Internet of Things and Applications: A Critical Review

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Abstract

Internet Of Things (IoT) has revolutionized the entire world by providing ubiquitous connectivity to the things due to which large data about various smart environments are made available online for further study and analysis through which effective decision making could be done. Based on the domain of application we have classified and explained smart agriculture, smart health, smart home and smart wearable. This review paper gives us an insight to the various applications where the IoT is being implemented and the challenges faced by IoTs.

Key Words: Smart environments, smart health and IoT.

1 Introduction

There has been a rapid advancement in the technology over the recent years and the main motive is to provide worldwide connectivity to all the things around us right from smallest of the devices in our physical environment so that they could behave smart and take decisions independently without much necessity of the human intervention. In Industry, a thing may typically be the product itself, the equipment, transportation means, etc.; everything that
participates in the product lifecycle [3]. Radio Frequency Identification (RFID) and Wireless Sensor Networks (WSN) are important role for IoT. In this paper section II describes the layers of IoT, section III gives a detailed information about the various applications that are implemented in the smart environments, IV gives the IoT based communication enablers, V discusses but the need for IoT security and challenges along with the conclusion is presented in the VI section.

2 Layers of IoT

The IoT system discussed here has two types of architectures the three and five layer architecture [9]. This forms the basis of the construction for various IoT applications. In a typical three layer architecture the perception layer has RFIDs and sensors that are placed in the physical environment and the sensed parameters are taken for further processing. The connectivity and communication among various smart devices are provided by the network layer. The sensed data is sent to the later layers through this middle layer and forms an important part in the IoT layers using wired or wireless networks. Application layer has the cloud computing platform for collecting and visualizing the data. 3-layer architecture is depicted in Fig 1. The 5-layer architecture is described in Fig 2. The main function of the transport layer is for transferring the data between the other various layers of IoT. Obtaining enormous amount of data is an easy task, but for detailed analysis and understanding we need the processing layer. Business layer manages the IoT based applica-
The major requirements for all the IoT applications are:- Sensing and data collection of the parameters from the physical environment, Embedded processing and microcontroller unit; wired and wireless communication; software for automating the tasks and cloud unit.

![IoT Five layer architecture](image)

Figure 2: IoT Five layer architecture

### 3 Smart Environments

IoT smart environments are subdivided based on the application domains as: Smart Agriculture; Smart Homes and Smart Health. For implementing these smart environments we need to meet the key goals like reduced cost of implementation, minimal or less user based interactions, improved utilization and overall proactive maintenance. All the smart environments have a network of sensing devices which work for a common goal to make the lives of humans easier due to this aspect they are regarded to be smart.

#### 3.1 Smart Agriculture

Main use for IoT in agriculture is in the water and energy. Water wastage due to leaky irrigation system and untimely irrigation, switching off the pumps and devices that are not in use, crop monitoring to look for unhealthy crops for pest control and fertilizer application. Patil, K.et al [7] describes a smart agriculture application using IoT where the soil parameters like humidity, ph., temperature and pressure are measured from the field and a decision is taken in an android or a browser application based on which the user can do...
irrigation or fertilizer application depending upon the atmospheric conditions and soil readings.

Manual observation has resulted in excessive use of pesticides or under usage of watering has resulted in less efficient and less productive crops. [4] describes an overall control of the water irrigation motor by monitoring the on field parameters like humidity, ph. etc. The system connects physical sensing devices with the irrigation control mechanism with the Things Speak (cloud).

Smart weather system is described in paper[2] where a Zigbee based weather system is used to monitor parameters like temperature, humidity, wind direction and wind speed. The humidity measurements are taken from soil and wind directly from the open using wind sensor based anemometers. This system helps in preventing any hazards from natural disasters by alerting the farmers. The main advantage of using Zigbee for this application: simple, cost effective, low data rate, low power consumption, secure data transmission and reliable.

3.2 Smart Homes

A Smart home is an intelligent system which uses IoT technology to makes lives easier by monitoring the daily aspects of our homes and provides energy efficient solutions. It consists of home appliances, different sensors, actuators, data processing elements and analyzers. Smart home based applications use wireless technologies like Bluetooth for short range data transmission between the control units and the devices.

A smart home environment is described in paper [6] where the user can monitor lighting, cameras, home appliances along with computers that are connected to the internet and allows the user to control the things without depending on the time and location constraint. A smart lighting system is also proposed where the unwanted home lights could be controlled by the user, this provides a huge energy efficient home automation.

A low cost smart home security system is discussed in paper [10] where the owner could be alerted during any unusual event (where an intruder is detected) either through a mobile or web application. This low cost security system utilizes a Pyro electric infrared sensor(with motion sensing) where the intruder could be
detected even during night time and a web cam is also installed to monitor the surroundings which captures the pictures and sends alerts to the user application though the R-pi controller via the Wi-Fi connection. Later, the user takes necessary action.

### 3.3 Smart Health

The major IoT applications in health care are in Blood pressure monitoring, oxygen saturation monitoring, body temperature monitoring, detecting respiration rates in a asthma patient etc.

A smart health system is described in paper[5] where the temperature sensor (DS18B20), body position sensor (ADXL335), pulse sensor (Pulse Sensor Amped) and ECG sensors (AD8232) for monitoring of heart rates are interfaced with the arudino controller in the perception layer. This data is sent to the Things speak cloud via a Wi-Fi module. The data (along with location) is analyzed by the health centers at the hospitals 24*7 and the patient is notified for any health problems.

Respiration monitoring system using LM35 sensors has been implemented in paper [8] where the voltage value of the inhaled and the exhaled air is calculated to compute the respiratory rate. The sensing nebulizer masks with the sensors are in a remote place where the data from these sensors are sent to an arudino based controller which communicates the data wirelessly using NRF24l01. Depending on the respiration rates of various people of different ages the data is compared.

### 4 Iot - Communication Enablers

IoT generally uses the three main communication protocols for data transfer across the network Wi-Fi, Bluetooth and Zigbee. Some of the protocols support long range and others short ranges so depending upon the smart environments these communication technologies are considered. For example Bluetooth (range-10m) is used for short ranges of communication hence they are widely used for smart home applications. Even Zigbee (range-100m) can also be used for smart homes as well as in smart agriculture applications where the range of sensing is small and low power consumption is
the need for cost effective IoT applications. Wi-Fi has medium level of power consumption and is used for long range purposes.

5 Iot - Security And Challenges

One of the major challenges faced by the IoT is the security issues. When we look at the various smart applications in the field of smart homes, smart agriculture and smart health a large amount of sensitive data are being fed to the cloud. Especially in the Smart Homes and Smart Health care systems the security cant be compromised since in the IoT applications the data can be easily tracked, identified and monitored which is an invasion of privacy. Compatibility issues also arise when different devices are connected to the IoT because there is no such availability of a universal language standard. Hence proper standards for various IoT layers must be well defined.[1].

6 Conclusions

Thus IoT has emerged as a new era of technology where connectivity of the devices to the internet has automated various applications. The future is bright and improving over the years for the various applications. The main need is to identify the applications that could have a great impact using IoT and thus the implementation can be made successful for the entire world. For making the IoT to be very successful we should be able to manage the enormous data that are being generated and also to provide good security and privacy to the various IoT applications.

References


