

A Review of Internet of Things from Indian Perspective



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Abstract Internet of things (IoT) refers to the technology of interconnected devices communicating among themselves with the help of the internet. Internet of Things has created a buzz all around the world. When we talk about India in particular, the masses lack the basic knowledge of IoT and it may take a while for them to get used to the idea of the emerging technology. Knowledge of IoT needs to be spread among the masses in India, so that IoT can expand in India. India has created its IoT policy aiming to occupy 5–6% of global market. In this paper, we have discussed about the government policies regarding IoT, opportunities, challenges, and applications developed in this sector. The paper intends to provide a detailed review of the development of IoT in India and the challenges involved.

Keywords IoT · M2M · Smart city · Smart agriculture

1 Introduction

1.1 A Subsection Sample

Internet of Things (IoT) can be described in some basic terms as an interconnection of things which are connected to each other using the internet. The idea behind this is to connect the things, so that they can exchange information and communicate among each other using certain information exchanging devices, and the internet. It attains the objective of intelligent recognizing, finding, tracing, monitoring, and

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K. Ray et al. (eds.), *Engineering Vibration, Communication and Information Processing*, Lecture Notes in Electrical Engineering 478,
https://doi.org/10.1007/978-981-13-1642-5_55

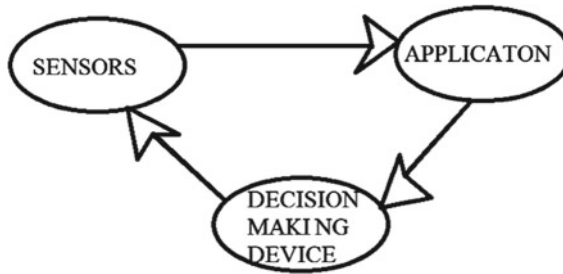


Fig. 1 Stages of IoT

dealing things [1]. The growth of IoT industry has helped in bringing the physical world and the computer-based systems close to each other. With the advancement of the VLSI technology and decreasing size of transistors present on a single chip of a microcontroller, the IoT paves its way towards its growth in the industry. There is a fine difference between IoT and the internet. As the name suggests the internet is a part of the Internet of things while IoT is the extension of the primary Internet [2].

The basic difference between the indigenous Internet and the internet of things is, that the internet of things does not just restricts the connectivity between computers, tablets, and smartphones but also connects multiplicity of sensors and actuators. India is still fighting ways to accept IoT [3].

Currently, India has an IoT industry making revenue of \$130 million annually and there are 400 companies currently working in the IoT sector. India has been estimated to touch \$15 billion in the IoT industry by 2020. The rate at which the tech-savvy consumers are increasing, it is not a dream difficult to achieve. In this paper, we discuss about the opportunity, status and capability of Internet of Things in India in Sect. 2. In Sect. 3, we have discussed Internet of Things in India. In Sect. 4, typical applications of IoT in India. In Sect. 5, challenges of Internet of Things in India, and in the last Sect. 6, we have given the conclusion (Fig. 1).

2 Opportunity, Status, and Capability of IoT in India

The opportunity, status, and capability of Internet of Things in India are discussed as follows.

2.1 Opportunity of IoT in India

Internet of Things is not a new concept but it is an extension of the old concepts along with the addition of new technologies. IoT can create huge opportunities in India.

It can provide ways that can reduce the work load of people by assigning certain specific tasks to mobile phones that can control a device over cloud and check their status. For example, a refrigerator that can inform the owner that it has run out of vegetables by sending a text message on the mobile phone.

IoT will also ensure increase in productivity and optimal utilization of resources and time. IoT can define a fine interaction between the physical and the virtual world by making them reliable so that the interaction becomes smooth and errorless. The development of many intelligent devices will generate a grid that will help the supply chains to interconnect in a better way [4].

India has an IoT policy document that enlists the IoT policy that India needs to adopt in order to compete in the race of digitization. Trillions of sensors work with billions of intelligent systems, which involve millions of applications attracting millions of consumers giving the direction to business. In the coming years, the digital highway will be analogous to water [5].

The Indian Government plans to achieve the establishment of 100 smart cities in the near future which will create many opportunities for the IT developers working in this field. The demonetization in the recent past with the aim of making India digitized in transactions is the first step towards the upliftment of IoT industry in India.

2.2 Status of IoT

IoT is going to create a new wave in the country and it has its use in every sector ranging from manufacturing, agriculture, electronics of daily use to home appliances, etc. India currently faces most of the socioeconomic challenges and lacks proper infrastructure for the development of IoT. By 2011, the count of devices connected by Internet (12.5 billion) has exceeded the count of human beings (7 billion) on the earth [3]. The Telecom sector of India accounts for 36% of the total revenue of the IoT industry. The electronics sectors accounts for 29% and the oil sector accounts for 23% of it. Hence, India owes 88% of the revenue to all of these industries mentioned above [6]. In India, there are professionals who have been working in this field since 8 years. Every year, a large number of fresh professionals are added to the IoT industry which contributes to its development. The companies like Tata in India have started to track the status and the apparent life of the truck with the help of sensors. There is scope for IoT in the insurance sector as well. The only problem that India needs to deal with is the internet, which is not a common phenomenon in India. The people in the rural areas still find it hard to handle and work with smart phones.

2.3 Capability of IoT

Internet of Things is relatively a new phenomenon for the Indians. IoT can be used to safeguard the data from the attack by the hackers. The IoT aims at providing smart cities, smart automobiles, and smart architectures and much more which is discussed later. There is so much that the IT-BPM companies need to do in order to compete with the world class companies like Google, Microsoft, and Apple Inc., etc. The current IT-BPM companies of India are working under the TCSs IoT center of excellence while collaborating with Intel, and taking up research initiatives on IoT under Infosys Laboratories and HCLs IoT incubation center with Microsoft. The Indian IT-BPM need to boast themselves up and move forward from just being mere partners with the global companies that work in the field of IoT [7].

3 India and IoT

The growth, building blocks, and the R&D plans of IoT in India have been discussed below.

3.1 Growth of IoT in India

The Indian Government aims at developing 100 smart cities in future and had allocated Rs. 7,060 crores in the Union Budget of 2014 for the massive expansion of IoT industry in the country. The introduction of the Digital India Program by the Government which aims at making the country digitized will also help in the progress of IoT industry in India. The Department of Electronics and Information Technology (DeitY) born from the Ministry of Communication and Information Technology makes it a separate government entity working in the expansion of IoT.

The DeitY intention is to transform India into a digitally vested society and knowledge economy [8]. The three key areas which come under the Digital India vision are as follows:

1. Digital Infrastructure as a Utility to Every Citizen—some of the key aspects of this vision are making high speed Internet, which is the most important requirement, private, and shareable space over public cloud space, ensuring the cybersecurity and enabling participation of people in financial space [8]
2. Governance and Services on Demand—some of the key aspects of this vision are making transactions digital and fast, services transformed digitally to ensure fast governance and easy business, real-time availability of services from platforms like mobile and online [8]
3. Digital Empowerment of Citizens—some of the key aspects of this vision are ensuring digital literacy and easy access of digital resources, the digital conve-

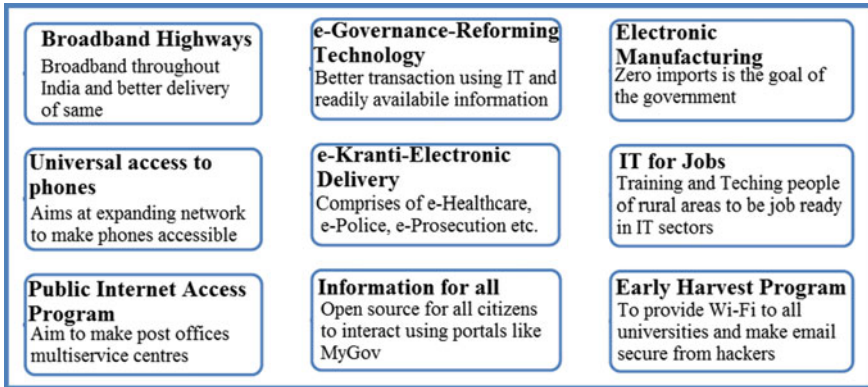


Fig. 2 Components of digital India [8]

nience of certificates and documents, availability of digital services in Indian languages, and readiness of entitlements through cloud [8] (Fig. 2).

The Ministry of Electronics and Information Technology (MeitYs) vision is to develop connected and smart IoT based system for our country’s economic, social, environmental and global needs [9]. The ministry also released a policy called the IoT policy which was revised in the year 2015. According to the policy, the key participants of the IoT enterprise will be the Citizens, the Government, and the Industry. Active participation of each of the enterprises will be required for the overall development of the IoT industry. There are some of the basic aspects of the MeitY that it needs to focus on in order to build a strong IoT environment in India.

The MeitY outlines some of the objectives which are listed below:

1. To create IoT Industry in the country of USD 15 billion by 2020. The connected devices will increase from 200 million to 2.7 billion by 2020. Assumption is that India will share 5–6% of the global IoT industry [9].
2. IoT specific skill set needs to be undertaken to attract global as well as national markets [9].
3. To start R&D for all the technologies required to give impetus to IoT [9].
4. To cultivate products for the IoT market that would be specifically for India [9].

3.2 Building Blocks of IoT

Here, are a few building blocks of IoT that lays the basic foundation of IoT in any network in any kind of environment (Fig. 3).

The building blocks mentioned above can be summed up in a nutshell as a step towards the betterment of IoT status in India. These blocks when used properly can

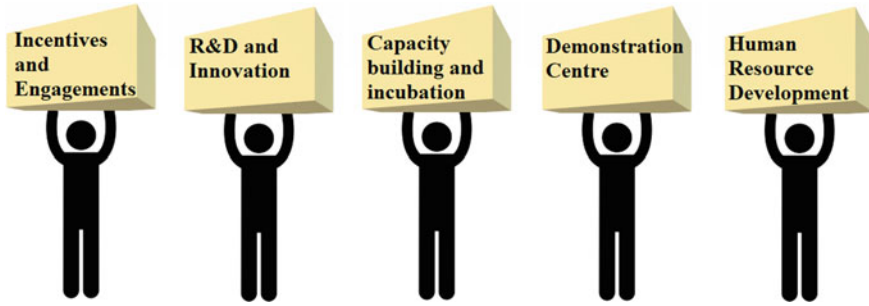


Fig. 3 Building blocks of IoT

be a great way to enhance the IoT quality and create a huge market for the same in the country.

3.3 *R&D Plans*

Government's IoT policy has enlisted some of the points for the development of R&D plans in the field of IoT and to fund them.

IIRC scheme has been initiated by the DeitY. Under the IIRC (International IoT Research Collaboration) scheme of the government, it will pledge agreements with other countries to invite projects for R&D. IIRC scheme will fund the IoT industry in the form of loans and will contribute 50% of the total cost. The organization appointed for the project will handle the whole process from starting till the end.

The main objectives of this plan are:

1. To create labs that would give impetus to R&D plans.
2. To recognize the R&D members in every field which aim at developing IoT.
3. To pledgee cloud-based source in order to help in the work of R&D.

This scheme came into picture with the objective of attracting investments from private sectors and has international partners. India needs to join hands with the international partners to ensure fast growth in this direction and for the betterment of the scheme.

In the light of growth of IoT industry in India, many startups have taken up the onus of ensuring proper development. Some of them are:

CARIQ: SMART DRIVING—It specializes in recording both mileage and speed, and also the driving pattern of the car.

SENSEGIZ—This sensor can be hooked to the thing that the owner is most likely to miss and using it can forget about losing it.

ENTRIB SHOPWORX—This makes the floor of a manufacturing industry smarter by giving a view about the manufacturing machines.

Table 1 Application of IoT

Fields	Typical applications
Smart water	It includes checking the quality of water in public places and timely check of the rise of the water level [11]
Smart environment	Projects aiming at raising alarms when the CO ₂ level exceeds a certain value and raise alarms about seismic tremors [12]
Smart health	It is a smart network between the doctor and the patients [13]
Smart waste management	To setup project that would help in the “SWACH BHARAT” initiative [14]
Smart safety	Projects to build wearables that can ensure safety of people [15]
Smart logistics and supply chain	Ensuring timely availability of ambulance in case of emergency, and reduce in food wastage [16]
Smart manufacturing and industrial IoT	Its objective is to timely check the equipment in order to prevent leakages of any form and prevent from fire and gas leakages [17]

TEEWE—A USB device which one connected to the any device like laptop and smart phone can make it a remote control of the Television.

LIFE PLOT—This is the first handheld ECG devices that can do all the work without the requirement of a paper.

Lately, Andhra Pradesh becomes the first state in the country to pass an IoT policy of its own and has decided to become IoT hub of the country. NASSCOM has established a center for excellence to bring together all the nurturing talents in the field of IoT and help it grow.

Recently, Luminous Company that specializes in making inverters has collaborated with Airtel to make the customer experience better than before. Airtel helped them realize this dream by making an IoT solution that can help the customer in the optimization of the inverter and they can track its performance in real time [10].

4 Applications of IoT

In India, IoT applications development includes are shown in the Table 1.

5 Challenges of IoT in India

A standard structure is needed to deploy IoT in a sophisticated manner. The wireless network should be capable enough to encompass the traffic that is a mixture of both machine-type and human-type [18]. IoT helps to transfer data from devices to Internet to enable it to be analyzed but this poses a threat to the security of data [19].

The IoT is bringing several opportunities for research scholars, entrepreneurs, and manufacturers to grow but presently IoT requires some standard theory and architecture to amalgamate real and virtual worlds and to solve privacy and security issues. Some challenges are:

5.1 Architecture Challenge

IoT encompasses of escalating amount of interconnected objects or things which are embedded and autonomous. Communication among objects are anticipated to work anytime, everywhere for any purpose, these communication is expected to be wireless, automatic, uninterrupted, portable, distributed, and multifarious. Data integration of various systems is sturdy and will be handled by modular interoperable components. To improve decision-making and make useful sense of Big Data, deduce and draw relation between large volumes of data, a system solution with sophisticated infrastructure is required, that is why one architecture cannot be applicable to other applications. Flexible architecture is required to include diverse applications of IoT. While laying the architecture for IoT the system, designers have to take under consideration all the functional and nonfunctional requirements which might be a tough task, but the changing requirements make a mountain of the molehill when the complexity increases [20].

An architecture must be unwarpred, unbounded, and having high standards, it must not bound user to use specific solutions. IoT architectures must be open to provide for cases of identifying, communicating, and processing through smart objects [21].

5.2 Technical Challenge

IoT technology is complicated for several reasons. To make IoT successful, it is important to connect as many things as possible. Size of IoT network becomes enormous due to all the connected things, and to interconnect different applications and networking technologies heterogeneous architecture is required. Different kinds of application will require different set of protocols, different security measures [22]. An economical network with reliable communication is required for connecting all the objects. All the connected objects will produce data in huge amount, first of all, a network which can handle the huge data is needed, then to process the huge

data and extract useful information we need new big data processing techniques, as conventional data processing techniques are unable to deal with the such amount of data and at last to store enormous data generated by the objects or things we require very large space. Cloud computing systems provides solution till some extant to store data out somewhere else [21].

5.3 *Privacy and Security Challenge*

The IoT will be interconnection of billions of devices. Its architecture can be divided in five layers. Large number of devices is out there communicating with each other wirelessly, which put a very large and important amount of information in open. Its architecture gives rise to many security issues that are discussed here and their solution will be new area of research [23].

Main security issues with Perception Layer is that sensors may get damaged, broken, and stolen. That is why it is beneficial to deploy sensors out of human reach and also ideally sensor should also be wireless, anti-radiation, and highly resistive from physical damage and have ability to work under temperature variations. Network layer executes the essential conception behind the Internet of Things, i.e., M2M communication, because exchange of information among the machines takes place in this layer, this is the reason why it is important to make this layer secure. There are possibility of illegal data access, confidential information leakage, and eavesdropping to manipulation of the data and other attacks in this layer. Highly secure communication is required to prevent unauthorized access and other possible attacks. To prevent unsafe data or virus coming from physical layer data filtration is required in this layer. Encryption of the data can be done to make this layer secure and safe. Hacking in application layer may lead to leak of personal information as well as confidential data which can lead to data tampering. Highly secure protocols are needed to solve or minimize such incidents. Smart access management system may help into stop unauthorized person to access the information. Encryption and decryption are the key to handle such issues.

In general, the wireless network depends on the router in order to communicate among themselves. While on the other hand, M2M communication does not as it is the one-to-one straight communication between two devices [24].

Software-Defined Networks (SDN), and more specifically, Software-Defined network Perimeters (SDP) are potent tool for the M2M IoT, and especially for emergency responders [25]. The IoT architecture would be made possible due to IPv6, which will provide global addressees to billions of devices taking part in M2M communication. Current approach for the security in networks is physical firewall. But in this approach, these devices will be left out in the open exposing them to the threats of internet hackers. But SDP can change all that. It will help in deployment of a network on-the-fly that can be reconfigured dynamically anytime and would be secure and Ad hoc in nature. Within an SDP logical network, M2M devices with global IP addresses can remain secure and hidden from the plain sight. It means a mobile and

secure M2M network can be created with SDP without investing too much in the physical network infrastructure. Minimum requirement would be Global IP addresses and Internet connectivity. Another advantage of creating this type of network by SDP is that it does not matter which technology is used for network communications [26].

5.4 Digital Literacy Challenge

Digital Literacy refers to the fact of evaluating, creating, and navigating information using the digital technologies [27]. In India, 40% of the total population lives below the poverty line and literacy rate is 25–30%, so talking about digital literacy stands nowhere in the frame. More than 90% of the population is below the digital literacy line. While the country is becoming the second largest in the world in terms of number of mobile users, it still lacks proper internet connectivity. Fast and high speed Internet in the country is the need of the hour, so that rate of digital progress in the country can increase.

NASSCOM and other private sectors have joined hands with the government to come up with National Digital Literacy Mission (NDLM) which aims at producing one person in every household who is illiterate. The Government has come up with projects like National Optical Fiber Network (NOFN) to extend the telecom infrastructure in the country. The four zones that need to focus are affordability, convenience, suitability, and acquaintance. In addition, it needs to be easily accessible and there needs to be some opportunities where this work can be put to display. Lastly, people need to be aware about the technology, so to ensure that there must be some awareness programs.

NDLM Program aims at spreading awareness about digital literacy in rural areas. NDLM will help the country to move a step forward in the digital economy.

However, the Ministry of Information Technology in India lays emphasis on the increase in production of M.Tech and Ph.D. level fellows in India [8]. While the need of the hour is to standardize the education of the engineering sectors to enhance the IoT development in India [28].

6 Conclusion

IoT technology is in toddler state in India, and the country has a long way to go. India needs to fasten its seat belt for the proper expansion of IoT. IoT will create a new generation of people that can lead a hassle-free life. IoT will generate a new field from the research scholars to the business class, which will lead to boost Indian economy and will contribute to the growth of its GDP. A proper utilization of resources is necessary to develop the proper infrastructure for the growth of IoT industry. This paper purpose is to provide the information about development of IoT in India that has been compiled with all the latest advancements in the country in this regard.

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