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ROLE OF RFID TECHNOLOGY IN INTERNET OF THINGS

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ABSTRACT

Today's the Internet of Things (IoT) has been emerging as the next big thing in internet. The IoT is basically a globally interconnected continuum of various devices, objects and things that are connected to the internet via heterogeneous access networks enabled by technologies such as embedded sensing and actuating, radio frequency identification (RFID), wireless sensor networks, real-time and semantic web services etc. RFID provide the facility of wireless storage and automatic retrieval of data and it also provides a significant improvement over conventional identification, tracking, healthcare and stocking of object. IoT is actually a cyber-physical systems and network of network. Nowadays, a large number of different means are used to enable communication between heterogeneous devices. The main objective of this paper is providing an overview of internet of things and role of RFID technology and its real-time applications for the usages in our daily life.

Keyword: *Internet of Things, RFID Technology, Wireless Sensors, Cloud Computing*

I. INTRODUCTION

IoT is the next technological revolution after the revolution of computer and internet. IoT integrates the new technologies of computing and communication (e.g. Sensor networks, RFID, Mobile communication and IPV6 etc).

The term "Internet of Things" was coined in 1999 by Kevin Ashton, then executive director of the MIT Auto-ID Center [1]. The Internet of Things (IoT) refers to the next generation of internet that contains billions of physical things or objects in general emerged with the RFID Technology, and this concept has considerably been extended to the current vision that envisages a plethora of heterogeneous objects interacting with the physical environment. With the huge number of things/objects and sensors/actuators connected to the internet, a massive and in some cases real-time data flow will be automatically produced by connected things and sensors. So it is important to collect correct raw data in an efficient way; but more important is to analyze the raw data to abstract more valuable information such as correlations among things and services to provide web of things or Internet of services.

In Fig.1, Radical evolution of the current Internet into a Network of interconnected objects that not only harvests information from the environment (sensing) and interacts with the physical world, but also uses existing internet

standards to provide services for information transfer, analytic application and communications. Analysts estimate that 50 billion devices will get connected to the internet by 2020[2].

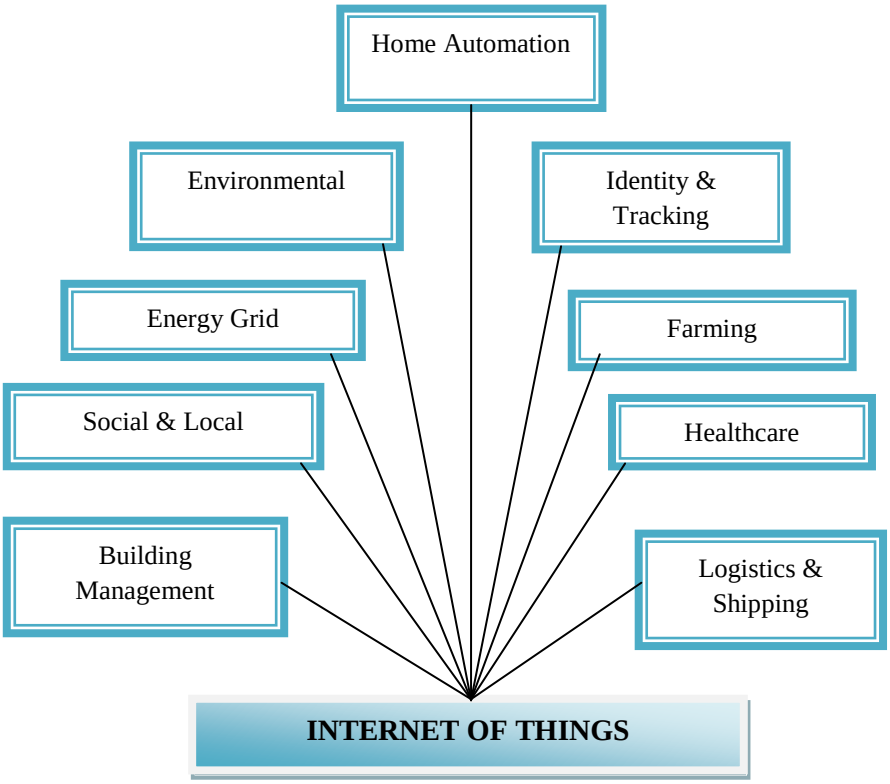


Fig.1: IoT Schematic showing the ends user and application areas based on data

II. RADIO-FREQUENCY IDENTIFICATION (RFID)

RFID uses electromagnetic fields to automatically identify and track tags attached to objects. The RFID technology is a means of gathering data about a certain item without the need of touching or seeing the data carrier, through the use of inductive coupling or electromagnetic waves. The data carrier is a microchip attached to an antenna (together called transponder or tag), the latter enabling the chip to transmit information to a reader (or transceiver) within a given range, which can forward the information to a host computer [3].

In 1948 first time RFID device is used in Britain. Later RFID technology is founded at Auto-ID center in MIT in the year 1999. RFID technology plays an important role in IoT for solving identification issues of objects around us [4]. RFID can be used in a variety of applications such as Fig.2: Major RFID applications.

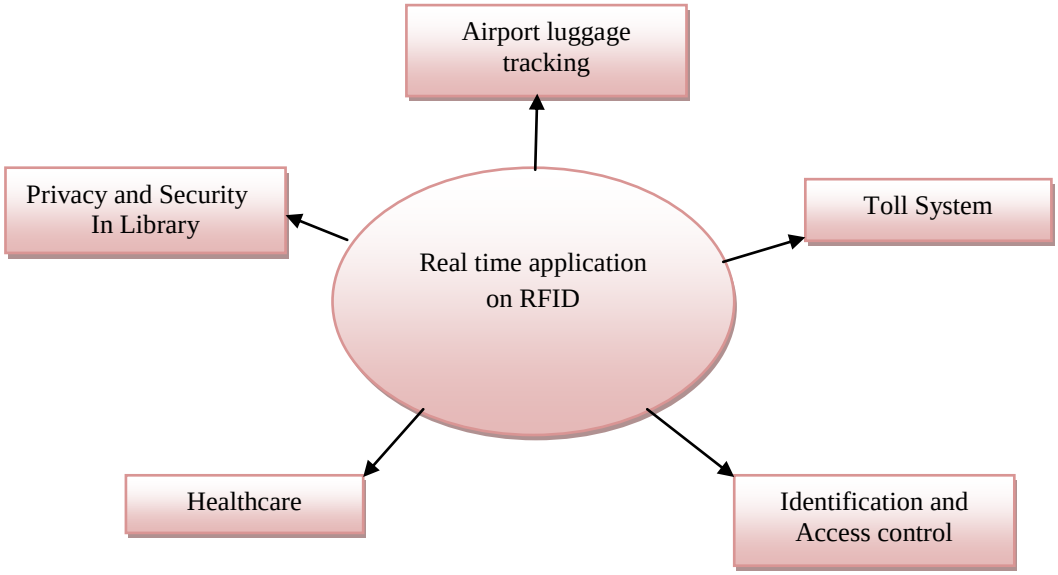


Fig.2: Major Application of RFID

2.1 Airport Luggage Tracking

Commonly communication within airports for luggage tracking is proposed using Radio Frequency Identification (RFID)-based technologies [5][6]. This proposed system aims to revolutionize baggage reclaim in smart cities' airports. Shown in Fig.3 is proposed system architecture.

Fig 3: Overall System Architecture [7]

A smart tag that can be easily charged and thrown into your luggage for its accessible, tracking and reclaim is the main component of the proposed system. This institutes communication between it and database server through Wi-Fi. The users, i.e. luggage Owners, are notified whether their luggage has arrived yet, its location (for connected flights), and the Estimated Time of Arrival (ETA) on their smart phones and smart-watches through fusion of multi sensor and flight data. [7]

2.2 Toll System

Toll systems using RFID technology to facilitate electronic toll collection is widely deployed, especially in highway and car park. The RFID toll system enables vehicles to check-in and check-out automatically under a fast, contactless, secure and convenient environment. However, cars must be queuing up and pass through the toll system gate one by one [8]. Electronic toll collection use E-ZPassis widespread. The active E-ZPass transponder attaches to a car's wind-shield or front license plate; as the car drives over a toll road, the transponder sends account information to equipment in the toll collection lanes. The toll then automatically deducts from a prepaid account [25]. RFID based automatic toll systems helps to solve the traffic jam problem caused by the long queue in human manned toll station.

2.3 Identification and Access Control

In Access control and personal identification applications, RFID tags are embed in ID cards, is another major application of RFID [18]. Now, new generation of ID cards and student smartcards adopt RFID technology. The USA passport embedded with a RFID tag inside. The RFID tags provide a more reliable storage of identification information compared to magnetic strips. Moreover, many organizations use RFID cards to control different levels of access according to different security levels granted to the card owner. Readers are deployed at the building entrance and only allow authorized person to get access.

2.4 Healthcare

The healthcare industry has been investing ever more money in information technology (IT) to reduce operating costs and improve patient safety, and RFID is expected to become critical to healthcare organizations achieving these two goals [19]. Therefore, some hospitals and medical institutes are starting to conduct their own small-scale RFID testing projects. However, "the hospitals have the form of a professional bureaucracy in that clinical staff, especially medical staffs, acts with a considerable level of autonomy" [22].

RFID technology could aid the medical staff in performing their duties and reduce medical error [19]. Another major RFID application in healthcare center is the access control of staffs and patients. Each of them is issued with a RFID card recording their access permissions. The control center can locate patient or staff by the readers deployed in different locations. The center can also track patients and control the access of medical equipment and restricted zone. Some hospitals tag all equipment and use the tag to track equipments. This helps managing inventory and ensuring proper maintenance of equipment. Some hospitals also use RFID tags on new-born babies to ensure their identification. If someone attempts to take the baby away from the hospital without authorization, the system will alert hospital staffs [20]. In drug managements, RFID technology could be used to identify fake drug and monitor real-time stock. In hospital, RFID also works with other sensors to collect patient's health information. RFID technology offers a great market potential in this area [21].

2.5 Privacy and Security in Library

The RFID tag also acts as a security device that give a scheme for building private authentication with work logarithmic in the number of tags and protocols that achieve private authentication without expensive cryptographic primitives. [27]

Many libraries are starting to tag every item in their collections with radio frequency identification (RFID) tags and make use of a bibliographic database to track circulation information about items in a collection. Each book has a unique number in a library, usually called a bar code. Without the bibliographic database, an adversary cannot directly map a bar code to the title and author of a book. Some library RFID proponents have argued that an adversary without the database and with only short-range readers poses little to no risk. In addition, some vendors suggest placing extra information on the tag, such as shelf location, last checked out date, author, and title [26][27]. Several libraries use RFID technology such as the University of Las Vegas libraries, New Hanover Libraries in Wilmington, NC, and the Santa Clara City libraries in Santa Clara, CA, the University of Nevada, and the Eugene, Oregon public library have already tagged every book, tape, CD, or other item in their collections.[27]

III. WIRELESS SENSOR

Latest trend of wireless communications have made available efficient, low cost, low power miniature devices for use in remote sensing applications. The combination of these all factors has improved the viability of utilizing a sensor network consisting of a large number of intelligent sensors, enabling the collection, processing and analysis of valuable information, gathered in a variety of environments [23].

A Wireless Sensor Network(WSN) consisting a globally interconnected continuum of devices, objects and things that are connected to the Internet using sensors to pass data along from one to another cooperatively monitor physical or environmental conditions, such as temperature, sound, vibration, pressure or motion at different locations (Wikipedia). A wireless sensor network is an important element in IoT paradigm. WSN based on IoT is widely used in many areas, such as military, homeland security, healthcare, precision agriculture monitoring, manufacturing, habitat monitoring, forest fire and flood detection and so on [9]. For example sensors mounted to a patient's body are monitoring the responses to the medication, so that doctors can measure the effects of the medicines [13].

IV. CLOUD COMPUTING

The recent trend in IT, takes computing from desktop to the whole World Wide Web. User has to bear only the cost of usage of service(s), which is called, pay-as-you-use, in cloud computing terms. With use of cloud computing, a smart phone can become an interface to large data center. Cloud computing is extended form of distributed computing, parallel computing, and grid computing [24]There are four types of services provided by cloud computing are: [11]

I. Software as a Service (SaaS)
II. Platform as a Service (PaaS)

III. Networks as a Service (NaaS)

IV. Infrastructure as a Service (IaaS)

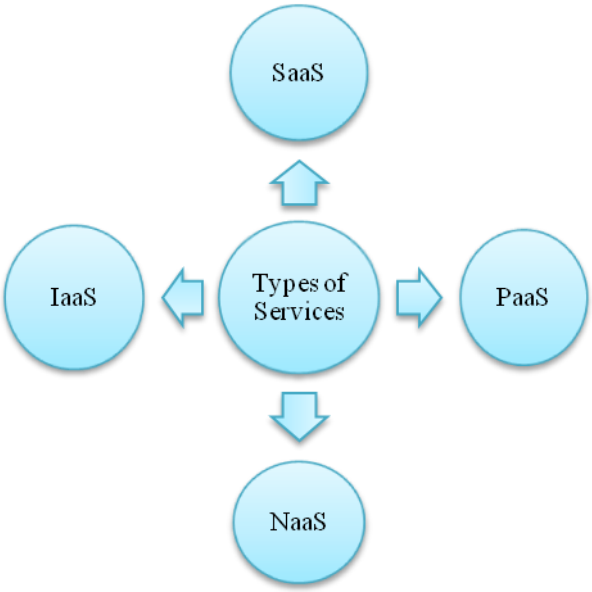


Fig.4: Types of Services of Cloud Computing

SaaS services refers to application working over the Internet, which is available for the end users on pay-as-you-go basis[16].Users only required Internet connectivity to access the service that has been rented out by the SaaS service provider on the cloud. Users not need to maintain the application.

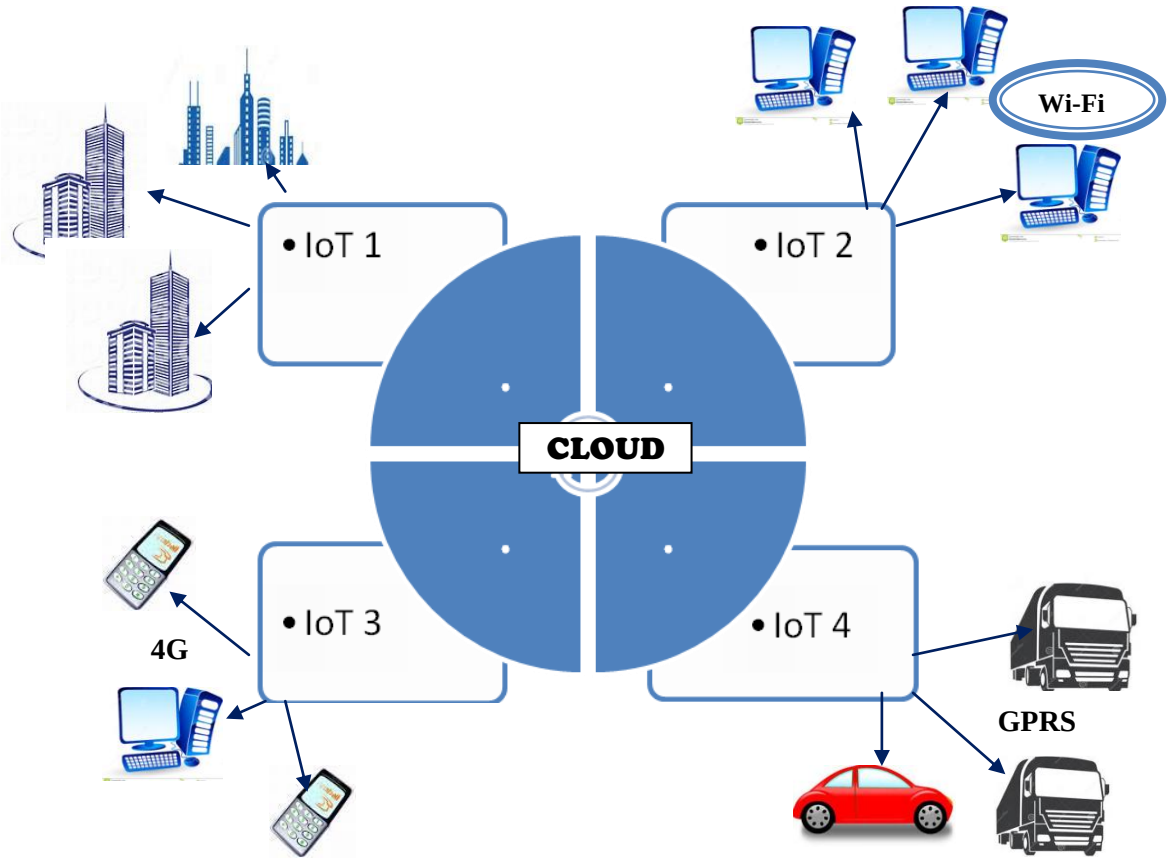
PaaS services are providing a platform to build applications and services, with all the toolkits and resources required to do so [17].

NaaS services provides virtual network to the users, with desired segmentation and policy enforcement. With NaaS, user can also have heterogeneous networks, for example, IPv4 and IPv6 segments working in co-existence or separately.

IaaS services are provides computation and storage services on rental basis. Instead of purchasing expensive machines, servers, and storage devices, even for small tasks, user can outsource this task to the IaaS service provider. With this storage services IaaS, not only the data is stored by the IaaS service, but also it makes the data universally accessible over the Internet [10]

4.2 Iot's and Cloud – Data Communication

CLOUD OF THINGS (CoT): Internet user is moving towards web3, the ubiquitous computing web. Since 2011, number of connected devices has already exceeded the number of people on Earth. Already, connected devices have reached 9 billion and are expected to grow more rapidly and reach 24 billion by 2020[12]. In today's world, number of connected devices is rapidly increasing, so there is going to be a lot of data as well. For storing such large amount of data locally and temporarily we need large storage space, all this is possible with the cloud computing. IoT and cloud computing working in integration makes a new paradigm, which we have termed here as Cloud of Things (CoT). Figure 5 presents an overall communication pattern of CoT [10].



V. CONCLUSION

In this paper, the most important terms in regards to the Internet of Things (IoT's) and their integration with cloud computing, RFID Technology and wireless sensors for efficient utilization of resources and more useful service provisioning to the user. IoT has been gradually bringing a technological change in our daily lives. This helps us for making our life simpler, faster and more comfortable through various technologies and applications. This integration or working in coordination, termed as Cloud of Things (CoT), which has been discussed in this paper.

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