Internet of Things (IoT): A Review on its Applications and Challenging Issues

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ABSTRACT

Internet of Things refers to the fastest growing network of connected physical objects that are able to gather and exchange data using embedded sensors and an internet. Refrigerators, lights, thermostats, cars and more appliances can be connected to the IoT. A thing in the internet of things is any object in the physical world embedded with sensors and actuators and are able to communicate data and information with other objects through an internet. IoT in these days is used in many applications like making homes smart, smart cities, traffic control, object tracking, environment monitoring, health care etc. This paper presents an overview about IoT scenario, various sensors like mobile phone based sensors, medical sensors, environmental sensors, actuators, its applications in various fields and point out some challenging issues that needs to be tackled.

Keywords— Actuator, Internet of things, Internet, IoT Applications, Objects, Sensors, RFID

I.INTRODUCTION

Internet of Things (IoT) defined as a paradigm of interconnected physical objects which are accessible through the internet. A thing, in the Internet of Things, can be a farm animal with a biochip transponder, a person with a heart monitor implant, an automobile with built-in sensors, a smart car connected with home electrical appliances, wearable objects that can be assigned an IP address and provided with the ability to transfer data over a network. IoT semantically means a "world-wide network of interconnected objects uniquely addressable, based on standard communication protocols" [1] [2]. In the Internet of Things, physical endpoints are connected through uniquely identifiable IP addresses and data can be gathered and communicated through embedded devices and software. When objects are able to represent themselves digitally through IoT then it can be controlled from anywhere which helps in collecting more data from more places ensuring improved safety and efficiency. IoT has high impact on everyday life. From the private user's perspective the most common effect of IoT is visible in smart homes and offices, enhanced learning, e-health etc. Similarly from the business user's

point of view IoT is changing the way of doing businesses in almost every field like automation and industrial manufacturing, business process management, logistics, intelligent transportation of goods and people etc. It is estimated that approximately 50 billion objects will be connected to the IoT by 2020.

Fig: Internet of Things (IoT) [3]

Benefits of Internet of Things (IoT)

A. Comfort

Internet of Things provides comfortable life to people. A car can drive by it when auto drive mode is activated. A Smart refrigerator can order milk online through the internet whenever milk pot becomes empty.

B. Tracking

The computers keep tracking the things at home such as knowing the expiry dates of the products and you will never run out of anything when you require it at the last moment.

C. Time Saving

IoT help in saving our precious time by constantly keep tracking and monitoring.

D. Money Saving

Iot help in saving money by replacing humans who are responsible for monitoring the things as it is now monitoring itself.

E. Assisted Decision Making

IoT helps in taking better decision by collecting data from various angles. In these days it is not very difficult to take better decisions.

II.SENSORS AND ACTUATORS IN IOT

All IoT applications need some kind of sensors and actuators to collect data from the environment and send the result back to the physical objects. A sensor is a transducer which is any physical device that converts energy of one form to another form. For example a microphone is a sensor which is used to convert sound waves into electrical signal that is useful for other components to correlate back the original sound. An actuator performs the operation in the reverse direction of sensors. It takes the electrical input and converts it into physical action. Following are some sensors and actuators which are normally used in IoT.

A. Mobile Phone Based Sensors

A smart phone has many inbuilt sensors embedded in it. The microphone and camera are built in sensors in every smart phone which is useful for capturing audio and visual information that can further be analyzed and processed. As an example we can use captured sound further for voice recognition etc. Similarly in smart phones we can use Global Positioning System to check the phone location. Some smart phones also have an inbuilt thermometer to check the current temperature. In the same way we can embed so many sensors in smart phones which turn a smart phone into an important IoT device. [5]

B. Radio Frequency Identification (RFID)

RFID is an identification technology that is based on RFID chip with an antenna also known as radio frequency identification tag and RFID reader. RFID tag is used to carry data which can be read by RFID reader. Data is transferred in this technology through radio waves and its range can be up to hundreds of meters and it also depends upon the frequency. RFID technology is popularly used in super markets and digital libraries. In digital library we can use radio frequency identification for automatically issuing and returning books without any human operator.

C. Medical Sensors

IoT is playing a major role in the health care applications. We can use different kinds of sensors to measure the various parameters of human body [5] [6]. Nano boats these days can check the various cells information in human body and send the collected information to the server where running algorithm takes the decision depending upon the collected data whether there is some disease or not and is there any symptom of any future disease and the report is sent to the concerned person as well as to the nearest hospital and if there is some critical issue then the nearest hospital takes the appropriate action immediately. There are also many kind of wearable devices like smart watch, smart lens etc which take care of various parameters such as pulse rate, heart rate, body temperature, blood pressure, glucose level etc of human body [7].

D. Infants Monitoring Sensors

Wearable sensors are available these days to monitor the various activities of infants. These sensors keep track of various activities of infants and notify about any problematic activity to their parents.

E. Neural Sensors

With the help of brain sensors we can check the state of the brain and train it for more focus and attention. This is known as neuron feedback [8]. Through EEG (Electroencephalography) we can read brain signals. Depending

upon the frequency of the brain waves it can be categorized as alpha, beta, gamma, delta, theta waves [5]. From these waves we can conclude that whether our brain is focused or wandering in the thoughts.

F. Environmental Sensors

Environmental sensors are used to sense various parameters of the environment such as temperature, humidity level and presence of various gaseous and other particles. Through sensors we can check the quality of the air and predict about the future weather and take appropriate actions. By using seismic sensors we can detect earthquake in advance.

G. Actuators

An actuator is a device that is used to convert electrical energy into physical energy. Example of actuator includes lights, motors, speakers etc. In smart homes we can use actuator to lock/unlock the doors, on/off lights, temperature control, alarm notification and threat notification etc. These actuators can be controlled wirelessly by using an internet.

III.APPLICATIONS OF IOT

Internet of Things (IoT) found its applications in many fields such as smart cities, smart homes, environmental monitoring, health care, traffic management etc which are discussed below.

A. Smart Cities

With the help of IoT we can make our city a smart city by managing environment, buildings, power and energy management, transport, water facilities etc through sensors, actuators and an internet. Transport based sensors avoid accidents by properly routing vehicles and keep checking that there should not be any kind of congestion in the city. Smart parking facilities, smart traffic lights, smart water inflow, outflow facilities through sensors are contributing in making cities smart.

B. Smart Homes

Sensors and actuators with wireless accessibility are making home smart and providing quality life. In these days we are seeing that intelligent locking/unlocking of doors, threat alerts, automatic on/off lights wirelessly, alarm alerts are making homes very smart.

C. Wearable Devices

In today's most of the wearable devices are embedded with sensors which can sense the data from the environment and send the sensed data to an internet that take decision based upon the sensed data. Wristwatch can sense the data from our body and tell us about body temperature, heart rate, pulse rate etc. Smart lens, smart glasses are sensing the glucose level from tears. GPS based smart shoes help the human to move in right direction. There are many other wearable devices like smart cloths, smart jewelerry, smart gloves etc which are responsible for making accurate and fast decision making.

D. Connected Cars

Connected cars are connected to your homes through internet and sensors. Whenever your car reaches near your home it automatically turns on lights, air conditioner etc.

E. Energy Management

IoT is responsible for energy management. It is expected that IoT based devices will be integrated into all form of energy based devices such as bulbs, power outlets, switches, televisions etc. and will be able to communicate with the utility supply agency to effectively balance energy usage and power generation. Some devices allow remote control through internet and cloud based interface.

F. Medical and Healthcare System

With the help of IoT devices we can monitor health remotely. These health monitoring devices monitor blood pressure, heart rate, pulse rate, body temperature etc. Through Nano devices we can keep constantly check on cells information in human body and keep track on any kind of future disease in real time. With the help of neural sensors we can check the current state of brain and depending upon the frequency of brain waves we can check that whether brain is focused or wandering in thoughts. With the help of wearable devices we can check on our fitness in a better way.

G. Manufacturing

Smart manufacturing involve use of IoT devices in manufacturing process. In today big organizations are investing in IoT device in all kind of manufacturing processes such as electronics, durable goods, chemicals etc to cope with the changing trends and faster manufacturing process. IoT based platform can be used to easily fetch the data from various sources and process it in and efficient manner.

H. Environmental Monitoring

IoT based sensors are used to check air purity level, various gaseous in the atmosphere, level of pollutants, humidity, temperature etc. These devices are able to predict about the upcoming weather and can notify us in advance about some extreme conditions. Seismic sensors can tell us in advance about the earthquake. Farmers can use these sensed data for their efficient production of crops. We can use RFID based sensors across the roads to sense the vehicles that are responsible for producing pollution beyond the permissible limit.

IV.CHALLENGES OF IOT

Although IoT is used in many applications these days in its scope is increasing day by day but it has also some challenges which need to be tackled properly for making IoT is the perfect technology of future. Some of the challenges of IoT are given as follow.

A. Security

As IoT interconnect many devices together so it becomes very important to transfer data securely. If the data is not sent securely then it becomes very easy for intrude to enter into the system and access the data. More layers of software, APIs, integration Middleware, machine to machine communication create more complexity and security risks.[10][11]

B. Privacy

Privacy is the major challenge of IoT that stem from integrating devices into the environment without using them consciously. Many tracking devices in our cars as well as in our mobile phones can track our conversation continuously and keep checking on our activities and send that data to a third party on the cloud.

C. Storage Issue

As almost all the physical objects in the future will be connected to IoT and will be able to send and receive data to and from the server which require a lot of space to store the data produced by billions of smart objects.

D. Standardization

As lot of unstructured data is being produced by these smart devices which is very difficult to store and query about it. It also consumes lot of storage space to store this unstructured data. So there should be some standard of structuring data produced by smart devices so that it can be stored in relational databases in can be easily queried.

E. Complexity and Compatibility

IoT is growing in many different directions, with many different types of technologies competing with each other to become the standard. This will cause difficulties and require extra hardware and software to connect devices and deploying them.

V.CONCLUSION

This paper presents an overview about the internet of things, various types of sensors and devices used in internet of things, its challenging issues and applications in different fields. Lots of objects of the physical world are connected with the internet and become smart and it is estimated that in 2020 approximately 50 billion objects will be connected to the IoT. Internet of things is still in a nascent stage and it is showing sign of maturity. However, a lot more needs to happen in the areas of IoT communication technologies and applications. The main reason why is has not truly matured is the lack of managing complexity, security, trust, access control etc. However lot of research is being done in this field to cope up with the various challenges of this technology and moving it toward the maturity and use this technology in many applications to make this world a better place to live.

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