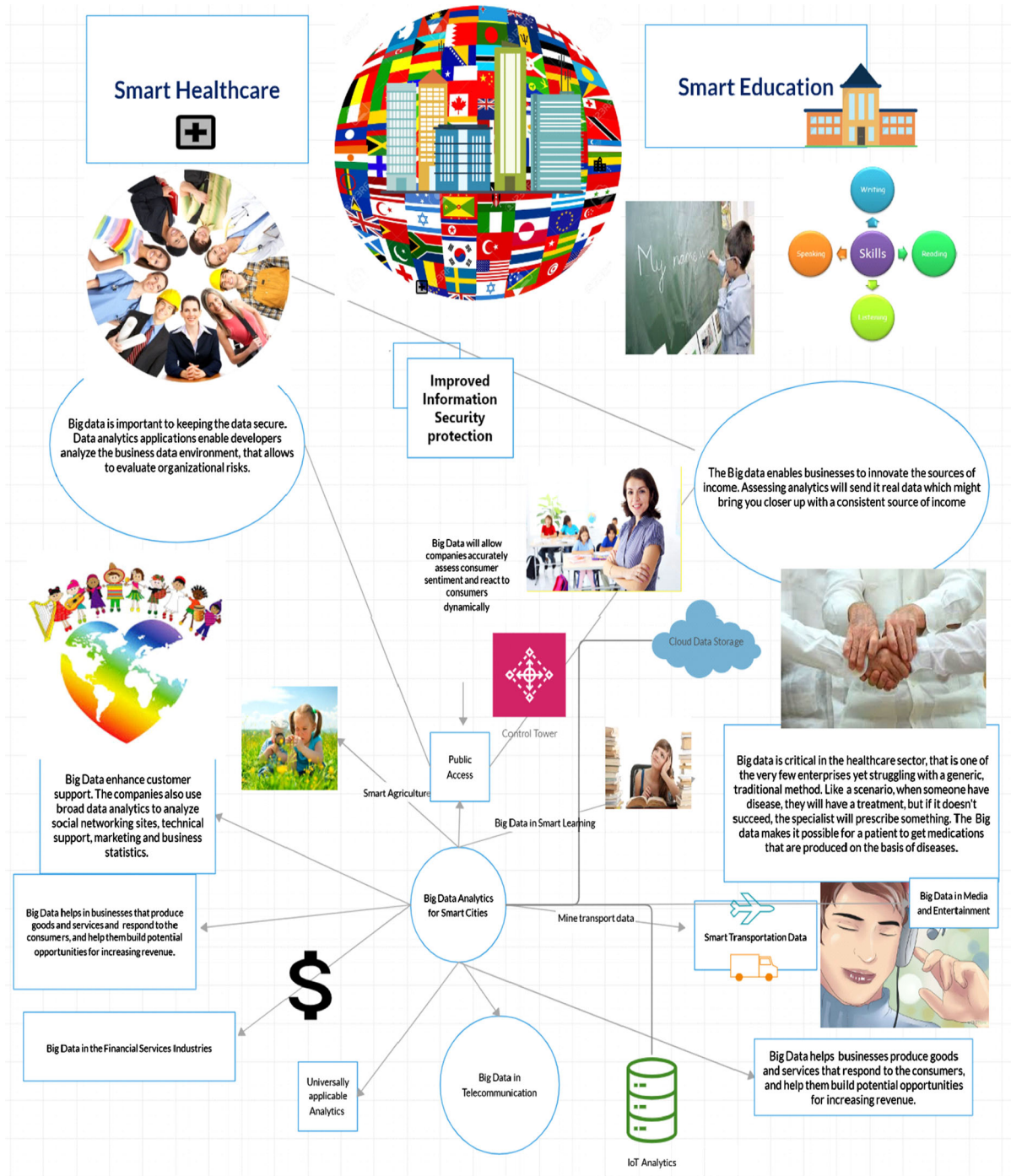

Fig. 4 Big data applications in smart cities

ensure the internet, mobile networks, and other forms of communication. Smart cities utilize IoT devices to easily capture and store data for deployment at a venue (Batty et al., 2012). Wireless infrastructure sensor nodes and smart gadgets are equipped with information from smart city nodes installed in an area and then analyzed for an effective decision-making strategy. Ensuring that people are safe has become the main

priority for every government and ensuring that people are safe in any scenario (Ismagilova et al., 2019). Throughout preventing problems within the region, analysis techniques can assess historical and regional data to identify where and when occurrences are probable to happen (Allwinkle & Cruickshank, 2011). A considerable growth rate might be the knowledge needed to turn the city into a whole happier place.

Big data analytics for smart cities

Massive data analysis is not the modern generation in the context of data processing and data mining techniques that have been used for years. Blockchain technology has grown dramatically over time to handle much larger sizes of information, perform queries more rapidly, and perform technically advanced experiments. Smart Cities are an urban area that allows multiple types of wireless sensing devices to collect data or use predictions from the dataset to efficiently implement funding, essential services (Deakin & Al Waer, 2011). Urbanites face multiple problems because of excessive residences, immigrants and refugees, and urban growth (Angelidou, 2015). Blockchain cities are futuristic projects to overcome some issues and problems (Piro et al., 2014). Efforts have been planned in smart cities to support people through information technologies (Hammi et al., 2017). People continue to have access to services wherever, including discussing neighborhood concerns (Trindade et al., 2017). Business analytics for Smart Cities brings several of the most innovative new advances to integrate predictive analytics. Systems across smart cities involve cloud services, emulation, knowledge collection for smart public transport condition assessment (John Paul et al., 2021), virtual simulation, and cyber-physical systems (Monzon, 2015). Business intelligence had been around for several businesses now know because if people gather the required data that passes via the activities, they could apply analytics and gain substantial benefits. But the new advantages offered by business intelligence are flexibility and effectiveness (Pellicer et al., 2013). Whereas a few years earlier a company might have gathered data, conducted analyzes, and learned knowledge that can be used for strategic strategy, the organization may now be using guidance for immediate decision-making (Aina, 2017). Getting the opportunity to work quickly and remain flexible offers businesses a strategic advantage they did not have throughout. It is divided into four kinds.

Concise analytics

Such techniques notify companies about what has happened. They generate general statements or models that show everything that has occurred at a specified moment. Its underdeveloped technical toolkits might be acceptable (Guller, 2015).

Data analysis diagnosis

Such approaches explain how it happened. More advanced than basic analytical methods, it also allows analysts to look into the details and define key problems for a specific situation (Tang et al., 2017).

Quantitative analytics

Among the most common Big Data analytics strategies currently useable, such methods utilize sophisticated technologies to decide what could happen early (Mikalef et al., 2019). These methodologies as well as enable the use of such device communication and computerization toolkits.

Legalistic analytics

Such a level of analytics, legalistic analytics, advises organizations about how to perform the task. Some of these approaches require fairly complex artificial intelligence features, and very few business models have valid capabilities (Mai, 2016).

Big data analytics advantages in smart cities

Big data advantages in smart cities are as follows.

Big data helps run a manufacturing plant when it doesn't have to adjust types of hardware-based on how many days or weeks they've been out on the project. This is costly and wasteful because various components split at different frequencies (Iqbal et al., 2020), (Okai et al., 2018). For example, when someone has the disease, they will have a treatment, but the specialist will prescribe something if it doesn't succeed.

Big data is critical in the healthcare sector, one of the very few enterprises yet struggling with a generic,

traditional method (Iqbal et al., 2020), (Okai et al., 2018). Like a scenario, when someone has the disease, they will have a treatment, but the specialist will prescribe something if it doesn't succeed. Big data makes it possible for a patient to get medications that are produced based on diseases.

- It would help businesses produce goods and services that respond to the consumers and help them build potential opportunities for increasing revenue (Angelidou, 2015) (Angelidou, 2017).
- It can enhance customer support. The companies also use broad data analytics to analyze social networking sites, technical support, marketing, and business statistics (Bolívar, 2015).
- This will enable organizations to evaluate consumer confidence correctly as well as respond rapidly to end-users.
- Enhanced data security might be another critical area for business intelligence. Access control produces an extraordinary quantity of consumer data (Cheng et al., 2017). By applying broad-based big data solutions for this data, businesses have also been able to identify and avoid cyber-attacks that could have occurred recently.
- Big data is essential to maintain information safety (Lamsfus et al., 2015). Big data tools allow creators to analyze the existing information model that enables the assessment of risk analysis. For example, users must understand whether or not sensitive information is affected. An even more classic example seems to be that users must be able to search for a 16-digit address or processing details (that might be transaction information) (Baig et al., 2017), (Pettit et al., 2018), (Kummitha, 2019).
- Big data helps businesses to grow on their revenue sources (Brohi et al., 2018). Analyzing metrics can give users basic information that could get them nearer to a stable source of funding.

Trends of Big Data Analytics in Smart Cities

Trends of big data analytics in smart cities are as follows.

Publicly accessible

As Big Data Analytics increases its reputation, the attention is on unrestricted-source strategies that help to promote and analyze knowledge. Respondents are servers such as Hadoop, Spark, and NoSQL. Usually, advanced approaches are often incorporating or promoting contemporary open-source techniques. Throughout the years ahead, it seemed unlikely to change.

Businesses strategy

Moreover, some general-purpose Big Data Analytics applications have entered the business sector, anticipating something more, concentrating on specific business sectors, such as defense, advertising, CRM, system success improvement, and recruitment. Big data services are now implemented at a growing pace into existing business systems.

Machine Intelligence and Learning

Although interest in machine learning has increased, companies have rushed to incorporate machine learning and predictive technology into big data mechanisms. According to Gartner, any emerging technology service, particularly big data analytics, will incorporate the evolution of machine learning through the 2020 end. By 2022, upwards of half of the latest major enterprise systems will incorporate applied knowledge using real-time contextual information to improve decision-making.3.4.4 Widely applicable Analytics.

Part of the move to intelligent machines allows companies to become more interested in widely acceptable big data analytics. Regarded as maybe the biggest type of big data analytics, these approaches will not only be required to determine the potential, however, may also be able to recommend behavior that might produce positive outcomes for organizations. Even so, for some types of technology to become successful, businesses would need to move forward on application development.

Reorientation decision-making process

As big data succeeds and is a function of business sizes in empirical systems, it is not too dissatisfied unless

the human element is momentarily overlooked until it moves to high demand. As Big Data Analytics has become widely known, it would be more like many major developments. Big Data Analysis has been a new methodology.

Big data applications for smart cities

Smart Cities and Big Data applications can be grouped into connectionless Big Data applications and connection-oriented Big Data applications. Connection-oriented Big Data applications are unique. They rely on individual attention and quick assessment to make a good decision or interference within a short period and are very accurate. In some situations, whenever a suggestion could not have been attained within that time, this becomes irrelevant. Immediately available so that the process is carried out in such an efficient and reliable way. As a result, large information applications in real-time usually need further processing. Figure 5 shows the smart education using Blockchains in smart cities.

In smart learning

Data mining throughout the educational sector offers outstanding opportunities for organizations like m-learning, teaching methods, enhancing the assessments, providing career planning to educators, and implementing a new educational system. Since the value of Big Data in learning, institutions may track educational outcomes, including a variety of subjects for learners and international standards, and develop tailored approaches to allows students to progress (Hammad & Ludlow, 2016). Reviewing student grades in various subjects could help guide learners more effectively, and the training plans can be implemented accordingly. Educators will also understand the causes and consequences of educational outcomes and establish positive strategies for big data. Several educators could only learn through listening, and a lot of educators can know by comprehension. Although many learners can understand through watch videos, while some can use specific other strategies. Interestingly, many students must adhere to a paradigm that may be contrary to their learning techniques, which prohibits growth. This may also have a significant impact on the student's learning performance.

In smart healthcare

Big data in healthcare services would be a perfect match for it. It helps the healthcare system better than ever previously. The amount of information that the healthcare industry needs to contend with will be incredible. Those days have passed where health professionals could not consider taking the opportunity of this knowledge (Pramanik et al., 2017). With finding a cure for diseases, Big Data has put all under

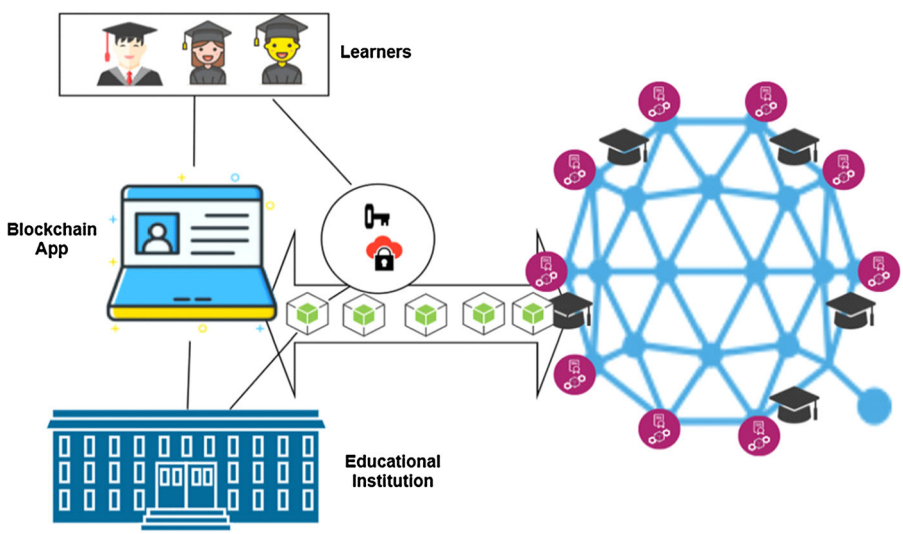

Fig. 5 Smart education using blockchains

its umbrella, and authorities have seen many life-saving consequences. Integrated wearable technologies have recently started to gain popularity, with emerging developments spanning individuals throughout all age groups. This generates large amounts of real-time data in the form of alerts that aim to save people's lives.

In smart tourism

Big data will benefit people in the tourism industry in several ways, allowing us to make better evidence-driven decisions. This makes it possible to accurately anticipate future behaviors, optimize business strategies, offer knowledge more precisely, and increase service quality (Xiang & Fesenmaier, 2017). Urban areas will have a lot of experience that could transform the future of visitors. Although even having information doesn't have to be trained to do that effectively. Urban areas and transportation visitors will need access to opportunities that would enable them to draw enforceable assumptions. Many of these results will encourage themselves to help not only visitors but also locals.

In a smart retail economy

Digital innovations have also become a catalyst for economic and social development. Green technology, inventions, and communication channels have significantly improved the economy, the financial sector, and people in recent economic upturns. Currently, it's not true. A new economic structure of the digital age is now the foundation of trading activities. Humans are beginning to witness the advent of a new age of information. A new smart environment has an unprecedented impact, both incredible and satisfactory. The retail industry is experiencing intense competition among all. Distributors are constantly searching for ways that give the business a good reputation against someone. Customers have, in fact, only been the real winners of experiences for the retail industry. Possible for retailers to thrive in this challenging market, distributors need to study and understand new customers. They look better as people learn the needs of their customers or how to help fulfill those standards (Bradlow et al., 2017).

In media and entertainment

Blockchain technology in the entertainment industry also enables enterprises to acquire sensitive data across customer interaction and enhance personalized ads. Information technology also holds the key to creating media and entertainment companies' further success. Digital and media companies will use vital information to measure user details, products, and required devices. As a result of the analysis of customer knowledge, technological improvements have become more profitable and appropriate. Humans will never know that the features consumers want and need to provide when they don't look at the specifics could significantly benefit them (Schlieski & Johnson, 2012).

In telecommunication

Telecom companies collect large amounts of data through name records, cell phone usage, network services, log documents, billing, and social media. They offer a wealth of knowledge about their customers and networks and how telecom companies can use this knowledge to improve their business. Business intelligence companies will be able to track places with low and high data traffic density. However, they will often be able to do whatever is done to maintain trouble-free internet connectivity. Information technology, and other industries, have made it possible for the telecom sector to identify its customers as highly successful. Big data will be motivating the technological revolution that we're now experiencing. Integrated communications technologies are at the center of the digital process taking place all over the world. In the ever-increasing growth of smartphones, the telephony business was overcome by a massive amount of data. Companies can provide customers with seamless connectivity through Big Data Analytics approaches, thus eliminating all the network barriers people face (Wang et al., 2017).

In automobile industries

Data analytics has now focused their attention on, although they are entirely responsible for leading the automotive industry. Not only is the concept of smart technology limited to digital equipment, but it is also at the core of automotive production. In addition to the

IT business, the automotive industry has gained the most from Big data analytics. It is a potential for automated driving to keep the streets safer, as 90% of the number of accidents is due to the driver's mistake. To be valid, those cars need details. Automobiles are fully equipped with sensors that track anything, like a place, speed, motion and directing, traffic signals, traffic warnings, and road alerts (Lv, 2019), (Onesimu et al., 2021).

In financial services industries

Financial firms will be the first to adopt Big Data analytics. Advances in computing technology and reduced costs are slowly making significant data activities socially and economically achievable. The usability highly depends on its data, and preserving the data is one of the most complex things affecting any financial organization. Data is the second biggest tool behind financial resources for all. Big Data is responsible for key aspects of financial firms, involving avoidance of fraud, controlling risks, predictive arbitration, and procedure and help (Fang & Zhang, 2016). Figure 6 shows the Blockchain, IoT, and Big Data together.

In smart education

Blockchain technology is useful when the information has to be exchanged by multiple parties without trust (Sharma et al., 2018). The blockchain is a way of transmitting information in a fully autonomous and secure environment, as forgery is practically unlikely (Treiblmaier et al., 2020). The blockchains are a time-stamped series of an unalterable data ledger intended by a network of computing networks not run through a specific individual (Dustdar et al., 2017). The blockchain is distributed, so everyone must consider any modifications to handle the blockchain (Chakrabarty & Engels, 2016). The most significant accomplishment of this analysis was the development of a learning network framework for interaction on the Internet utilizing blockchains and IoT (Ijaz et al., 2016). The system is especially relevant for devices when data is routinely transmitted to devices connected to the internet connection. In contrast, it uses a retransmit approach, customizable packet size, or congested traffic to boost the system architecture. The integrated system can be designed to communicate securely among IoT devices.

Blockchains in IoT offer a framework for accessing secure information records through IoT devices. The transaction can be tracked or checked by anyone confirmed to communicate across the IoT network. The integration can boost secure communication the following are the key benefits of the integration approach:

1. Establishing trust among public IoT nodes or mitigating the risk of injury.
2. Minimizing travel expenses by direct interaction without third-party companies.
3. To accelerate real-time transactions.

Many smart contracts are published in the accepted Blockchain database via imaging services, mediators, or fog owners. IoT nodes discover smart contacts from inside the approved Blockchain database. The approved Blockchain database generates a token for IoT smart app. The smart device demands the codes in the middleware from the public key and guides the request message. The main system receives the token from an approved blockchain database or generates a token for each smart device and system response. These IoT nodes can be participants, educators, employers, administrators, or representatives of the accreditation system.

Big data challenges in smart cities

The information security professionals demand has risen with big data analytics. The following are the main issues that have been identified.

- Speedy data production
- Data that tend to evolve at a higher pace allows it a difficult challenge to obtain observations. Every moment, higher and higher data is acquired from which important and useful data must be gathered for further consideration.

Capacity

Large volumes of data are a problem for companies to obtain and manage without good software solutions.

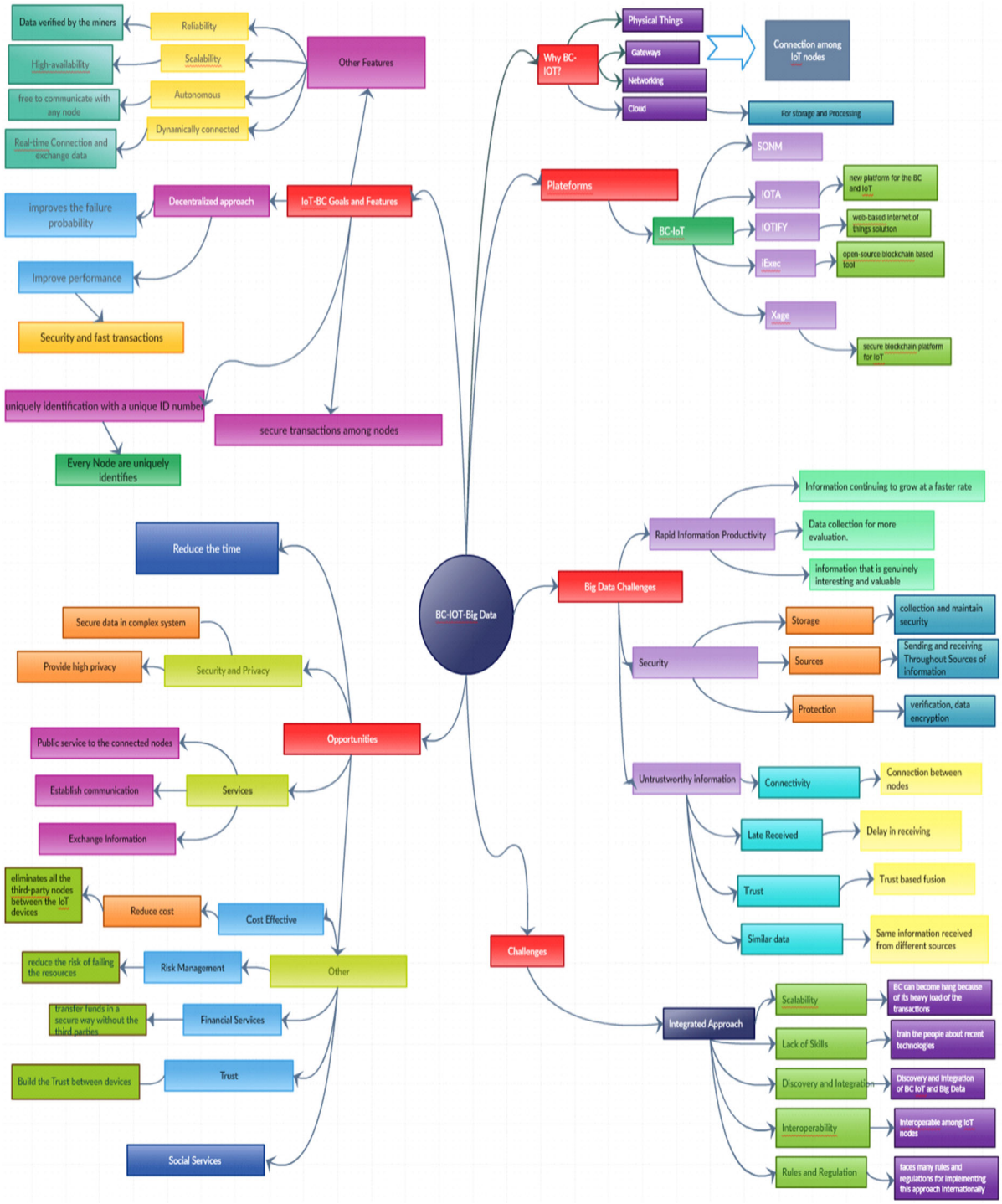

Fig. 6 Blockchain, IoT, and big data together

Transmitting across communication channels

This means that the information provided by one source may not be changed because the company generates data from multiple sources, in particular by analyzing the outcomes to another source.

Safety

Large volumes of data in businesses can potentially become the target of complex persistent actions. However, there is more difficult for businesses to consider information secure by adequate authentication, data encryption, etc.

Unreliable data

No one could avoid the fact that big data can never be 100% accurate. It may lead to incorrect or unreliable content and discrepancies.

Case Study of First Blockchain City, Dubai

Dubai targets to become the first city to be entirely driven by blockchains (Singh, 2015). The procedure, including its approves of residence permits, money transfers, and license renewals, generates over 100 million papers per year—so many of them would be electronically accessed on the blockchains by this - year (Al Hasani, 2019). Moving entirely digital would save USD 1.5 billion in operating expenses annually, decrease Carbon dioxide emissions through 114 MTons, and remove unnecessary business activities through 25 million hours (Smart Dubai, 2021). The first blockchain city (Dubai) is shown in Fig. 7.

The Blockchain Project for Dubai would support the fulfillment of the dream of Sheik Mohammed bin Rashid Al Maktoum to be the first city entirely operated by Blockchain by 2021. It will make Dubai the happiest city in the world. Three core foundations of governance, business development, and foreign competition are included in the Plan.

There is a significant attempt to break down the amount of paperwork that is using currently. It may be an expressive potential overvalued by others. The digital office's dream is over two decades older-blockchain could be doing it today (Badran, 2019).

The blockchains expert named ConsenSys, contributing towards the creation of Ethereum-enabled applications for manufacturing and service industries. Blockchains policy from Dubai persuaded the company to establish head offices inside this area. "an effect of flashing the banner has been massive, Grabski says." Often many groups came to Dubai – people enthusiastic regarding blockchain – and started speaking to one another. This was a significant factor that is difficult to overestimate.

Blockchain-enabled opportunities in Dubai

The government of Dubai strongly believed that blockchains could enable hundreds of novel business possibilities. Commercial property, financial services, health system, transports, power, manufacturing, and tourist industry are also some of the industry sectors required to advantage (Khan et al., 2017), (Efthymiopoulos, 2016), (Al-Azzawi, 2019), (Bishr, 2019) and (Kaur & Maheshwari, 2016). Through its implementation, Blockchain is standardized. One other feature that differs from the acceleration of deployment is the position of comprehension. Since May 2020, IBM has collaborated with multiple government agencies to launch the Dubai Blockchain Business database Framework. It's a first of this kind consolidated business ledger that would make it much easier to manage and do business in Dubai city (Abbara, 2017), (Khan et al., 2020), (Farsi et al., 2020). This will simplify the process of establishing and starting a new business in Dubai.

Dubai blockchain strategy (DBS)

DBS was launched by the partnership between both the Smart Dubai Office (SDO) and the Dubai Future Foundation (DFF) to continuously discover and analyze the advanced technological developments that provide an ability to achieve extra efficient, stable, productive, and influential city environments (Picioroagă et al., 2018). Blockchains are a modern, efficient way that most shapes the Internet's infrastructure through quick, effective, and reliable exchanges (Mohasses, 2019). DBS will help Dubai accomplish His excellency Sheik Mohammed bin Rashid Al Maktoum's dream of building Dubai's strategy and making Dubai the happiest place in the world (Sahib, 2020). DBS will unlock the door to

Fig. 7 The first blockchain city (Dubai)

business opportunities with all sections of the economy and enhance Dubai's status as a leading global leader, following Smart Dubai's mission to be a top country in the smart nation, energy innovation, and international standing (Dassani et al., 2015), (Zakzak & Salem, 2019), (Dubai, 2016), (Khan et al., 2019).

SDO is working on "Uses of Blockchain"

SDO is responsible for promoting the digital transition of Dubai, has also aimed to create a range of Blockchain applications throughout various areas. SDO said it has partnered with government and private organizations to build scenarios to incorporate the new technologies within Dubai city. SDO noted that the DBS contributed to the release of use cases, the Blockchain Collaborative Forum, and the Dubai Blockchains Plan. Institutions and government agencies have collaborated on use cases in eight areas, like financial, educational, real estate, the tourist industry, infrastructure development, healthcare, transport, and defense (Nam et al., 2019), (Breslow, 2020). Throughout a discussion to address developing Dubai as the global city of Blockchain advancement, SDO said that the Blockchain policy plays a vital role in convincing the world's economic start-ups like Atlas Group to support the Dubai Block Expo and World Blockchain Summit 2020. Atlas Capital is interested in building a Blockchain Hub as part of the Dubai Expo 2020 project.

The vision of Dubai the happiest city in the world

The continued growth of Dubai in several economic markets indicated that conventional mechanisms had to be consistently revised to improve productivity and quality. Financial performance has become crucially important, particularly in Government to Consumers (G2C) and Government to Government (G2G) facilities. The Smart Cities Global Networks (SCGN) is a worldwide partnership of smart-cities stakeholders that links cities and provides a regional forum to exchange opinions, perspectives, and proposals on the appropriate strategies for developing sustainable futuristic cities. Data first increases information enforcement with Dubai Data First increases information enforcement more with the Dubai Data Act and enables supporting organizations to promote a sustainable competitive imagination. Facilitate the communication of the latest technological ecosystems and provide a way to highlight emerging trends. Monitor participation matrices are for the events operated by Smart Dubai Information. It can cooperate with data demands. The parties to strengthen cooperation among the government companies to comply with all data demands. It promotes inter-functional collaborations among government bodies. The faster development and growth power of technology along a variety of industries is fascinating. However, there is an essential need for a comprehensive and accessible dialogue on AI ethics and the values organizations use such innovation to follow.

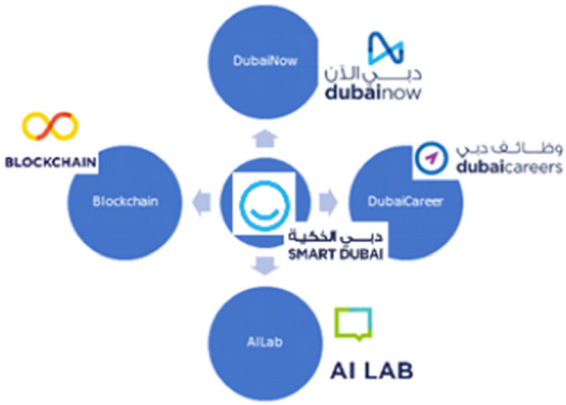

Fig. 8 Smart Dubai

Start-ups

SDO and the collaborators throughout the emirates administration are willing to commit to turning Dubai into a unique testing ground for start-ups and designers to develop and expand technological innovations. They successfully implemented and started running a variety of services in the last two years.

The International Blockchain Problem

For the last two years, SDO has organized the World Blockchain Competition, welcoming Blockchain developers worldwide to introduce their new blockchain technologies that could be applied in Dubai, UAE. In the last competition, 17 candidates were nominated and confirmed as the three top winners at the Future Blockchain Summit on 3rd May 2018.

The Dubai smart city ignition

Dubai Smart City ignition is a pioneering start-up funding visionary firm in Blockchain and communication, Digital technology and Mobility, Artificial Intelligence, IoT, digital cities Information, intelligent buildings and Working, Smart Society, and Smart Retailing.

Dubai Future Accelerators

Dubai Future Accelerators (DFA) is an ambitious two monthly initiative connecting the world's most advanced new technologies firms across highly influential government entities to build visionary ideas. SDO has integrated the DFA group, focusing on using new technology like a public ledger, Artificial Intelligence, Machine Learning, and the IoT.

Happiness Agenda

Researchers are working to make Dubai the happiest city in the world. When they shape the future of Dubai via advanced technologies and innovative thinking, they have prioritized happiness as their main target. Through achieving the basic desires of their citizens and tourists, they will maximize everyone's short-and long-term satisfaction and well-being and build standards for specific communities to pursue their path. Smart Dubai's strategy has a goal of happiness at its foundation. However, the city is altered by adopting the Happiness Project as a one-of-a-kind, empirical and systemic method to boost and maintain happiness and evaluate its effect on citizens and tourists. The aim is to discover people's feelings and desires, promote social improvement, improve understanding and promote self-reflection, and measure the effect of happiness using the city-wide Happiness Index tool.

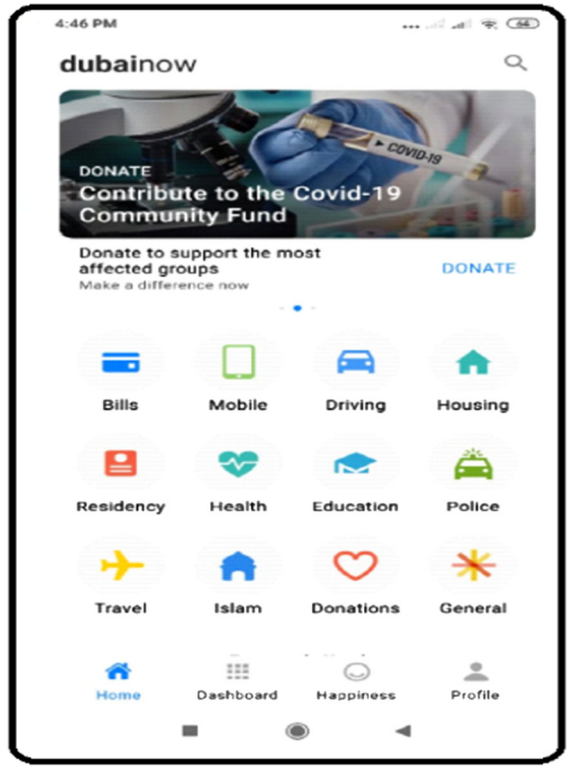

Fig. 9 DubaiNow app

Winners constitute a significant element of such an interconnected solution to broadcast happiness across all city areas to accomplish happiness. Contributing to the effectiveness of the Happiness strategy, people collaborate as representatives and a wide variety of governmental and non-governmental organizations, integrating happiness in the Genetic material of those organizations. The main goal is to build a pleasant, happy impression for everyone, consistent, secure, personalized, productive, and successful (Happiness Agenda, 2021).

Paperless

The aim is to build a paperless digital future city. Throughout 2021, the Dubai government would be fully paper-free, minimizing over 1 billion papers used in government transactions annually. Based within government departments, the integrated architecture represents this big step in building Dubai a smart city of the future and enhancing the level of happiness for both workers and people and save time, resources, and the culture. Reducing the 1 billion papers used by the public sector annually may save so much money to feed 4 million people, help protect 130,000 trees, and save 40 h of productive output (Dubai Paperless Strategy, 2021).

Smart Dubai

Smart Dubai is suitable for a variety of innovative innovation-backed technologies that drive the daily life of tourists and citizens. It includes DubaiNow, SmartEmployee, Rashid, DubaiPulse, DubaiCareers, HappinessMeter, and several other applications. Figure 8 shows the Smart Dubai.

DubaiNow app

Install the DubaiNow app to connect more than 120 public facilities from more than 30 government and corporate agencies in Dubai city. Through this app, pay the fees, pay the traffic violations, pay Salik and Nol, register car insurance, request a residence, and so on. Public services make everything from the ease of the home simple and quick (DubaiNow App, 2020). Figure 9 shows the screenshot of the DubaiNow App.

Fig. 10 DubaiCareer app

Blockchain in smart Dubai

Dubai does have a strong history of pioneering in the world's information technology. Today, Dubai would be leading modern technologies for communities for the first time and sharing online. Dubai would be the first country driven by the blockchain, shaping the financial sector if it works. Accepting Blockchains, Dubai is set to acquire 1.5 billion dollars of savings annually in data collection lonely. DBS sets out a development plan for the emergence of blockchains for Dubai and an online system for technology sharing with cities around the world. DBS is based on three key elements with government effectiveness, business emergence, and global strategic vision.

DubaiCareers app

Dubai Careers is an ambitious, integrated work platform that helps job seekers worldwide view thousands of openings in Dubai public bodies – corporate industry positions are short to be listed.

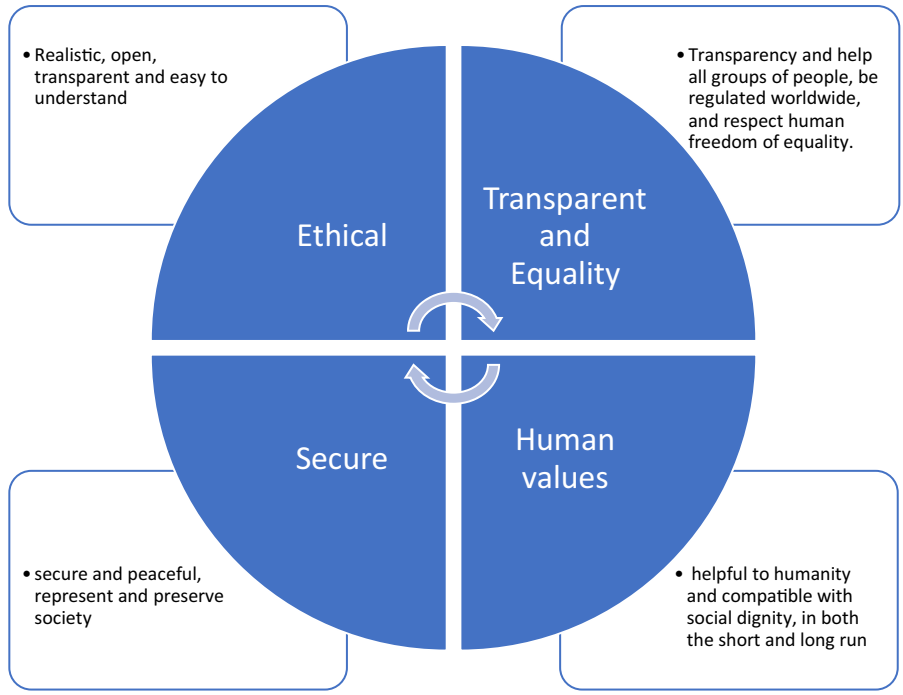

Fig. 11 Roles of AI

Produced by Smart Dubai to help companies interact with qualified people through such a smart-match mechanism that links applicants to perfectly match vacancies across a grading process (DubaiCareer, 2021). Figure 10 shows the screenshot of the DubaiCareer App.

- simply sign
- Suggest a family member or a relative
- viewing the chosen job through social media networks
- Visiting video conferences through smart devices
- Allow Arabic to look for a position—first career platform to allow languages.
- Create job openings and connect them directly to the application.

Artificial Intelligence Lab (AI Lab)

The Dubai Ethical AI toolbox is also developed to offer support and guidance around the city's environment. This helps businesses, academics, and persons to consider that Artificial intelligence could be used professionally. This includes standards and practices and a self-assessment method for builders to test each service. The objective is to provide consistent guidance that maintains the brand in cooperation with the societies. The ultimate aim is to achieve a broad consensus and implement widely accepted regulations to educate the appropriate usage of Artificial intelligence in Dubai and throughout the globe. The goal is for Dubai to succeed in producing and using artificial intelligence in ways that foster creativity and offer social benefits and satisfaction (AI Lab, 2021). Figure 11 shows the roles of AI lab.

Ethical principles Artificial intelligence must be realistic, open, transparent, and easy to understand.

Safety Artificial intelligence must be secure and peaceful and represent and preserve society.

Human value Artificial intelligence must be helpful to humanity and compatible with social dignity in both the short and long run.

Internationalism artificial intelligence would also help all groups be regulated worldwide and respect human freedom of equality.

Conclusion

Blockchains are not only the foundation of the Bitcoin cryptocurrency. The framework of validation and secured transaction on the network aims to revolutionize the administration of smart cities with Blockchain-based Cities, an effort to organize, combine and monitor various public services with accountability, reliability, and security. While Dubai achieves towards adopting blockchains with all economic sectors by 2021, it would improve efficiency, usability, privacy, and visibility. And placed it through perspective, the typical contract would include a lot of documents of paper. Blockchain would remove all this and substitute it with smart contracts technology. Dubai not only boosts the digital financial sector but will also preserve the natural atmosphere from waste materials.

Declaration

Conflicts of interest The author is declared that there is no conflicts of interest.

Research involving Human Participants and/or Animals Not applicable.

Informed consent Not applicable.

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