



INTERNET OF THINGS (IoT) FOR SMART CITIES

RAVI PAYAL and AMIT PRAKASH SINGH

Joint Director-CDAC Noida, India

E-mail: ravipayal@cdac.in

USCIT-GGSIP, New Delhi, India

E-mail: amit@ipu.ac.in

Abstract

In the Current Scenario industry is trying to connect most of the objects through a Internet. As in IoT large amount of informative Data is generated and this data is used for various types of Applications. This paper covers the concept of IoT with respect to Smart city. The paper discuss about different type of Technologies which are used in IoT, Types of Protocols for IoT, about IoT Applications for Smart cities, various types of challenges for IoT. Various papers, books and websites were referred for this survey paper.

I. Introduction

The term “Internet of Things” which is also known as IoT consist of the two words “Internet” and “Things”. The term Internet refers to the Group of Global System of interconnected computer network which uses standard protocol. The all over the world users are connected to each other through internet. There can be a various type of Networks. These networks can be of type Public, private, academic, business, and government. If we talk about things, most of the times people thought of electronic gadgets like laptops, computer, smart phones or other equipment. But on the other hand, things can be any living or Nonliving object. It can include the things like homes, food, clothing, air, water, landmarks, water bodies, animals, trees etc. Although there is no general specific definition of IoT but when we combined these two terms “Internet” and “Things” then the term “Internet of Things (IoT)” forms. Basically in IoT we connected different Living or Non-living objects through the internet and run certain applications. These applications

2010 Mathematics Subject Classification: 68M11, 68M18.

Keywords: Internet of things, Smart City, Smart Grid, Challenges of IoT, IoT Technologies.

Received February 4, 2021; Accepted April 7, 2021

are centrally controlled. The large amount of data is generated and collected in IoT. This data can be processed and used for the Different type of applications. A person when coming to home after office in summer can controlled his Home Room Temperature by maintaining the home Air conditioner temperature to his comfort level before reaching the room. When his car reaches the Home the garage door will open automatically. These are some applications of IoT.

It is a prediction that by the year 2022 billion of devices will be connected wirelessly. When This number of devices will be connected to each other through internet then security issues will also arise. So now days the Security for the IoT is also a new research area. The Figure1 represent the IoT definition.



Figure 1. IoT Definition.

A smart city concept is related to urban area. It refers How we managed our available resources efficiently. Basically in a Simple Term Smart City refers how we manages our different resources smoothly and organized way for the society. Smart City will make life smoother and easy for the peoples. The Sensor technology plays very crucial role in smart city. Generally Smart city install sensor based Nodes all over the different point of city and these nodes will transfer that data to the central server through IoT [1] and we get all the information. Once can say that IoT is the Main backbone for a smart city. The concepts like Smart building, Smart education, Smart Healthcare, Smart Traffic systems, Smart governance comes under the smart city planning. Along with this we have to manage our environment smartly.

Smart city concepts can be implemented for Smart buildings, Smart healthcare systems, smart security, smart traffic systems, Smart education, smart governance, Purpose. The city is known to be a smart city if city is able to develop itself on three main areas and those are Energy sector, Traffic or transport system and ICT. For making city smart there should be proper planning, new innovation and efficient use of available resources are required.

II. IOT-Based Smart City

IoT is a key technology for the success of any project related to smart city. Due to the fast growth of population in the metro city's, now a days there is a requirement of new type of infrastructure and services [6]. So for the IoT based smart city applications there is a big requirement of different types of Digital Devices like sensors, actuators, smart phones etc. All these devices are inter-connect and communicate with each other through the internet. Smart Cities which are using latest digital technologies will become smarter day by day. A smart city depends on the use of different type of electronic elements and by using these elements different type of applications can for the society can be developed [1]. In the year 2011, the number of peoples are less compared to the number of devices interconnected together. Basically Internet provides the infrastructure by which many people are able to interconnect to each other [1].

Technology Drivers of Smart city

There are different types of Technology drivers exit for the For the Smart city. These technology drivers can be categories as follows.

i. Smart Meters and Sensors. In India from last ten years many cities have started to modernize their electric power grids, their water and gas networks. In Last ten years' millions of smart meters and smart sensors are installed in large number of Cities for different type of applications [5].

ii. Electronic Records. It's a Digital World. India is also running on Digital India Concept. Now Also in India like other developed countries of the world we are managing our data in the form of Electronics.

iii. smart highways. Due to the evaluation of Smart parking apps and intelligent Transportation system our highways and byways are becoming

smarter. Due to the development of apps related to Navigation and display equipment's for real-time traffic lot of problems related to Traffic has been solved. GIS plays a major role in this.

iv. Cashless Transactions. Government of India is also promoting the cashless transactions [8]. This is a Major part of Digital India project. Large network of Near-field Communication (NFC) is established all over the cities now a days for the cashless transactions.

v. Smart phones. Now a days Smart phones are widely used for the different application. For the smart city applications, smart phones are used not only as a sensor node but also as a delivery platform. Now a days Smartphone contains a GPS locator, a microphone, Sensor, High revolution Camera, accelerometer, barometer, thermometer and other type of sensor based measuring applications.

vi. Social Media. There are lot of Free platforms are available which provide updates, alerts. Facebook and Twitter are these type of platforms.

vii. Cloud Computing. This concept used not only for the data storage but also for running the different types of applications. It does not have a permanent fixed structure. Most of the companies now a days are using the cloud solutions via internet. Suppliers are saving the lot of money by using the cloud, different users are using the applications through cloud.

viii. Data Analytics. For the analytics perspective, now a days we can Big data techniques. These Analytics techniques are cost effective and handle the high volume of data – e.g. Big Data. Big data analytics are used to for the finding the uncover hidden patterns, unknown correlations, market trends etc. The industry now understands that if they capture all the data that streams into their businesses, they can apply analytics techniques on it and get significant value from it. By applying these analytics techniques, the system becomes more efficient in terms of speed and efficiency [8].

ix. Big data technologies. For storing large amount of data and doing things efficiently Hadoop and cloud based analytics techniques are used. These techniques are used for analyzing the huge amount of data.

x. Internet of Thing (IoT). In IoT different type of physical objects like cars, houses, devices and other products which contains sensors, software's

etc are connected in a network. Through IoT objects are located and controlled through remote technology.

xi. Internet of Everything (IoE). Internet of everything talked not only about physical objects but it consists of objects, process, people and data.

III. IoT Technologies for Smart Cities

The IoT network uses different type communication protocols for data transfer. The main concept of IoT is to identify and sending the desired data from one location to another location [9]. For this purpose different type of protocols are used.

A. Radio Frequency Identification (RFID). The RFID majorly used in Wireless Data Communication. RFID is used for the smart identification of anything, RFIDs are used as a bar Code in products. RFID system consist of readers and tags. we can identify each object by using these technologies.

B. Wireless Sensor Networks (WSN). WSN is another famous technology used in IoT. In this Network sensors interact with each other through WSN. The WSN Network Consists of WSN hardware like sensor interface, processing units, transceiver units and power supply; WSN communication task; WSN middleware and secure data aggregation.

C. Data storage and analytics. The IoT basically generates large amount of data. This large data is used for different purpose. Generally, data is used for smart monitoring and actuation. Different types of machine learning methods based on neural networks, artificial intelligence, genetic algorithms are used for this purpose. From last few years Cloud based techniques are used for this purpose.

D. Visualization. For the purpose of interaction of the user with environment visualization is very important for the IoT applications

IV. IOT Applications for Smart Cities

There are various types of IoT Applications of IoT which can be used for the smart city or in other words we can say that for s Smart city concept IoT applications are useful. IoT has a Potential of creating huge number of applications. These applications can be used for the society. In Figure you can

see some of the application areas of IoTs. These applications can be categorized into different groups

i. Smart agriculture. IoT can be used for the agriculture. India is a Agriculture country. There are various areas in agriculture where we can use the IoT. It can be used for the Monitoring the Soil moisture and Soil quality which can be very helpful for the farmers [9]. IoTs can be used for the study of weather conditions, so farmers will get the timely information about the rain, drought, snow or winds from the Meteorological Station Networks. By using the IoT farmers can use the concept of Selective irrigation in dry zones.

ii. Smart Homes. With respect to Smart homes IoT concept is very popular. We can controlled the different devices at home by using the IoT platform. For this purpose Sensor networks are used. By using, IoT we can manage and monitor our applications regularly and reduce the monthly bills and resource usage [9]. We can switch on and of light, fans, ACs, TV etc according to our need and save the energy. IoTs can also used for monitoring the conditions inside museums and art warehouses.

iii. Intelligent transportation Systems. This is another area where our government is focusing. IoTs platform can be used for the Smart and intelligent Parking systems. RLVD concept is installed at many places in traffic system. Vehicle tracking system is also a part of Government project and IoTs concepts can be used in for the Tracking of any vehicle [1]. Now a day's government of India is using Intelligent Highways with warning alert messages and prior information about the route diversions with respect to alarming climate conditions, traffic jam and accidents.

iv. Health Care. Now a days Doctor can monitor the patients remotely with the help of IoT platform. Health technologies are improved by using the IoT system. IoTs technologies help to improve the patient healthcare, medical errors, reduces the healthcare costs. IoTs can be used for monitoring and control the medical fridges condition [1]. These freezers are used for storing medicines and different type of vaccines. Patients surveillance can be done anywhere.

v. Smart energy and Smart grids. Smart grid is designed for the efficient power distribution and transmission. On Smart grid network sensors are installed on the network and these sensors transforms information of power

consumption to the central server [7] and after that consumption pattern Central server we can determines the consumption pattern. This will help to improve the power production.

vi. Industrial maintenance. In factories time to time Monitoring of Temperatures and motor vibrations are very important factors. This will detect the irregularities of machines. On these machines sensors are installed and these sensors will track the correctness of the machine. Generally, Companies will invest Huge amount of money on maintenance. Companies save huge amount of money and time by doing this.

vii. Air and water Pollution Detection System. The IoT can also used for the detecting the Water and Air pollution detection. The use of WSN is very helpful for this application. Currently lot of Cities in the world are working on this domain and they are using this type pollution detection system. Different types of Air monitoring and water quality monitoring systems are deployed in the city. The Government and private agencies are collecting data regularly from different part of the city and giving real time information about the pollution level to citizen. With the help of Smart phones now a day's people will get live information of the pollution related to air and water.

viii. Smart Agriculture. Improvement on Agriculture systems is always required. The IoT concepts are used for understanding the Meteorological conditions, different Meteorological stations uses the different methods for rain, drought, windy conditions. This information's are very useful for the farmers. Now a days different data mining techniques are also used for the predictions.

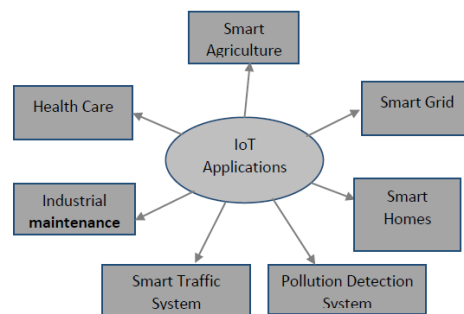


Figure 2. IoT Applications.

V. IoT Challenges

During IoT implementation lot of challenges wrt technology and research comes. The important challenges are

1. Scalability. As compare to traditional internet of computers, the Internet of Things potentially has a high scope. Most of the things still are running in a local environment (small scale). For Different type of small and large scale environments it is important that communication services should distribute equally.

2. Interoperability. In IoT each and every object is connected with each other. Each and every object have processing and communication capabilities. These capabilities will vary from object to object. In order to make synchronization between Each and every device some common standards are required to fix. This is very important to wrt address of objects. So to establish the proper communication between two systems is very important and there are lot of challenges in this.

3. Data volumes. Now a days Big Data concept involves in most of the IoT System. Most of the IoT Applications related to Smart city contains huge amount of data on network nodes and servers. These data is used for the analysis. To manage this huge amount of data is a big challenge.

4. Data interpretation. The Big amount of data which system collected need to be interpreted, for this different data interpretation techniques will be used. There are various types of Data interpretation techniques like Descriptive analysis, Regression analysis, Factor analysis, Dispersion analysis, discriminant analysis, time series, evolutionary algorithms and Fuzzy logic.

5. Security Challenges. Since large of amount of Private data is transferred through the Sensor nodes to the server related to different applications. The Security issue is the very critical issue in IoT and it should be handled carefully [8].

6. Privacy Challenges. Now a day's data that IoT device collects are very sensitive. There should be proper precautions for the data storage and data sharing with different service providers. Vendors and manufacturers use proper security technique's for data storage.

7. Connectivity challenges. For a Big network where we have to join billions and trillions of sensors or devices for a smart city application. Such systems require a big investment in terms of money and time. Generally, these types of systems require a cloud server. To establish a connection between different devices and sensors is one of the biggest challenges of IoT.

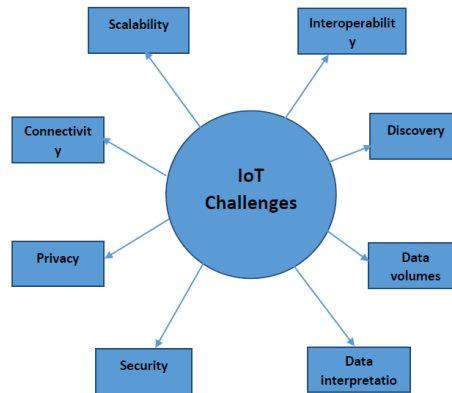


Figure 3. IoT Challenges.

VI. Conclusion Remarks and Future Trends

This paper discusses about the internet of things, various types of technologies of IoT for Smart city and applications for the smart city. Now a days these applications are the Hot area for the research in IoT with respect top Smart city. The increasing number of different types of complex IoT applications have raised new challenges in the Field of IoT area. In future it is expected more number of real time applications will be used and data collected by using these applications can be used for the research and future trend analysis.

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