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Survey Paper on IOT Enabled Technologies, Protocols and Smart Applications

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Abstract- This paper presents Internet of Things in a wider context with enabling key technologies, system architecture and the major application domains where the Internet of Things will play a vital role. IoT is enabled by the latest developments in (Radio Frequency Identification) RFID, Machine to Machine (M2M) communication, and Near Field Communication (NFC), sensors, actuators, mobile phones, etc. The current revolution in the communication field is the internet of things. In the world of new technologies RFID seemed to be necessary for the IoT. These technologies are used to implement the modern concept of IoT as explained in this paper. Including these technologies, IoT architecture and application of this existence technology, we have proposed an idea of unique identification. Using the Aadhaar card, the unique identification (UID) would be the solution of various fake schemes such as fake polling, fake identity etc. The Aadhaar card is a digital identity of unique 12 -16 digit alphanumeric number to provide more security digits which would not just help the government way down individuals, but also make life extreme easier for citizens. UID system helps to deal with people's personal detail. This system would help to provide authenticated polling and makes our welfare system right for the every citizen of India using the IoT technology.

Index terms- *Internet of Things (IoT), RFID, UID, NFC, and M2M*

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I. INTRODUCTION

Internet of things is the network of tremendous devices, vehicles, buildings, and other items embedded with electronics, software, sensors, actuator s, and network connectivity which enable these objects to collect and exchange data. The term ``Internet of Things" was introduced firstly by Kevin Ashton in 1999[1]. However, the key research and development works in IoT has started around 2010[2]. The IoT is expected to bridge diverse technologies to enable new applications by connecting physical objects together in support of intelligent decision making [3]. For the investigation of the IoT in depth, communication between two computers was made possible through a computer network using TCP/IP. The brief discussion of layered architecture is shown in the next section. As the generation has changed the rapid growth in technology has became possible as an example after the commercial use of internet has started Later, the World Wide Web (WWW) became available in 1991. The next step towards internet development was that, the mobile devices connected to the Internet and formed the mobile-Internet. After this revolution in the internet, all objects around us will be able to connect to each other (e.g. machine to machine) and communicate via the Internet and this is called the internet of things [12].

According to Gartner report, by 2020 about 20.6 billion devices across all technologies will connect to each other. This will be the huge change in the world of internet and connected devices. Then the privacy and security would be the most concerns, but we can't ignore the advantages of IoT. Today's IoT provides Best-Effort communications for cloud Services [4]. The goal of IoT is to create a "connected world for human beings".

II. IOT LAYER ARCHTECTURE

IoT is an enormous network having seven layers as shown in fig 1. It deals with an open system, that is, system that are open for communication with other systems. This system is called OSI (Open System Interconnection) reference model.

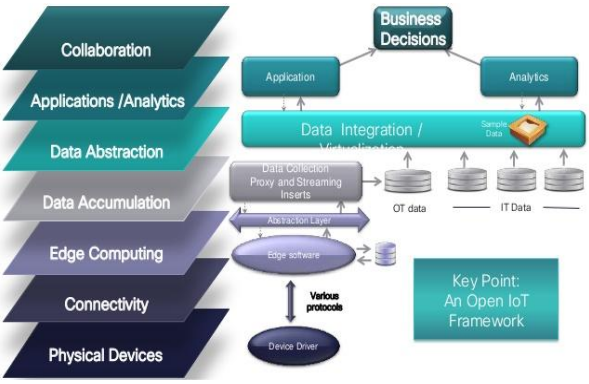

Fig.1- IoT layer architecture

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IoT layer architecture has seven layers-

A. *Physical layer*- Physical layers define mechanical, electrical, functional and procedural aspects of physical link between networks. This layer work as things in the internet of things.
B. *Data link /Connectivity layer*- Main task of the data link layer is to transform a raw transmission facility into a line- This layer of IoT framework works as a connectivity layer.
C. *Network/Edge computing layer*- How the data are routed through a network is defined in the network layer. This layer provides the feature of data element analysis and transformation.
D. *Transport/Data accumulation layer*- Transport layer is responsible for reliable delivering the complete message from the source to the destination. The major objective is to provide end-to-end error recovery and flow control. This layer works as data accumulation or storage of "thing" data.
E. *Presentation/Data abstraction layer*- For application programs to understand the information transferred between devices which have different internal data information such as character code, data types, and file formats. Hence this layer protocol determines what syntax to use and encryption and decryption of data.
F. *Application* /Analytics *layer* - The application layer contains high level protocols. One widely used protocol is HTTP [9]. This layer provides the functioning of reporting, analytic and control within the network.
G. *Collaboration and processes*- This layer involve people and business process.

III. ENABLING TECHNOLOGIES

A. *Radio Frequency Identification (RFID)*

Radio frequency is an enabling technology of IoT that uses radio frequency waves to transfer data between the reader and movable item to identify categorize track[10][8]. Radio-frequency identification uses electromagnetic fields to automatically identify and track tags attached to objects. The tags contain electronically stored information which can be read by RFID reader. Tags contain the specific address of an object. Unified Information Devices (UID) Identification Solutions provides a 100% secure method for the identification of animals and other items using RFID technology [11]. UID combines current RFID technology in the form of Microchips and RFID Labels too automatically and 100% accurate data collecting. RFID tags can be accessed and the information stored in tags can be obtained, modified, and deleted by the adversary [3][5]. A one common type of storing data set is Electronic Product Code (EPC) using the EPC code objects can be identified uniquely. The tag is written by the RFID printer and contains 96 bit string of data.

Types of tags:

- *Passive Reader Active Tag (PRAT)*: As the name implies that the reader is passive and receives the signal from the battery operated active tags. It is used for freight containers and air pallets.
- *Active Reader Passive Tag (ARPT*): This tag does not have onboard power supplies, so it harvests the energy required to send data from the query signal sent by the RFID reader.
- *Active Reader Active Tag (ARAT*): In this both the reader and the tags are active tags.

Radio-frequency identification (RFID) uses electromagnetic fields to automatically identify and track tags attached to objects. The tags contain electronically stored information. Passive tags collect energy from a nearby RFID reader's interrogating radio waves and active tags may operate on hundreds of meters from the RFID reader and have a local power source such as a battery. This method is one of the methods for Automatic Identification and Data Capture (AIDC).

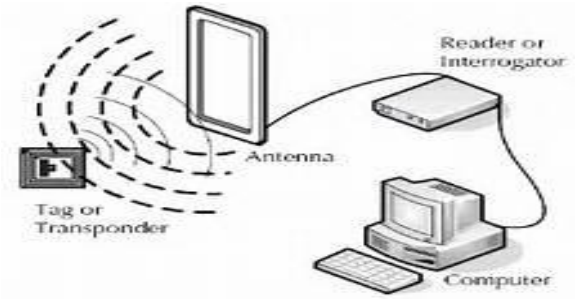

Fig.2 Radio frequency identification

Signaling between RFID reader and tag:

Signaling between the reader and the tag is based on the frequency band used by the tag. Tags operate on low frequency (LF) and high frequency (HF) bands near to the reader antenna because it operates in near field region, in terms of radio wavelength. The tag is closely coupled electrically with the transmitter in the reader these tag can modulate the field produced by the reader by changing the electrical loading.

Active tags may contain functionally separated transmitters and receivers. More than one tag will respond to a tag reader when process occurs. Two different types of protocols are used to "simulate" a particular tag, allowing its

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data to be read in the midst of many similar tags. In a slotted Aloha system, the reader broadcasts an initialization command and a parameter that the tags individually use to pseudo-randomly delay their responses. When using an "adaptive binary tree" protocol, the reader sends an initialization symbol and then transmits one bit of ID data at a time; only tags with matching bits respond, and eventually only one tag matches the complete ID string

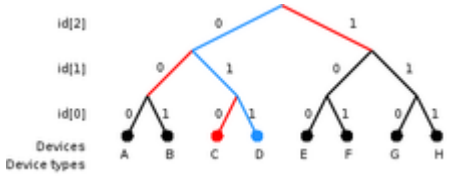

Fig.3 An example of a binary tree method of identifying an RFID tag

B. *Near Field Communication(NFC)*

Near field communication is wireless short range high frequency technology. In the popularity of smart phones this short range communication is mainly aimed for mobile or handheld devices. It is quite similar to RFID and can be said that it is an integration of RFID but it enhance the security compared to RFID. NFC can also be seen as a type of radio communication which is established by touching the two phones or keeping them in proximity of a few centimeters (up to 10 cm)[4]. In this way of communication are inherently more secure because it does not suffer problems of contact wear, corrosion. Data exchange rate of contactless communication today up to 424 kilobits/ sec.NFC transfers the data in close proximity (10 cm) with the frequency range of 13.59 MHZ.

It allows for simplified transactions, data exchange, and wireless connection between two devices and allows consumers to perform contactless transactions, hence it connect electronic devices with a single touch.

C. *Machine to Machine Communication(M2M)*

Machine to Machine (M2M) communications enable ubiquitous sensing, controlling, and acting via sensors, actuators, and actors [5]. Reliability and security are most important features of wireless M2M systems. Machine-type communication (MTC) is the key technology to support data transfer among devices (sensors and actuators) in Internet of Things [4]. M2M communication has many features such as the wide distribution, high-density deployment and small-sized packet transmission etc.

M2M communication is often used for wireless remote monitoring as warehouse management, traffic control, supply chain management, remote control, robotics, Fleet management and telemedicine etc.

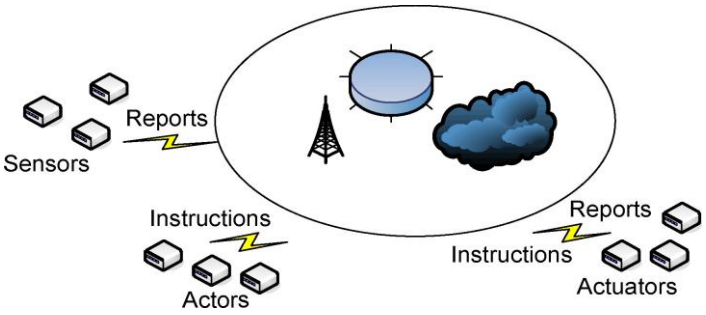

Fig. 4 Model for wireless M2M communication [5]

IV. PROPOSED SYSTEM

Unique Identification Authority of India (UIDAI) is issuing an AADHAAR card to every individual resident which contains a 12 digit unique identification number as identity proof for availing all service of government and non-government. Aadhaar card is provided with highly secured authentication. The biometric authentication is usually based on personal information, bio metric, demographic and One Time Password (OTP).The proposed system would make our welfare system fairer for every citizen of India. The project of unique identification system has been decided to take biometric of all ten fingers, iris scan of both eyes and face authentication accomplished. This information is send to the service provider which connects with the Authentication User Agency (AUA) that establishes a secure leased line to the Central Information Data Repository (CIDR) at UIDAI to seek identity authentication response. The CIDR verifies the collected information based on the already stored data and give the response either authenticate or fake.

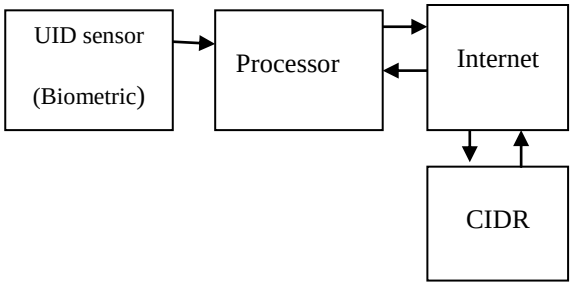

Figure.5 UID authentication.

This scheme of polling will reduce the fake voting and duplication and will make our welfare system fair to every citizen. This paper is an attempt to make the authenticated welfare system and thereby decreasing the fake voting at the time of election using this biometric authentication scheme. Fewer components are used to reduce the cost. This system is validating, cheap and unique as shown in fig.5

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V. THE EXISTENCE OF IOT TECHNOLOGY IN TODAY'S WORLD

The new wave of connectivity is going beyond laptops and smart phones; it's going towards connected cars, smart homes, connected wearable, smart cities and connected health care, smart apps for controlling room activities, agriculture, transportation, defense, smart infrastructures, managing parking areas in cities and a lot more, Basically a connected life. In our daily life there are many internets of things examples-

A. Domestic & Home Automation

- Remote Control Appliances-Switching on and off remotely appliances to avoid accidents and save energy.
- Smart home is most popular IoT application ranking as highest IoT application.

B. Smart Cities

- Smart Parking- IoT helps in Monitoring of parking spaces availability in the city.
- Traffic Congestion- IoT solve the problem of Monitoring of vehicles and pedestrian levels to optimize driving and walking routes [10].

C. Smart Environment

- Forest Fire Detection-Monitoring of combustion gases and preemptive fire conditions to define alert zones.
- Air Pollution-Control of CO2 emissions of factories, pollution emitted by cars and toxic gases generated in farms.

D. Industrial Control

- M2M Applications- M2M communication is often used for remote monitoring using iot and also used in Machine auto-diagnosis and assets control.

E. Retail

- NFC Payment- NFC technology enables contactless transactions, access digital content, and connects electronic devices with a single touch. It is simple and safe two-way communication.

VI. Advantages and Disadvantages of IoT

IoT network benefits not one but all i.e. individuals, society, stake holders of businesses etc. The smart technology has many advantages into our lives, which are Time, Money**,** Tracking and Monitoring etc. Security and vulnerabilities are the challenges in IoT [7]. Devices can make decisions and adapt without human guidance. According to the modern technology of IoT it is possible that, if you are out of home and your home's electronic devices communicate together and maintain the room temperature, and inform to you that your medicines have expired or that the milk is over or you need more pepper and more controlling tasks occurs. Like advantages there are also many disadvantages of IoT platform as well in Privacy/Security, Compatibility, and Employment but its advantages of saving the consumer time and money can be ignored to the disadvantages.

VII. CONCLUSION

In this paper, a comprehensive review of IoT has been presented, including architectures, enabling technologies and smart applications as well as the fairy authenticated welfare system.UID Identification Solutions provides a 100% secure method for the identification of voter or citizen. The concept of internet of things will have an enormous effect on the world, this will be very useful and can be used to benefit and improve the lives of individuals all across the world. Like advantages there are also many disadvantages of IoT platform as well but the IoT will have a positive impact on the world so we should be excited for this new concept and look at it as a way to improve our lives every day. In 2020, the number of objects is expected to reach 50billion.

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