A REVIEW ON INTERNET OF THINGS

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Abstract:-

Now a days Internet of Things (IoT) is new era of computing technology .The IoT encircled of smart machines interacting and communicating with other machines, objects, environments and infrastructures. As a result, huge amount of data are being generated, and that data is being processed into useful actions that can command and control things to make our lives much easier and safer.The main objective of this paper is to reviews of IoT enabling technologies and the sensor networks. Also, it describes a layered architecture, characteristics and applications of IoT in various fields.

Keywords:-
Internet of Things, Introduction, Characteristics, IOT architecture, RFID, WSN,IoT applications.

Introduction:-

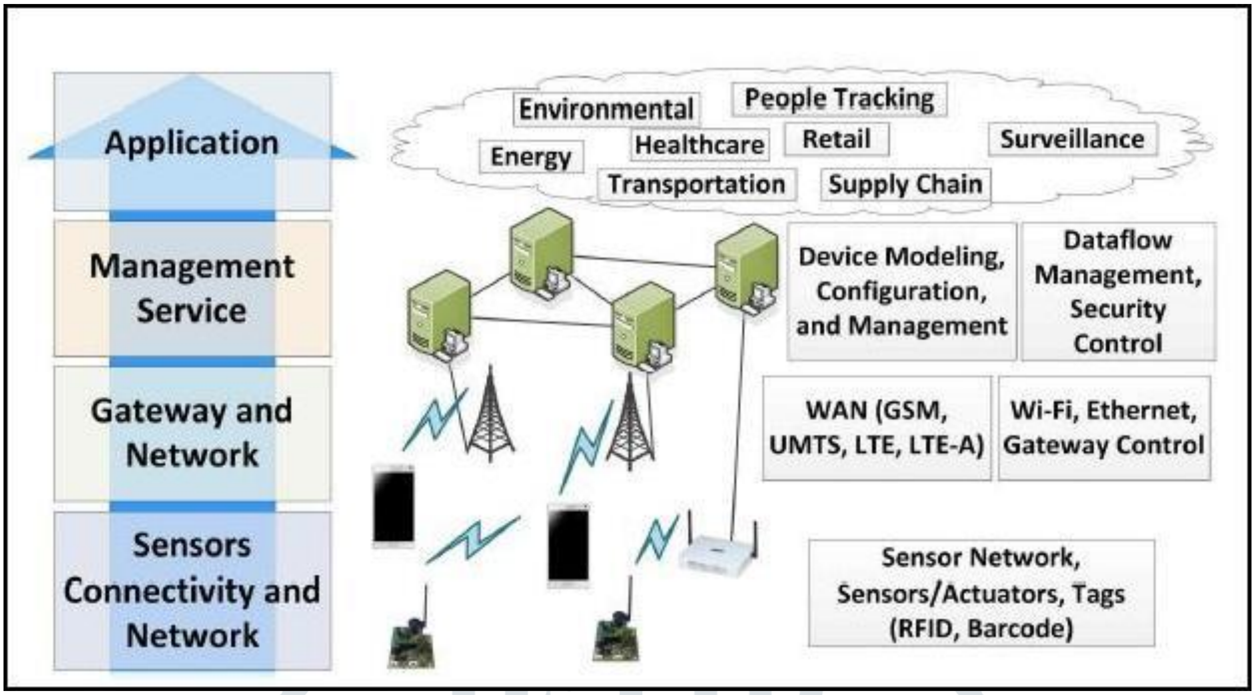
The Radio Frequency Identification (RFID) development community has inventedidea of IoTin 1999, whichhas recently become more important to the practical world because of the growth of mobile devices, embedded and wall to wall communication, cloud computing and data analytics.Think of a world where billions of objects can sense, communicate and share information, all interconnected over public or private Internet Protocol (IP) networks. have The data is regularly collected, analyzed and used to initiate action, that provides intelligence for planning, management and decision making is done by interconnected objects. IoTis network of physical devices, vehicles, home appliances, and other items embedded with electronics, software, sensors, actuators, and connectivity which enables these things to connect, collect and exchange data.

IOT Architecture:

A. Smart device / Sensor layer:

The bottom layer consists of smart devices that integrated with sensors. The interconnection of the physical and digital worlds allowing real-time information to be collected and processed by enabling the sensors. There are different types of sensors for various purposes. The physical value of temperature, air quality, speed, humidity, pressure, flow, movement and electricity etc can be measured by sensorsand convert it into signal that can be understood by an device. According to their unique purposes the sensors are grouped.

Most sensors require connectivity like Local Area Network (LAN) or Personal Area Network (PAN) to the sensor gateways. The sensors which do not require connectivity to sensor aggregators, their connectivity to backend servers/applications can be provided using Wide Area Network (WAN) such as GPRS, GSM. Networks commonly known as wireless sensor networks(WSNs) are formed by the sensors that use low power and low data rate connectivity. WSNs are gaining popularity as they can accommodate far more sensor nodes while retaining adequate battery life and covering large areas.



B. Gateways and Networks

Huge amount of data produced by sensors require a robust and high performance wired or wireless network infrastructure as a transport medium. Current networks maintain machine-to-machine (M2M) networks and their applications to serve a wider range of IOT services and applications such as high speed transactional services, context-aware applications, etc. Different technologies and access protocols are needed to work with each other in a mixed configuration with multiple networks . These networks are built to support the communication requirements for latency, bandwidth or security, it can be in the form of a private, public or hybrid models. Gateway networks such as (WI-FI, GSM, GPRS…) & gateways such as (microcontroller, microprocessor...) are used by Network.

C. Management Service Layer

Information possible through analytics, security controls, process modeling and management of devices supported by this layer.

Business and process rule engines are one of the important features of the management service layer. IOT does connection and interaction of objects and systems together which provides information in the form of events or contextual data such as temperature of goods, current location and traffic data. Some events requires the immediate situations such as reacting to emergencies on patient's health conditions, while others needs post-processing systems such as capturing of periodic sensory data. In analytics area, various analytics tools are used to extract related information from huge amount of raw data and to be processed at a much faster rate. In-memory analytics allows big volumes of data to be cached in primary memory instead of storing it in physical disks.It also minimizes data query time and enhances the speed of decision making. To make decisions in a fraction of seconds streaming analytics plays an important role. In it analysis of data is considered as data-in-motion, which is required to be carried out in real time

The ability to manage data information flow is Data management .With management service layer; information can be accessed, integrated and controlled. Higher layer applications can be secured from the need to process unnecessary data and reduce the risk of privacy disclosure of the data source. Data filtering techniques such as data anonymisation, data integration and data synchronization, are used to hide the details of the information while providing only essential information that is usable for the relevant applications.

Security of the system prevents system hacking and compromises by unauthorized personnel, thus reducing the possibility of risks.

D. Application Layer

"smart" environments/spaces in domains covered by IoT applications: Transportation, construction, City, Lifestyle, Retail, cultivation, Factory, Supply chain, Emergency, Healthcare, User interaction, Culture and tourism, Environment and power.

Characteristics:-

1. Intelligence

IoT comes with the combination of algorithms and computation, software & hardware that makes it smart. In spite of all the popularity of smart technologies, intelligence in IoT is only concerned as means of interaction between devices, while user and device interaction is achieved by standard input methods and graphical user interface.

2. Connectivity

Internet connectivity is either available within the device itself or can be provided by a hub, Smartphone or access point (base station). If connectivity is provided by an access point then it is most probably collecting data and operational information from a range of sensors for a specific device and then communicating with the cloud to relay this information.

3. Dynamic Nature

The primary activity of Internet of Things is to collect data from its environment, this is achieved with the dynamic changes that take place around the devices. The state of these devices change dynamically, example sleeping and waking up, connected and/or disconnected as well as the context of devices including temperature, location and speed. In addition to the state of the device, the number of devices also changes dynamically with a person, place and time.

4. Enormous scale

The number of devices that need to be managed and that communicate with each other will be much larger than the devices connected to the current Internet. The management of data generated from these devices and their interpretation for application purposes becomes more critical.

5. Sensing

Sensors are an important aspect of devices and systems within the internet of things. The sensors monitor, track and measure the activity and interactions of a device and then relay this information using the cloud. Some examples of such sensors include ones that monitor a person's health and fitness or sensors that can detect whether a door has been opened in your house or even ones that monitor usage statistics (eg: for utilities).

6. Heterogeneity

Devices in IoT are based on different hardware platforms and networks and can interact with other devices or service platforms through different networks. IoT architecture should support direct network connectivity between heterogeneous networks. The key design requirements for heterogeneous things and their environments in IoT are scalabilities, modularity, extensibility and interoperability.

7. Security

Devices connected to the Internet of Things may be transmitting information that maybe highly sensitive and regulated, an example is health related or financial data. Since a variety of sensitive data can be relayed by these devices it is very important that there is good data security as this is vital.

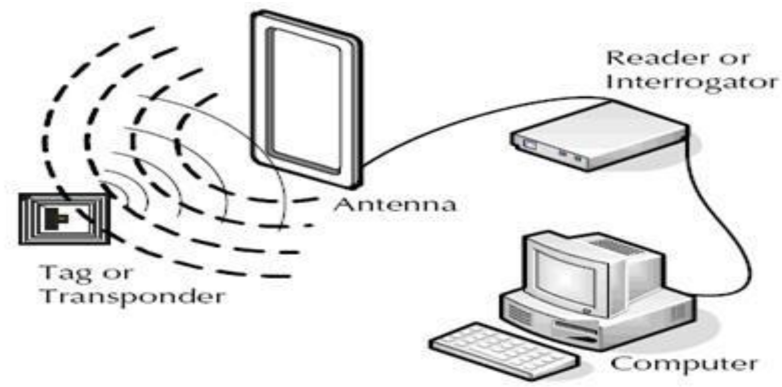
Technologies:

The development of all over computing system where digital objects can be uniquely identified and can be able to think and interact with other objects to collect data on the basis of which automated actions are taken, requires the need for a combination of new and effective technologies which is only possible through an integration of different technologies which can make the objects to be identified and communicate with each other.

1) Radio Frequency IDentification (RFID)
The Objects can be uniquely identified by RFID technology.
It's reduced size and cost makes it integrable into any object. It is a transceiver microchip which could be both active and passive, depending on the type of application.
.Active tags have a inbuilt battery to them dueto which they continuously emitthe data signals while Passive tags just get activated when they aretriggered. Active tags are expensive than the Passive tags.They have a wide range of useful applications

"Radio-frequency identification" (RFID) refers to a technology whereby digital data encoded in RFID tags
Emits the identification,location or any other specificification about the object, on getting triggered by the generation of any appropriate signal and it is captured by a reader via radio waves.

Fig. 1. RFID Scenario



With respect to type of application, RFID frequencies are dividedinto four different frequencies ranges, which are given below:

(1) Low frequency (135 KHz or less)
(2) High Frequency (13.56MHz)
(3) Ultra-High Frequency (862MHz 928MHz)
(4) Microwave Frequency (2.4G, 5.80)

RFID is similar to barcoding system. RFID has number of advantages over systems that use barcode tracking software.

Bar Code is an optical technology so it requires human labor to scan each label separately. But when there is use of RFID tracking software, hundreds of tags may be read per second, as the tags are activated by radio signals from the reader. Because of that, the time it requires for scanning many items can be drastically reduced.

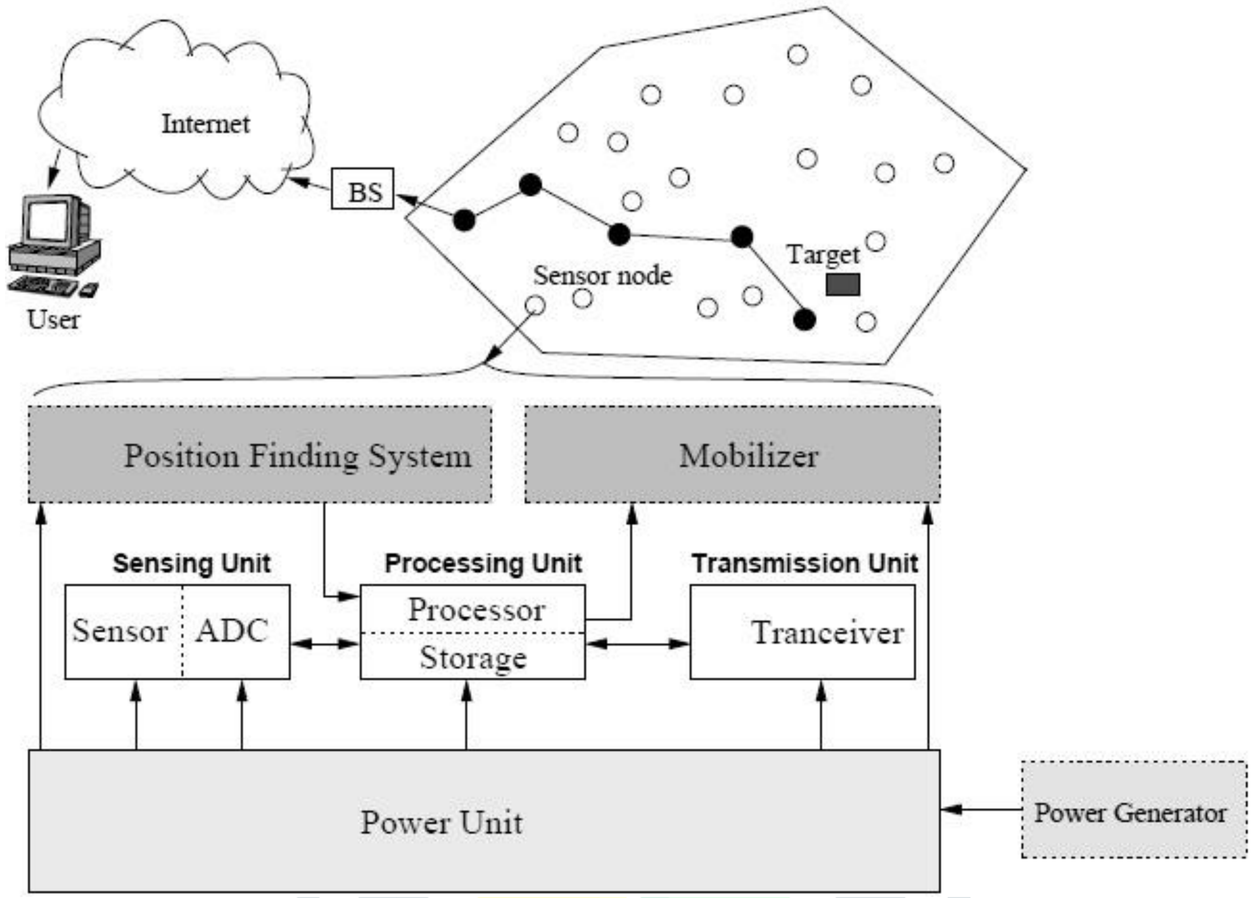
Moreover, an RFID can work as an actuator to trigger different events and it has even modification abilities which Bar codes clearly don't have.

2) Wireless Sensor Network (WSN)

Wireless Sensor Networks (WSNs) bi-directional wirelessly connected network of sensors and infrastructure-less wireless networks to monitor physical or environmental conditions, such as temperature, sound, vibration, pressure, motion or pollutants and to cooperatively pass their data through the network to a main location or sink where the data can be observed and analysed. A base station acts like an interface between users and the network. Typically a wireless sensor network contains hundreds of thousands of sensor nodes. The sensor nodes can communicate witheach other using radio signals. A wireless sensor node is in need with sensing and computing devices, radio transceivers and power components.

Each sensor is a transceiver having an antenna, a micro-controller and an interfacing circuit for the sensors as a communication, actuation and sensing unit respectively along with a source of power which could be both
battery or any energy harvesting technologySensing node also have a Memory unit for saving data.

A typical sensing node is shown in the figure below:
Fig. 2. A typical sensing node



Wireless Sensors Network technology and RFID technology when combined together opens up possibilities for even more smart devices,for which a number of solutions have been proposed . An example solution is provided by the Intel Research Labs in the form of Wireless Identification Sensing Platform (WISP). WISP is a passive wireless sensor network with built-in light, temperature and many other sensors. Both WSN and RFID Sensor Networks
have their own advantages but RFID Sensor Networks have a low range and their communication is Asymmetric while WSNs have a comparatively longer range and their communication is Peer-to-Peer. Moreover most of the WSNs are based on the IEEE 802.15.4standard, which specifies the Physical and MAC layer of Low-Rate Wireless Personal Area Networks (LR-WPANs).

3) Cloud Computing
Cloud computing is the on demand availability of computer system resources, especially data storage and computing power, without direct active management by the user. The term is generally used to describe data centers available to many users over the Internet.
C**loud computing** and the **IoT** have a complimentary relationship with one another.
The IoT generates massive amounts of data, and cloud computing gives a pathway for such data to travel to its destintion, which in turn increases efficiency in our work.
Cloud computing increases speed and ability of processing while making resources available to developers.
You can save money on operating data centers and can deploy your applications worldwide in a matter of minutes.

Fig.3. A typical Cloud Computing Scenario:

4) Networking Technologies

In the success of IoTnetwok technologies have an important role since they are responsible for the connection between the objects, so to handle a large number of potential devices we need a fast and an effective network.
The 3G, 4G networks are commonly used for wide-range transmission network. But as we know, mobile traffic is so much predictable since it only has to perform the usual tasks like making a call, sending a text message etc. so as we move forward into modern era of pervasive computing, it will not be predictable anymore so there is a need of
a fastest, powerful fifth generation wireless system which could offer a much more bandwidth .
Likewise we can use technologies like Bluetooth, WiFietc for a short-range communication network.

5) Nano Technologies

The nano technology technology shows smaller and improved version of the things that are interconnected.
In this technology the consumption of a system can be decreased by enabling the development of devices in nano meters scale which can be used as a sensor and an actuator just like a normal device. Such a nano device is made from nano components and the resultant network defines a latest networking paradigm which is Internet of Nano-Things.

6) Micro-Electro-Mechanical Systems (MEMS)

Technologies MEMS are a combination of electric and mechanical components. By combination of Electric and mechanical components working together provide several applications including sensing and actuating which are already being commercially used in manyfield in the form of transducers and accelerometers etc.
MEMS combined with Nano technologies are a Cost-effective solution for improvising the communication system of IoT .Its combination also gives advantages like size reduction of sensors and actuators, integrated pervasive computing devices and higher range of frequencies etc.

7) Optical Technologies
Rapid developments in the field of Optical technologies in the form of technologies like Li-Fi and Cisco's BiDi optical technology could be a major breakthrough in the development of IoT. Li-Fi, an epoch-making Visible
Light Communication (VLC) technology, will provide a great connectivity on a higher bandwidth for the objects
interconnected on the concept of IoT. Similarly Bi-Directional (BiDi) technology gives a 40G ethernet for a big
data from multifarious devices of IoT.

Application of IoT

In summary, the IoT applications shall have the following capabilities.

1) Location Sensing and Sharing of Location Info

The IoT system can collect the location information of IoT terminals and end nodes, and then provide services based on the collected location information. The location information includes geographical position information got from the GPS, Cell-ID, RFID, etc., and absolute or relative position information between things. More typical IoT applications include at least the following.

a) Mobile asset tracking

This application can track and monitor the status of commodity using the position-sensing device and communication function installed on the commodity.

b) Fleet management

The manger of the fleet can schedule the vehicles and drivers based on the business requirements and the real-time position information collected by the vehicles.

c) Fleet management

Traffic information system: This application can get traffic information such as road traffic conditions and congested locations by tracking the location information of a large number of vehicles. The system thus assists the driver to choose the most efficient route.

2) Environment Sensing

The IoT system can collect and process all kinds of physical or chemical environmental \no break parameters via the locally or widely deployed terminals. Typical environmental information includes temperature, humidity, noise, visibility, light intensity, spectrum, radiation, pollution (CO, CO_2, etc.), images, and body indicators. Typical applications include at least the following.

a) Environment detection

IoT systems offer environmental and ecological, such as forest and glacier, monitoring; disaster, such as volcanoes and seismic, monitoring; and factory monitoring. All are with automatic alarm systems using environmental parameters collected by large number of sensors.

b) Remote medical monitoring

IoT can analyze the recurring indicator data collected from the device placed on patients' body and provide the users with health trends and health advice.

3) Remote Controlling

IoT systems can control IoT terminals and execute functions based on application commands combined with information collected from things and service requirements.

a) Appliance control

People can remotely control operating status of appliances through IoT system.

b) Disaster recovery

Users can remotely start disasters treatment facilities to minimize losses caused by disasters according to the monitoring mentioned before.

4) Ad Hoc Networking

IoT system shall have rapidly self-organized networking capability and can interoperate with the network/service layer to provide related services [7]. In the vehicle network, in order to transfer the data, the network between vehicles and/or road infrastructures can be rapidly self-organized.

5) Secure Communication

IoT system can further establish secure data transmission channel between the application or service platform and IoT terminals based on service requirements.In practice, an IoT application consists of different types of capabilities and even applications based on the service requirement. Table II shows examples of different IoT applications.

Conclusion:

The IoT emerging model of networking will influence our day to day activities ranging from the automated houses to smart health and environment monitoring by embedding intelligence into the objects around us.Currently, there are more than 50 billion connected devices these days, exceeding petabytes of data between them. This is number is likely to expand in the future. However, only one percent of IoT data is used and analyzed. All these technologies are going to take IoT to the whole new level. Therefore, if you are not familiar yet with the IoT application development yet than you should hire IoT app developers or you should look to hire IoTdevelopment company who can guide you in developing your IoT business project.

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