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A Survey on Internet of things: Technology, Protocols and its Applications

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ABSTRACT

The internet of things is the network of the devices which allows connecting, interacting and exchanging data without human-human communication and human-machine communication. The IoT involves extending internet connectivity to non-internet enabled physical device and everyday objects beyond standard devices. The main objective is to provide a study of different technologies, protocols and applications of IoT.

Key words: IoT, Bluetooth, RFID, Wi-Fi, M2M

1.INTRODUCTION

The Internet of Things is a network of physical devices which is connected using API and sensors. Now a days “Internet of things" (IoT) is becoming an increasingly growing topic of conversation both in the workplace and outside of it. The basic idea of this concept is the presence of a variety of objects such as RFID, RFID reader, Wi-Fi, Arduino controller, NFC, mobile phones. The RFID is the most important concept in IoT. Different technologies like RFID, machine to machine communication, vehicle to vehicle communication etc. are implemented using IOT. The “Internet of Things” involves networking the non-internet enabled physical device and everyday objects beyond standard devices.

There are various technologies that can be used to implement the concept of Internet of Things. In this paper, we discussed the following technologies:

- Radio Frequency Identification (RFID)
- GPS
- Machine-to-Machine Communication (M2M)
- Vehicle-to-Vehicle Communication (V2V)
- RFID Reader
- Internet Protocol(IP)
- Wireless Fidelity (Wi-Fi)

2. TECHNOLOGIES IN IoT

2.1 RFID

RFID (Radio Frequency Identification) devices are wireless microchips used for attaching objects for automated identification and tracking tags attached to it. It use radio waves in the form of serial numbers [2]. This technology plays vital role in IOT for solving identification issues. RFID system is composed of a reading device called reader and many RFID tags [9]. These tags use radio-frequency electromagnetic fields to transfer data attached to an object. These tags contain electronically stored information. Passive tags collect energy from a nearby RFID reader's cross-questioning radio waves [3]. The RFID device serves the same purpose as a magnetic strip or bar code on the back of a credit card or ATM card it provides a unique identification for that object. And, just as a barcode or magnetic strip must be scanned to get this information, the RFID device must be scanned to get back the identifying information.

2.2 RFID Reader

A radio frequency identification reader is a device which is used to collect information from an RFID tag, which is used to track individual objects. Radio waves are used to move data from the tag to a reader. The tag must be within the range of an RFID reader, which ranges from 3 to 300 feet

2.3 INTERNET PROTOCOL (IP)

Internet Protocol (IP) is the primary network protocol which is used in the Internet. The two versions of Internet Protocol (IP) are: IPv4 and IPv6. Each version defines an IP address uniquely [2]. There are five classes in IPv4: Class A, Class B, Class C, Class D and Class E, while commonly used classes are A, B, and C[2].

2.4 Wireless Fidelity (Wi-Fi)

Wireless Fidelity (Wi-Fi) is a networking technology. Wi-Fi allows computers and other devices to communicate over a wireless signal.[2] Wi-Fi is a technology for wireless local area networking with

devices based on the IEEE 802.11 standards. [5]Devices that can use Wi-Fi technology include personal computers, smart phones, digital cameras, tablet computers, and modern printers. Wi-Fi compatible devices that can connect to the Internet via a wireless access point and WLAN network. [2]

2.5 Machine-to-machine communication (M2M)

Machine-to-Machine (M2M) refers to the communications between computers, smart sensors, embedded processors, mobile devices and actuators [9] . The use of M2M communication is increasing in the scenario at a fast pace M2M has several applications in various fields like , smart robots, cyber transportation systems (CTS), manufacturing systems, smart home technologies, and smart grids[9]. Example of M2M area network typically includes personal area network technologies, such as Ultra-wideband and Local networks or Bluetooth.

3. ALGORITHM USED IN IOT

Trilateration Algorithm [6]

From Figure 1,

- Trilateration is an algorithm of determining relative or absolute locations of points by measurement of distances [6].
- Trilateration does have practical applications such as navigation and surveying, including global positioning systems.

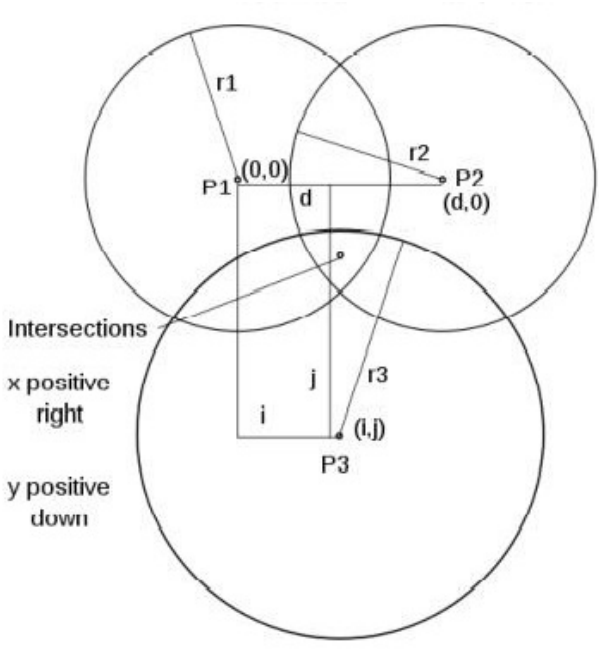

Figure.1: Trilateration Algorithm

4. IOT ELEMENTS

1. Sensing

The first step in IOT workflow is collecting information at a "point of activity" [1]. This can be information captured by an appliance or a wearable device. The sensing can be environmental, biometric, biological, visual or audible. The unique context of IOT is that the device doing the sensing is not one that typically collected information in this way. Sensing technology specific to this purpose is required. There are temperature sensors, current sensors, voltage sensors, web page, and relay. [7]

2. Communication

Most of the new IOT devices are not designed for optimal communication with cloud services. IOT devices require a medium for transmitting the information sensed at the device level to a Cloud-based service for subsequent processing.[1] This is where the great value inherent in IOT is created. This requires either Wi-Fi or WAN communications.

3. Cloud Based Capture

The collected data is transmitted to a cloud based service where the information that comes from the IOT device is collected with other cloud based data to provide useful information for the end user. The data being combined with information from other internet sources as well as from others subscribing with similar IOT devices.

4. Delivery of Information

The final step is delivery of useful information to the end user. That may be a consumer, an industrial or a commercial user. It can be another device in the M2M workflow. The goal in a consumer use case is to give the information in simple and transparent a method as possible.

5. Semantics:

Semantic in the IOT refers that the ability to extract knowledge smartly by different machines to provide the required services [1]. Knowledge extrication includes discovering and using resources and modeling information

5. PROTOCOLS IN IoT

In Figure 2, We have broken the protocols into the layers to provide some level of organization [4]:

1. Infrastructure (IPv4/IPv6)
2. Identification (IPv6, URIs)
3. Transport (ex: Wi-Fi, Bluetooth,)
4. Discovery (ex: Physical Web, DNS-SD)
5. Data Protocols (ex: MQTT, CoAP,)
6. Semantic (ex: JSON-LD, Web Thing Model)
7. Multi-layer Frameworks (ex: Home kit).

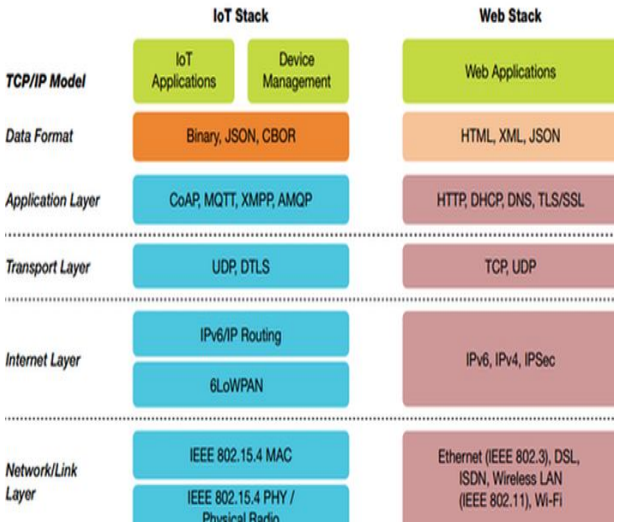

Figure 2: Protocols in IoT

6. IOT CHALLENGES

A. Availability

Availability of the IOT must be realized in the hardware and Software levels to provide services anytime and at anywhere for customers. The availability of software refers to the ability of the IOT applications to provide services for everyone at different places simultaneously.

B. Security Concerns

If the IOT devices are not secured, cyber attackers will use them as entry points. To cause harm to other devices in the Network. This will lead to loss of personal data to the public.

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C. Privacy issues

These devices collect user data without their permission, analyze them for only to known to the parent company. The social dependence of the IOT devices leads people to trust these devices, with collection of their personal data without understanding the future use.

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D. Inter-operas ability standard issues

The information exchange should take place between all the interconnected IOT devices in an ideal environment. But the actual scheme is inherently more complex and depends on various levels of communication protocols stacks between such devices.

7.APPLICATION OF IoT

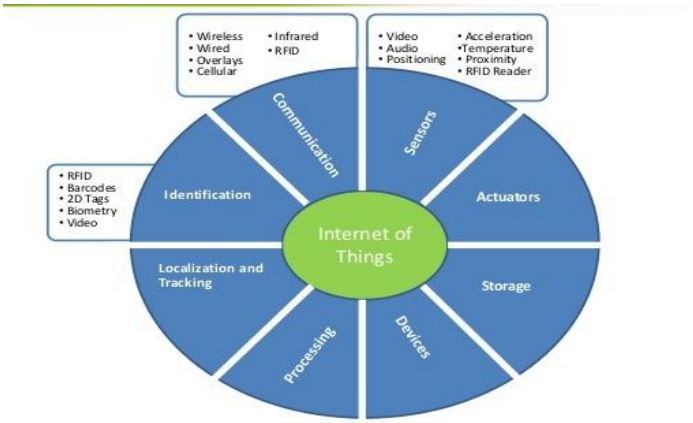

Figure 3: Applications of IoT

A. Smart Home

Smart Home clearly stands out, ranking as highest IoT application on all measured channels. We are surrounded by various electronic gadgets around us such as refrigerators, microwave ovens, heaters, washing machine air conditioners, fan and lights etc.[8]. Actuators and sensors can be installed in these devices for the effective use of energy sufficiently and also to add more comfort in life. These sensors can measure the outside temperature efficiently.

B. Smart parking

The new Smart Parking sensor's to be buried in parking spaces to find the arrival and departure of vehicles. The Smart parking provides extensive parking management solutions which helps the user to save time and fuel [9].

.C. Health

It can collect information about health and send the collective data to health monitoring center. [9]These centers can, analyze health and provide the valuable report and information to the individual.

D. Smart City

Smart city spans a wide variety of use cases, from traffic management to water distribution, urban security, to waste management and environmental monitoring. Its popularity is fueled by the fact that many Smart City solutions promise to reduce real pains of people living in cities these days. IOT solutions in the area of Smart City solve traffic congestion problems, reduce noise and pollution, help make cities safer, and more eco friendly

E. Smart Water Supply

Smart cities must monitor water supply to ensure that there is sufficient access for resident and business need. Wireless Sensor Networks provide the technology for cities to monitor their water piping systems more efficiently and discover their greatest water loss risks.[9] Cities that are addressing water leakage problem with sensor technology are producing high profit from their investment.

F. Smart Cars

Machine to machine (M2M) communications, and especially Smart Cars, could help to reduce accidents. [9]The**se** driverless cars will provide safety, save valuable time and reduce stress of driving.

8. CONCLUSION

Today IOT is being implemented everywhere Smart city, smart environment, security and emergencies, smart business process, smart agriculture, domestic and home automation and healthcare as shown in Figure 3. In this paper, we presented how the technologies and its specification can make Internet of Things a reality. After that, we state some examples where Internet of Things is of great use, and we discuss some open issues which are still to be solved before the wide acceptance of this technology.

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