Applications, Challenges, System Design and Scope of Internet of Things: A Review

Dr Monish Gupta

Electronics & Communication Engg Dept., University institute of Engg & Technology, K.U. Kurukshetra, India

Abstract: In today's world due to availability of miniaturized highly efficient embedded devices and due to improvement in data handling, processing capabilities and further due to improved data communication capabilities there is explosion of the Internet of thing applications ranging from home automation, Health care service, Public securities Industrial automation to other important domains. This paper explains the applications, challenges and scope of Internet of things technology in current era. This paper will open issues pertaining to implementation of Internet of Things Technology by new world.

Index Terms: Internet of things (IOT), Embedded Technology, Sensors, Controllers.

I. INTRODUCTION

In technology using Internet of Things many smart devices are interconnected using internet to communicate with each other so as to perform a real time application. Devices are smart in the sense that they are equipped with embedded technology to interface either with sensors or controllers and can communicate with each other through high speed internet without human intervention [1-4]. The most severe requirement in IOT system is identification of various devices. Every device in IOT should be uniquely identifiable so as to obtain an efficient and optimized system [5-8]. A complete IOT system is basically convergence of two technologies i.e. operational Technology and information technology. Operational technology includes various smart devices interfaced by sensors and controllers. Operational technology is used to sense the desired physical changes through sensors, convert the collected information from sensors in to form compatible for transmission and convert the received information into form recognizable by controllers using smart devices equipped with embedded technology [9]. Information technology on the other hand is concerned with handling all the process on data like storing the date, efficient transmission and reception of date, encoding and decoding the data for security purpose. Data transmission rate and energy requirements to transmit data are the two important factors

which must be considered for efficient IOT system. In IOT systems convergence of two technologies i.e Operational technology and information technology is achieved in such a way to avoid human intervention.

Human intervention is avoided to improve the reliability of the system so as to get rid of human errors.

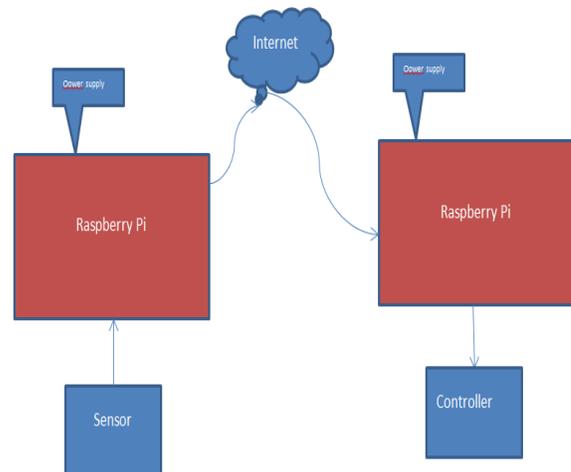A typical IOT system using Raspberry pi is as shown in Fig (1)

Fig (1) (IOT system)

Sensor is used to sense a particular event. Sensor used should have the features of miniaturization and low power operating capability. Raspberry pi is used to sense the date from the sensor and is used to convert it into form suitable for transmission through internet. At receiver Raspberry is concerned with receiving the transmitted signal through WiFi module and gives the output to controller for desired action. Python or C language is generally used for programming Raspberry.

This paper is organized into four sections. In section 1 the theory behind IOT, structure of IOT system and technologies behind IOT is presented. Section II

elaborates the potential applications of IOT in industries, home automation and health care services. Section III describes the system design and implementation using IOT. Section IV elaborates the various challenges to implement IOT system. Section V elaborates the skills required for IOT industry. Conclusion is presented in section V. Finally references used are presented in section VI.

II APPLICATIONS OF IOT

Practically any device that needs to be controlled remotely requires the use of IOT technology. This technology can be used potentially in

(1) Smart home applications.
(2) Industrial automation applications.
(3) Health care applications.
(4) Weather forecasting and monitoring applications.
(5) Agriculture applications.
(6) Utility applications.
(7) Natural resources monitoring applications.

Applications of IOT in smart houses includes automatic controlling of electric appliances, automatic door controlling, automatic monitoring and controlling of devices through sensors used for motion detector, fire sensors, Gas sensor etc to attain high degree of security.

Industrial automation is the key application of IOT. Due to various risks involved and to improve the efficiency of production many smart devices can be installed to monitor and control the operation of various machines used in industry. It is assumed that IOT will provide the fourth revolution in industry.

Sensors installed on wearable devices made it possible to measure and transmit some parameters related to health like pulse rate, ECG, EEG, Blood pressure directly to doctor for analysis and diagnose purpose. So using smart devices using concept of IOT time of treatment can be reduced by avoiding unnecessarily delays in accessing the doctor, avoiding admission delays and further processing delays.

By sensing some parameters like temperature, pressure, humidity, IOT can be used in weather forecasting and monitoring by using smart devices which are installed across large geographical area. Natural hazards like Earth quakes and tsunami can be predicted monitored and analyzed using IOT without human intervention.

The application of IT and devices installed with various sensors like moisture sensor, PH sensor, Moisture sensor, Water level sensor along with drones can be used to improve the productivity in agriculture. Animal tracking using RFID is another application of IOT used in agriculture industry.

The most common use of IOT in utility is to collect the reading of electric meter using Automatic Meter Reader. Meter reading can be collected at the billing station without visiting the field. This not only reduces the wastage of time but also enhances the accuracy of the system.

IOT can be used potentially in monitoring and controlling water level in rivers, dams and canals. An unpredicted loss can be minimized by taking preventive action in time.

III. SYSTEM DESIGN AND IMPLEMENTATION USING IOT

In this section implementation of smart home and smart grid IOT is presented.

(a) Smart home: In Smart home every equipment to be controlled is connected to central processing unit through Wi-Fi. In this design system raspberry is used as CPU. Various sensors like Temperature sensor, Motion detector, Gas sensor are connected to CPU. Based upon the output of these sensors appropriate action can be imitated by CPU. Further various appliance like lightning system, opening and closing of doors, security system can directly be controlled by the owner by using high speed internet. The smart home system implemented by using IOT is as shown in Fig
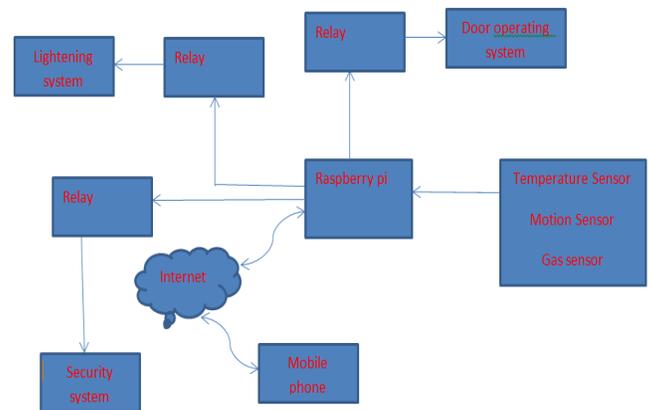

Fig (2)
(Smart home)

(b) Smart grid system: In smart grid system we can monitor and control the production and distribution of electricity. The system model for implementing smart grid using IOT is as shown in fig 3. Raspberry is used as central processing unit. Raspberry acts like the controlling device for controlling the action of all devices interfaced with it. Through LCD we can monitor the reading of smart electric meter. Working of digital electric meter can be controlled by consumer or by owner through interfacing of raspberry by internet. Further an alarming condition may also be implemented by suitable programming the raspberry.
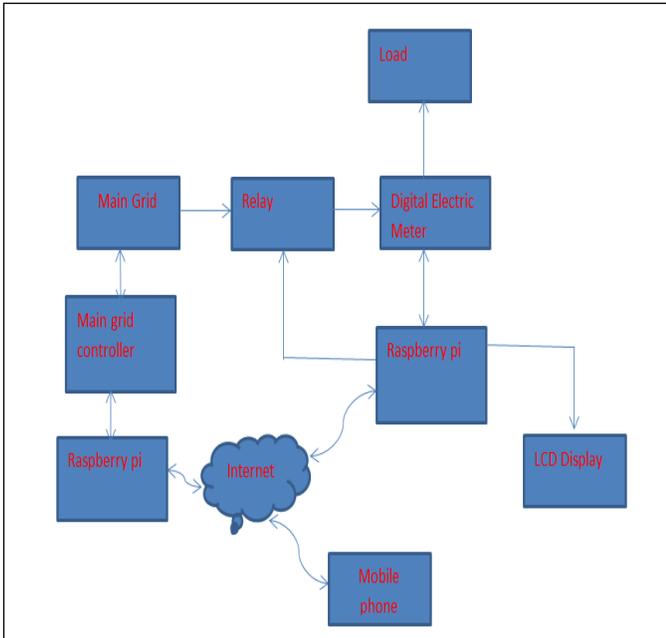

Fig (3) (Smart grid)

IV CHALLENGES TO IMPLEMENT IOT SYSTEM

Some of the major challenges to implement IOT system are enlisted as :

1. Internet availability one of the most basic requirements for implementation of IOT system is the availability of internet of good connectivity and large bandwidth. Generally in IOT system we are supposed to work on real time applications. Delay in transferring data and incapability to transfer bulk of data defeats the purpose of IOT system.

2. Cost of IOT System at present cost of equipment's used for the purpose of installation of IOT system is high. Cost is high due to low production of smart devices used for the installation of IOT system. High cost makes the IOT system far from the reach of common man.

3. Maintenance of IOT system Due to unavailability of skilled labor maintenance time as well as maintenance cost of IOT system is very high.

4. Communication protocols in IOT systems heterogeneous devices are required to communicate with each other. It is difficult to design efficient and reliable communication protocols between heterogeneous devices.

5. Energy requirements Sometimes devices need to be installed at remote places or inaccessible places where it is very difficult to supply energy to devices for their operation. Under such conditions designing algorithms and hardware for low energy consumption devices remains a challenging job.

6. Privacy and Security issues Privacy and security issues require encryption and decryption of data at transmitter and receiver end which makes IOT system complex and less energy efficient. Highly energy efficient algorithm is required to improve Privacy and security issues in IOT systems. Certain security constraints as enforced by the concerned authority makes the system further complex.

7. Scalability of IOT system Scalability basically represents the capability to adopt future requirements. Due to fast growing technology and to handle large amount of data as per the requirement of the society IOT system like any other system should be Scalable to meet the future requirement.

8. Interoperation ability is basically the ability of the smart devices to communicate with each other irrespective of their manufacturer. International standards are required to meet Interoperation ability

V. Skills required for IOT professional

Today IOT is fast growing technology which is spreading its roots into every corner of the society. In order for successful implementation of IOT, professionals with skills in following technologies are required

1. Embedded systems: The very first skill required for IOT professional is knowledge of embedded technology. Things component in internet basically represents embedded systems. Things in IOT are embedded systems which interconnected by using internet for the purpose of communication. A processor is the heart of embedded systems. Processor along with sensors and controllers constitutes the main part of the embedded system. Generally an Arduino or Raspberry pi is used for designing embedded system.

2. Networking in IOT all devices are expected to be connected through internet for exchange of data. So IOT professional must be acquaint with architecture and properties of networking.

3. Machine Learning in IOT system date is collected from various sensors. Machine learning helps in driving the rules from the gathered information. Machine learning basically make the system intelligent. Shogum is the most important tool for implementing Machine learning.

4. Cloud computing in IOT a lot of data is generated in IOT. Storing such huge date is a problematic issue. So professionals who have the knowledge of storing and retrieving data on cloud will be preferred for IOT implementation.

5. Mobile application development generally most of the applications of IOT need to be operated from smart mobile phone, Tab. So professionals having skills in mobile app development will be required to implement IOT system.

6. GPS development there is major requirement of professionals who can develop GPS enabled technologies.

VI. Conclusion

This paper goes through the various aspects of IOT technology ranging from applications, Challenges and skills required to implement this technology. It can be concluded that there are tremendous opportunities in the field of IOT but the need is to make IOT system acceptable by the society. The requirement of society in terms of cost, reliability and compactness of the IOT system need to be addressed while designing IOT system.

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