Literature Review of IoT & 5G

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***Abstract*—The future of human life will be dependent on Internet of Things and 5G, which will transform the devices into intelligent machines. The purpose of this paper is to give an overview of IoT and 5G. In this paper, all the basic information about IoT and 5G is provided and also that how these technologies can change the perspective of human towards digital world. Because these technologies are going to be very useful in daily life for any type of person, from a small child to an old man, and from a student to a business tycoon. However, this paper will help new researchers, who wants to do research in these technologies.**

Keywords— IoT, 5G, Frameworks, Contribution

I. IOT-INTRODUCTION

The Internet of Things (IoT), is nothing but an environment of interrelated devices which are connected through internet. These devices have unique identifiers called as UIDs. In IoT, devices can transmit data using internet or any network. The best part is that it does not require any command from humans. So the communication between these devices are call machine to machine (M2M) communication. In simple words we can say that an IoT device can work automatically without any need to operate it by humans. An IoT device can be useful to monitor heart rate of a person, or it can be used to monitor air pressure in an automobile car by using sensors, it can be used to turn off all the lights in a home when no one is inside the home. Nowadays, organizations are using IoT more to control their working environment more efficiently, and to provide good services to customers.

II. IOT-HISTORY

- Kevin Ashton which is co-founder of the Auto-ID Centre at MIT. He was the first person who used the internet of things in a presentation he gave to Procter & Gamble (P & G) in 1999. He called his presentation “Internet of management”.
- Neil Gershenfeld who is professor in MIT. He has mentioned in his book “When Things Start to Think” appeared in 1999. He didn’t say the exact term but elaborated where IoT was leading.
- IoT has grown in these years, and nowadays there are many IoT devices available in the market, many examples are there like, smart Home, smart phone, smart watches, smart fire alarm, fitness tracker, medical sensors, smart bicycle etc.

III. WHY IOT MATTER

As we know that an IoT device is always connected to Internet, so means that it can transfer the data both sides, like sending and receiving, this feature transferring the data to both sides is called smart, that’s why IoT devices are called Smart.

For example, Our Mobile Phone(Smartphone), at a time we can do many things, and if we want we can listen any song or any video in the world but that song or video is not stored in our phone but because our phone is connected with Internet and all the songs and videos are stored in the servers somewhere in the world which can be accessed through Internet. Smartphones have that feature to transfer the data both so it can bring that video for us, it can send and receive. Smart devices don’t have huge storage, but they just need a little computing device which can connect to the internet and can transmit data from the device to somewhere else and vice versa. In IoT, we can divide all the devices into three types:

- Devices that gather info and then transmit.
- Devices that get info then process and react.
- Devices that perform both tasks

And all three of these have tremendous advantages that feed on each other.

A. Gathering and Transmitting Info

The gathering task is done by sensors. There are many types of Sensors available like, temperature sensors, motion sensors, moisture sensors, sensors to check air quality, light sensors, etc. These sensors can gather the

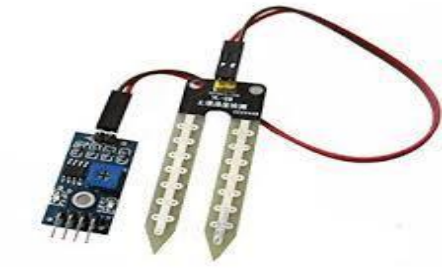


Image 1 Soil Moisture Sensor [11]

information from its surrounding area or environment automatically and can transmit it to the system from which it is connected.

For example, we take moisture sensor's use, we can use this for farmers, farmers can use it, so it will tell the information of soil and by that farmers can get an idea when they have to water the crops. By this, farmers will neither water the crops more nor the less but the exact amount of water which is needed for the crops. So, it will save the water and crops can be more healthy and better. It will help the farmers to earn more money, more crops which are needed for the world.

A human can see, hear, smell, touch, and taste similarly sensors can sense its surrounding environment which can be useful for humankind.

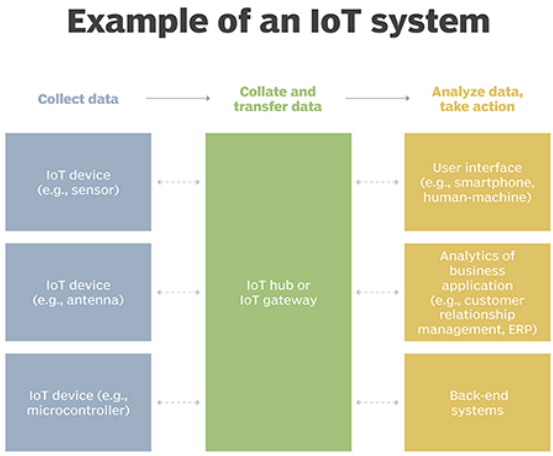
B. Getting and Process then React on Information

Any device must have a system from which it is connected. In this, devices which gather information and transmit is received by the system. Here we can say that there are few devices by which water can be supplied to the crops. But these devices also need to be operated by some human interventions. It is similar to commanding to print any document from our computer and printer prints it easily. It needs a command; we know that we can command a device by using the internet from anywhere in this world. But this is not real use of IoT, what if this can be done automatically, that would be smart.

B. Doing Both Tasks

It can be the system, which performs both tasks of gathering information and transmitting it to the system and processing the information and taking action according to the processed information. In this we can create a system including devices which can perform the first and second task which can be operated by a smart system, and farmers do not need to water the crops by themselves, the system will take care of everything. System will water the crops according to the data provided and processed by the devices and farmers can do other work. The system can also take the information of weather, and if there are chances of rain then it won't water the crops. Just think about this, and think that how much water is going to be saved by this whole system.

We can make large systems which can work on complex algorithms, and we can use different types of sensors, how much time is going to be saved, and what tremendous change we can see. By that we can also identify that the crops are ready to harvest or not. By this we can get the idea that all the farmers get these systems and it can be beneficial for the whole world.



IV. IOT-IMPORTANCE

The internet of things is very helpful for people to live easily and work more efficiently. We know that using IoT devices we make a whole smart home, but IoT is also important and helpful for industries. IoT helps businesses to know what actually going on into their companies. Using IoT they can track each and every activity in each department easily in their company and by using they get all the reports easily. It helps to improve their performance and better customer support. [1].

Using IoT, Industries can change their environment with IoT devices by this they can reduce labour cost. Companies can reduce their waste so that products will be less expensive and sales can increase. They can improve service delivery, by offering transparency to customers. IoT is useful for each and every type of industry or companies like healthcare, finance, retail, manufacturing and smart cities. Smart cities are trending things nowadays. In smart cities, there are smart homes, less energy consumption, and sensors can be used for farming too.

As we can guess, that IoT is going to be an important technology. It is useful for everyday life. It will grow every year, because in each department or type of field people has started using it and more research are going on into this field.

V. IOT-BENEFITS TO ORGANIZATIONS

- Observe all process.
- Customer experience gets better.
- Improves economy.
- Increases productivity from employees.
- Unify business models.
- Helps in decisions making.
- More profit.

VI. IOT-PROS AND CONS

A. *Advantage of IoT:*

- Accessing information is much easier.
- It provides better communication.
- Saves time and money because connected network.
- Businesses which are adapting automation are providing good services and reduced human interaction.

B. *Disadvantages of IoT:*

- Increment in Hacking, Hacker has many sources from where he can attack and can steal important information because the number of devices are increasing and they are connected.
- Managing all devices will be challenging for Enterprises because the count is increasing daily.
- A network of connected devices can collapse If there is loop hole or bug.
- There are many difficulties for the devices of different manufacturers for communication because there is no international standard for compatibility of IoT.

VII. IOT - STANDARDS

There are several emerging IoT standards:

- 6LoWPAN, it used for communicating internet because it uses low power radio signal. It also uses internet protocol version six (IPv6). It provides wireless personal area network. It is used for home automation. [2]
- ZigBee0, is an IoT standard which is mainly used in industrial settings. It is a low-power, low data-rate wireless network. [2]
- LiteOS, it is an operating system. LiteOS is used for IoT devices. [2]
- OneM2M, it is a layer in the architecture, which is called machine to machine, can be used in software and hardware for the connection of IoT devices. [1]
- DDS (Data Distribution Service) is standard for IoT devices. It is used for better communication. [2]
- AMQP (Advanced Message Queuing Protocol), is a protocol. It is open source protocol. It is used for asynchronous messaging through wire. Provides end to end encryption. [2]
- CoAP (Constrained Application protocol), designed by the IETF. It provides the specification for low-power devices. [2]
- LoRaWAN, stands for Long Range Wide Area Network. It is created for large networks. [2]

VIII. IOT – FRAMEWORKS

There are several IoT frameworks:

- AWS IoT, stands for Amazon Web Service released by Amazon. It is a cloud platform for IoT. This framework helps IoT devices for secure and easy connection to cloud.
- Microsoft's Azure, it is also cloud from Microsoft. It is a platform which provides services for IoT devices.
- Google has also launched Brillo/Weave. It is a platform which is useful for development of IoT apps. It has two main things. First, Brillo which is an operating system and second, Weave is a protocol, it is a mediator between devices and cloud.
- Calvin is released by Ericsson company. It is open source. It is a platform. It is used for developing and managing networking applications for devices which can talk to each other. Calvin is used in applications and runtime environments.

IX. IOT – APPLICATIONS

IoT has many real-world applications, it can be used for consumers, can also be used for enterprises, can be used for manufacturing and also can be used for industrial purposes. It can be used for energy, automotive things, and telecom companies.

For consumer purpose there are many examples, like smart homes which has different types of sensors to identify home is empty or not, smart appliances in smart home, smart lighting which can be accessed remotely via smartphones or computers, devices which can be worn have sensors and software that gathers information of users, these can transfer the data on the command of the user to anyone makes life easier, wearable devices can also be used for safety purpose in emergencies for firefighters.

IoT can also be used in healthcare, it has many benefits, like we small sensors can be implanted into patients' bodies to monitor their health. Hospitals have already started to use IoT devices for the benefit of patient's health.

In smart buildings IoT devices can be used for saving electricity, just like a smart home, if people forget to turn off the air conditioner then an IoT device can sense if there is no person in the room and it turns off the air conditioner automatically. It is just one example.

IoT can play an important role in agriculture as we mentioned above. It can be used for smart farming. Using IoT devices in farming can help to harvest crops, and can save a huge amount of water.

IoT devices can be used for smart cities, for example smart lights will turn off in day, and get on at night. IoT

devices will help to improve traffic, it can also be used for cleanliness.

X. IOT - SECURITY AND PRIVACY ISSUES

IoT is connecting devices to internet and the count is increasing day by day. By that involves large amount of data which needs security because it can be confidential. Whenever we talk about new technology we think first about security and privacy because in digital world hacking a common thing.

In 2016, Mirai attack was done which was a major attack. Dyn was attacked by Mirai, Dyn is a domain name server (DNS) provider. Because of it many websites were collapsed. It was a biggest DDoS attack. Hacker just hacked one of the devices which was less secure. [4]

Hackers can find a single vulnerability or loophole in any IoT device and can manipulate the data of the whole network because IoT devices are closely connected. Devices which are getting updated after a certain time period are more vulnerable.

Hackers are not only a threat, one of the major concerns is Privacy. It can also happen that companies which implement IoT devices, may sell user's personal data for the sake of money.

XI. IOT-FUTURE

Future of IoT is very bright and market is increasing daily, as follows:

- Bain & Company said in one of its articles that sales in IoT will be more than $450 billion in 2020. [5]
- More cities will become "smart".
- Artificial intelligence is going to transform the digital world into another environment.
- 5G Networks will play the key role in the growth of IoT.
- Cars will get even smarter – Tesla has already launched these types of cars. A driverless car which will pick you up automatically.
- IHS Markit said that IoT devices will grow 12% each year. [5]
- Gartner estimates that 20.8 billion IoT devices will be active by 2020. [5].

XII. 5G-INTRODUCTION

Currently the 5G wireless technology is the latest version technology is there in world. 5G technology will be increasing the data transmitted speed, because we will use the advance antenna technology. In 5G we have many features like speed, capacity, latency. using this features our mobile can do multiple network connection in a single network. for example: A self-driving car will use multiple network at each different place, so we will be having the multiples antenna at any different place so that we can use that antenna or we will be connecting with that, for these types of aims the 5G technology is helpful to provide a better connection[6].

If we get 5G technology in today world then we will get a better connection and because of that we won't get disconnected with any call. Any other which is related to internet connection as well. Using 5G we won't face these types of problem. In 5G technology we get better connection with better security, if security will be better than our data will be safe. Using wireless our highest ret will go up to 19 to above as well in future.[7].

XIII. HOW 5G WORKS?

The network which are wireless, we normally divide them into parts. So that we can send the data using radio waves. The previous technology was using the less frequency of order. The industry is also using the less frequency collaboration connection. Less frequency will get bigger distance. The order of connection between to 20 to 400 GHZ for high speed and to reach the destination in less distance.[6]

As I said in 5G technology we will have multiple connection so that we can cover the area and for millimetre waves order as well. In millimetre waves we face a problem with area means how much area we have to cover, using 5G, accordingly less frequency collaboration network could be used to build their network. We have mentioned that in 5G technology we use antenna to cover the whole area or any other location, in that case we use small-small cells to cover. Before we were not using that but in today's Date, we do this. By every cell when we move from one to another then we get another cell network that is how antenna or cells are working in 5G technology.[9]

XIV. STATUS OF 5G?

In the four countries- china, japan, south Korea and united states. In these few countries 5G technology is available. In these countries much and more money business has invested for 5G. many countries where 5G is not available yet even. Now in case we have 5G technology in our country than we should we have a 5G smart phone as well. In the market Samsung and apple are the only two companies are there who provide 5G phone. So, if we want to use 5G technology than we must have to buy a 5G phone as well.[9]

XV. WE WILL HAVE 5G?

We already have 5G, but we don't have the smartphones yet. We are not able to use 5G technology. The 5G technology has been launched already in the countries, so there is some condition as well we have. Like as I said in the market only more than 2 mobile phones are available for 5G technology. With that phone only we can use 5G technology otherwise not, because these cell phones are compatible with 5G technology.

XVI. 4G VS. 5G

Every technology of different – different generation have been differentiated. We cannot differentiate a technology only basis on its speed, also we identify the end user requirements. In every new generation we define the new technology. So that we can get something better features then previous. Like in the 4g if we have speed up to 10% then in the 5G will have speed up to 20%. Which is better than 4g. In the 5G the internet speed will be good then 4g. [8]

XVII. 5G TECHNOLOGIES

A. *Communications of Millimetre Waves:*

The high frequency order or collaboration gives us more orders. The frequency of 5G can used around 10 GHz to 30 GHz or can use more than this as well. Every country provides the different order for frequency. In the millimetre waves actually, we define or represent the communication between the two devices with their frequency that on what frequency rate that can communicate. So, there will be different – different rate we will have for communication. Some time it has 10 GHz. Sometime it can have more than this. So, it depends about the devices, their network and may be on their smart phones. Because if considered two different technology like 4g and 5G then it matters.[9]

B. *Waveforms:*

We can see new waveforms. 4G uses high data rate systems with OFDM is used successfully in important areas, but there are some controls in any situation. Some others include GFDM waveform are discussed to generalized Frequency Division Multiplexing, Universal Filtered Multicarrier, and as Filter Bank Multicarrier. This is no pure waveform, or this is understandable that OFDM in the form of OFDMA is use to provides better performance without requirement of processing on the big level [9].

C. *Multiple Access:*

once again is 5G technology is doing an investigation that has different types of new plans. We should discuss including PDMA, SCMA, NOMA, OFDMA, MUSA and IDMA in 5G technology. since suggested, before this seems that OFDMA is the most hopeful format.[9]

D. *Dense network:*

The cells of size provide a reduction that spectrum is possible used effectively. There is required that the secure technology of small cells in the macro network and also femtocells required. Technologies are improving for a challenge because they allow adding a large number of additional cells to a network [9].

E. *Outlook:*

5G is accessible here, but not completely, it should be large because many cities are coming online from 4G technology into 5G technology and 5G devices are available in the markets. many people were hoping that 5G will came in 2019. however, when the crowds will have an important force for next-generation in 2020. when we expect the first 5G phone in Next year is not only, but when the network is converted into a large area of the network. we will see the power of 5G technology.

CONCLUSION

In the end we can say that, IoT is future but for as we know that IoT devices require internet with better speed and connectivity, and 5G will play a major role in this task. IoT devices will make human life better and more efficient and 5G will provide better communication system for IoT devices. So, in the conclusion we can say that both are reliable on each other, so that IoT and 5G market can grow easily. IoT will play a major role for business because it will provide a base platform. 5G will provide a better communication to those platforms and with that large amount of data can be transferred via internet easily.

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