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Internet of Things: Architectural Components, Protocols and Its Implementation for Ubiquitous Environment

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Abstract:

Ubiquitous data processing of the sensing nodes has revolutionized the development of electronic industries manufacturing. The concept of the Internet of Things (IoT) is the connectivity of distributed sensing and processing nodes from anywhere rather than fixed computing. For the Implementation of Ubiquitous smart environment, anything and everything can be converted to smart IO Things, and where things have sensing and processing abilities for automation and analysis of environmental processes. Sensors, actuators, embedded processing systems, networking gateways, and IoT Cloud Services are the building blocks of IoT implementation. This paper presents a brief discussion on the connectivity of building blocks with various enabling technologies for the implementation of the Internet of Things. Moreover, many of data link standards and the internet of things data communication protocols will be in the discussion.

Keywords: Internet of Things, IoT Cloud Services, Embedded Processing, IoT Protocols

1. INTRODUCTION:

Internet of Thing (IoT) is basically a Network Things around in the real world; a network in which the physical devices from real-world that are embedded with sensors, actuators, network connectivity, and software are interconnected to This inter-networking allows the exchange of data between these devices to monitor the data and control the working of devices and ultimately getting control on the environment. IoT is an accepted idea of the devices that are made smart and are connected through some network to interact with each other and serve humans in various ways for the automation of real-world tasks including industrial and environmental automation [1-2].

In the year 2004 after the invention of the Radio frequency identification (RFID) system, the meaning for automation has taken revolutionized rise. Before the invention of RFID, there were only millions of devices that were connected to internet connections. However, the development of IoT concept and the automation using the IoT has not only revolutionized the electronic industry but in few years the count of connected devices over the internet becomes about 12 billion by 2012 which was about twice the human population. Further, the expected growth of IoT devices is assumed to be around 50 billion by the year 2020, which will flow a multibillion to trillion dollars' business for electronic/ IoT related industries. It is the need for the recent ear to understand the development of the IoT system, its architecture and its implementation for various ecosystems using smart electronic devices, sensors, and actuators working with embedded computing systems [3].

Smart devices are basically heterogeneous devices that take input from there environment and surroundings using sensors, perform analysis on that input data and generate useful output [4]. Internet of things is the domain that fills the gap between physical devices and the world of the internet or web[5].

"The Internet of Things (or IoT) is what we get when we connect Things, which are not operated by humans, to the Internet."[6]

In this article, a brief evolutional development reported by many scientists, architectural components/ layers for the IoT development, various protocols for efficient data communication and its implantation models have been discussed.

2. LITERATURE REVIEW

The Internet of Things technology extends its applications to all areas of living. The implementation of IoT based aumation involes integration of several realted technologies working togather for common purpose. The development of versatile sensors and actuators has made it possible for scientists and enginners to automate any type of ecosystem from indurty to agriculture and from business to home automation. [7]

Ruan et. al. (2019) discussed the implementation of IoT based business ideas in the area of agriculture. IoT based system was suggested to manage and enahance to arigculture production and supply chain management. It was dissucsed the article the IoT based smart agriculture solution can provide green energy production and analysiss of data can help to further rise the business.[8]

Shinde et al. (2017) discussed the IoT based automation in dairy farming business. IoT sensors can moniter the health parameters of animals in the form and automated system can produces various health analysis for the guidance of dairy former. Based on the IoT analysis the dairy former can make sure the health of cattles by time precautions. IoT based management of health of cattels, can not only enhanced the production of milk and meat, also the efforts of dairy former will be significantly reduced [9].

Khan et al. (2017) proposed a low cost and time saving solution for oil and gas discovery. It was discussed the conventional WSN and SCADA system are expensive and provide slow data acquisition, as well as these system are not felexible and scalable. The proposed IoT based solution is a simple and roboust system design, that can provide quick response. This of IoT based system has ability to be integrated with cloud networks for remote moitering and control [10].

3. ARCHITECTURAL COMPONENTS AND LAYERS

An IoT device is basically an assembly of four working units that are hardware, software, connectivity devices, and sensors. These are the four major components of the architecture of IoT devices [1]. It is important for the system that the sensors and devices are seen as two independent entities that work co-dependently.

It is worth mentioning here that there is not yet a single architecture that has been universally accepted and agreed on. The most generally accepted architecture has 3 basic layers [11]:

i. Perception Layer (sensing layer)
ii. Network Layer
iii. Application Layer

The most accepted architecture from the perspective of research is a 5 layered architecture. This architecture has some additional layers in it, that can help the researchers look deeper into the things [1-12]. Following are the layers of that architecture:

i. Perception/Sensing Layer
ii. Transport/Network Layer
iii. Processing Layer or Cloud
iv. Application Layer
v. Business Layer

The generalized architectural model can be visualized as given in figure 1, consisting of architecture components as layers of sensing, network, data processing and application [11].

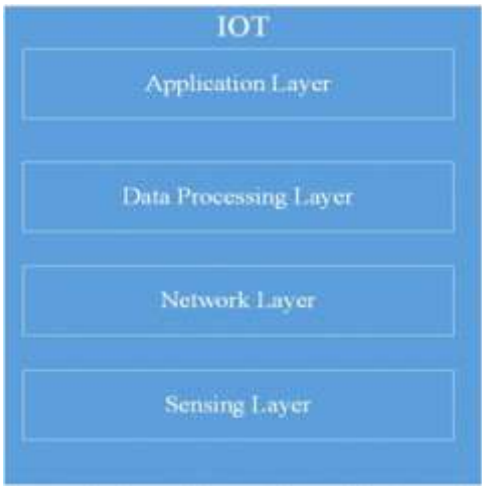

Figure 1 : Generalized model for IoT, based on architectural layers

3.1 Layer 1: Sensing Layer

The job of collecting data or sometimes even information is done at this layer. This layer has a lot of sensors, these sensors are integrated or installed into the devices through sensor hubs [13].

3.1.1 Sensor Hub

The sensor hub is basically a microcontroller unit that collects the data from different sensing units and processes it. It is like a connection point used by multiple sensors that have the following in them:

i. Multi-point Control Unit
ii. Coprocessor/ Digital Signal Processor
iii. Process Data (from sensors)

Sensor hubs perform the job of sharing the workload of the CPU or the device's microprocessor [14]. There are various divisions of sensors for implementation of IoT based ecosystems, some of these are:

1. Motion sensor
2. Environmental sensor
3. Position Sensors

These sensors collect information and provide them to the sensor hub for further processing.

3.2 Layer 2: Network Layer

The job of this layer is to transmit data between the servers, clouds, smart things and network devices, etc. It should be able to monitor and manage the huge network traffic, as well as process and control it. It is better defined as a communication channel that provides a pathway to the data that is gathered by the sensors to the connected devices. This is made to happen by planting communication tools and technologies in the devices so that the devices within one network can share their data with each other. The devices on that layer bearing sensors, need to be connected to some network (or the internet) through some networking device that is called the IoT Gateways [1,15-17].

3.3 Layer 3: Data Processing Layer

This layer has the main data processing unit of the IoT device. In this layer, the collected data is analyzed and decisions are made on the basis of the result of the analysis. It is also called the middleware layer [15]. This layer could be an embedded system or a cloud-based data processing system. They flood a lot of services or facilities for the processing of data by the decision making algorithms and taking of data-driven decisions in this regard for the protection or encryption of data [17].

3.4 Layer 4: Application Layer

This is the last or final layer of the architecture; it is on top of the architecture. This is where the results are shown and implemented [1]. The data collected by sensors in layer 1 and processed in layer 3 is converted into something actionable here. This layer serves the user by performing different tasks for the user. The diversity in the applications of IoT is huge that means that data at your disposal can be used in any way to generate any outcome [18]. All functionalities of the middleware are exploited here.

These components are the building blocks of IoT, here is another representation in the form of equation [1,19]:

Figure 2 : Implementation of IoT architecture

6. CONCLUSION:

IoT is actually a new era of technology. Its stable architecture allows us to unlock so many achievements by relying on the capabilities of machines. One may look at it as a world where machines share the burden of man and provide ease at the cost of huge complexity. Machines that make our tasks simpler and easier are basically a complex composition of countless 1's and 0's, it's as if the ease they provide in proportional to difficulty or complexity in their creation. But of course, there is nothing that cannot be achieved by a little effort. The human brain is way powerful and capable than one can imagine, machines can do only so much for it. The implementation of IoT based smart eco

systems require the understanding and evolution of above discussed related technologies.

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