

A Comprehensive Survey on Applications of Internet of Things (IoT)

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Abstract: Today human life is entering in new era of technology where all functions that depends on human will be done by many interconnecting devices called internet of things (IoT). Internet of things is able to provide billions of services at any time and any place. There are many reasons that make IoT most interesting most researchable topic today. IoT provide dynamic control in daily life, enhance the resource utilization, and create dynamic relationship between humans and nature. In this survey paper many applications (smart homes, connected cars, wearable, use in industry, smart cities, in agriculture, smart retail systems, energy management systems, in health care, in poultry and farming) of IoT are discussed in details. Importance and challenges are also discussed in this survey paper

Keywords: *IoT, Applications, Importance, Challenges, Technology*

1. Introduction

The Internet of Things (IoT) alludes to the utilization of insightfully associated gadgets and frameworks to influence information assembled by implanted sensors and actuators in machines and other physical objects. IoT is required to spread quickly over the coming years and this intermingling will release another element of administrations that improve the personal satisfaction of purchasers also, profitability of undertakings, opening an open door that the GSMA alludes to as the 'Associated Life'.

For purchasers, the IoT can possibly convey arrangements that significantly improve vitality effectiveness, security, wellbeing, training and numerous different parts of everyday life. For endeavors, IoT can support arrangements that improve basic leadership and profitability in assembling, retail, horticulture and different segments. Machine to Machine (M2M) arrangements - a subset of the IoT – as of now utilize remote systems to associate gadgets to one another and the Internet, with insignificant direct human intercession, to convey administrations that address the issues of a wide scope of ventures.

In 2013, M2M associations represented 2.8% of worldwide portable associations (195 million), demonstrating that the segment is still at a moderately beginning time in its advancement. An advancement of M2M, the IoT speaks to the coordination of different sellers' machines, gadgets and apparatuses associated with the Internet through different systems. The internet is living entity and it is always adding new technologies in the global village in the form of

business and IT. The benefits of internet of things are to develop and emerge economy.

The IoT is not only deep vision of future but also it is under implementation. In this review paper various uses of internet of things are talked about in subtleties, today our homes are smart homes due to internet of things, wearable, for example, garments, watches are more intelligent today, internet of things likewise engaged with horticulture, industry, poultry and cultivating, in shopping centers, vehicle leaving frameworks, our urban areas are additionally more brilliant today because of internet of things. Every one of these uses of internet of things are talked about in the detail with one research paper for every application. In section 2 every application is explained with one research paper, section 3 challenges and importance of internet of things are discussed and section 5 is conclusion.

2. Applications of IoT

In this section detailed discussion is given on the applications of internet of things with the help of research papers. For each application a research paper is reviewed and then discussed, in discussion a short overview of author's work is explained briefly with system diagram. The system diagram explain that how the system is working and also explain that what functional requirements for the proposed work are. The following figure-1 is block diagram for all applications discussed in this paper. This section is the core section of this survey paper.

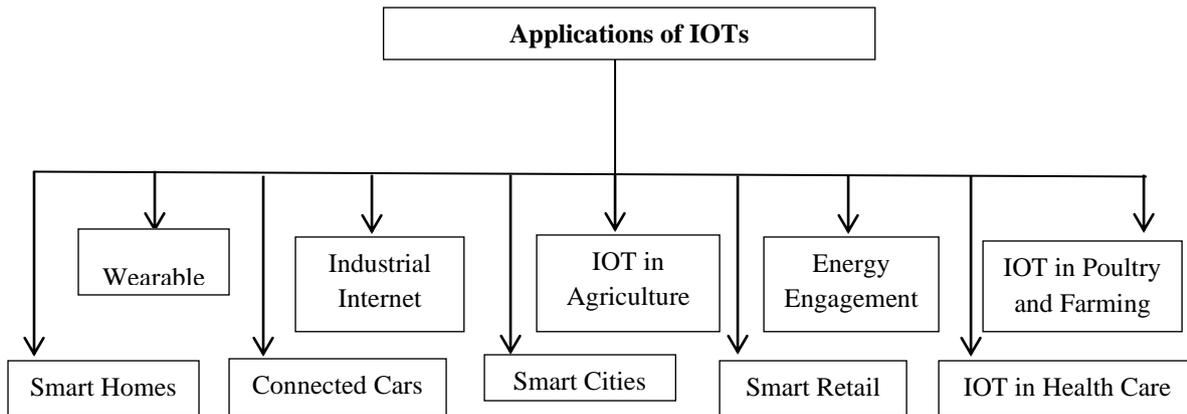


Figure. 1 Applications of IOT

A. Smart Homes

In the current era internet of things playing very important role in almost every field of life and providing the solution of daily life problems and also IOTs are making human life easier to easier. Smart home systems based on IOTs makes man life very easy, a man can control his whole home by using internet of things he can manage electrical and electronics devices as well as monitor his home by one click. In this paper a smart home indoor location detection system is discussed, the main purpose of this system is to detect location of specific person. In this paper [1] a system is discussed which is basically a location detection system based on voice, this system uses Amazon Echo as the interface and HC-SR04 ultrasonic sensor to detect location of specific person/patients. A lot of work has been done on location detection systems in homes because monitoring the location of specific is very important because this allows us to detect any abnormal behavior of residents. The novelty of this system is that it works with voice.

The system components of this system are following

- Amazon Echo
- The server
- Location detector
- Speaker

The following diagram gives the system overview

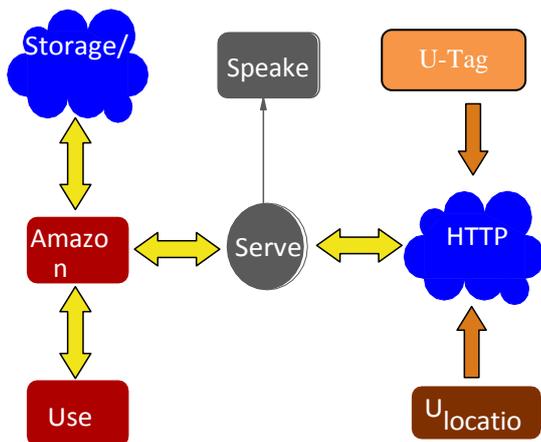


Figure.2 System Diagram [1]

B. Wearable

Our heart is very important organ of body and in the past and present it is realized that most of the deaths are due to heart attack and the reason behind this is delayed in detection. In this paper [2] a prototype is developed for monitoring of heart rate and inters beat intervals, this prototype is rationalized by using a wearable smart watch Samsung gear S3 with library web socket, nodes and JavaScript. In this system architecture server nodes act as signal processing and GUI code for client. The wearable technology which is described in this paper will be able to detect the physical conditions of patient like heart beat and skin moisture and then transmit it to a centralized data processor via internet network. This technology is possible to be use in medical field.

For example if a outpatient is using the wearable device and if he has ability to read heart rate then he can sent the information to the data processing server and if heart rate data indicates heart attack then a processing server can send warning message to the family of patient and doctor can gives first aid to the patient. This wearable smart watch use 2.3 Tizen operating system and also use various sensors that can measure different body conditions , this operating system is more reliable for this smart watch because it uses Linux program code and the OS made by Linux is lightest mobile operating system and it allows less memory and processor power. Tizen directly supports the development of web based applications and it supports native application development by using C/C++ and web apps with HTML5, CSS and JavaScript. The wrist of the patient is attached to the wearable smart watch Samsung gear S3 the functions of heart beat sensor activated in accordance with the algorithm that made. The sensor can measure the heart beat rate and also blood pressure and tells that condition is normal or not and then through Wi-Fi module on Samsung gear S3 the signal sent to the server via access point connected to the internet network. System components designed for this

system divide into three parts first one is client side second is monitoring and third one is sever side. The following figure show the system architecture discussed in this paper.



Figure. 3 system architecture for heart rate monitoring using IoT [2]

C. Connected Cars

The idea of smart car parking system is recently attracting more attention in many countries owing to the need for a new way of finding available parking places. The IoT provides the capacity to deal with such challenges, as it can be designed to capture sensors data for monitoring points of interest in smart cities and in current research smart car parking system topic is more significant. In this paper [3] a method is proposed that will help users to find the nearest parking space in minimum time and it also provide information about traffic congestion status to the users. The major contribution of this paper is that, firstly it will collect data from different sensors and secondly collected data is analyzed and processed by IoT devices.

The structure of smart car parking system is consist of three main parts the first part consist of sensor nodes, micro-controller devices and parking facilities, the second part consist of cloud that is middle layer between sensors and user mobile application, and third part is user android mobile phone application. The functionalities performed by the system are processing of sensors data, displaying the availability of car parking space and ability to guide the user to find the parking space and that will be the nearest space from the driver location. This system has many advantages over previous systems like it provide right direction to user for free car parking, it also provide nearest location for parking in worst traffic situation, it also provide speech module for users and users do not have to look at their phones while driving for purpose of safety.

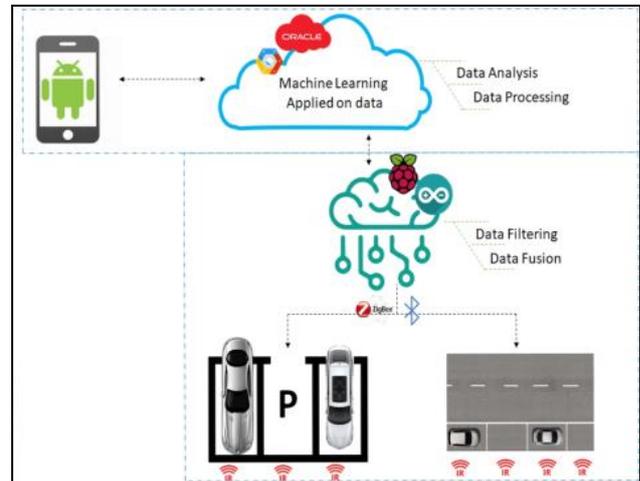


Figure. 4 Functionalities of Smart Car Parking System [3]

D. IoT in Industry

The most of the food which is consumed by the humans in the world is produced by food industries. Food industry is being one of the biggest industries in the world but it is facing many problems regarding food quality management, wastage of food and also cost ineffectiveness. Today technology is growing fastly and internet of things playing a vast role in industries, food industries can also overcome their problems by using internet of things in their platforms, here one of the usage of IOTs is discussed to overcome certain problems, food quality management, wastage of food and cost related problems. In this paper [4] a quality check method is proposed by identifying influencing process parameters and proposes a retrofitting architecture for existing machines by implementing a hardware device that collect process data in huge amount and integrate that data to a cloud platform for further analysis. Retrofitting architecture requirements have been categorized into hardware, communication and cloud. The hardware consists of two parts one is sensors and other is sensor nodes. Communication also consists of two parts that are standardized information model (a model that specifies the entities and relation between them with syntax and semantics) and middleware communication protocol (used for data integration between sensor and cloud). The third requirement for retrofitting is cloud that is used for data analysis, persistent storage and for forecasting. The proposed architecture is consists of two layers the first one is device layer and the other is integration layer. The device layer consists of one or more devices for example sensor nodes and sensors. The field devices reads values form sensors and do some calculations and forward it to next layer through communication interface. The second layer that is integration layer also consists of physical device that communicate with sensor nodes and provide the value of process parameters. The proposed architecture is given below in diagram.

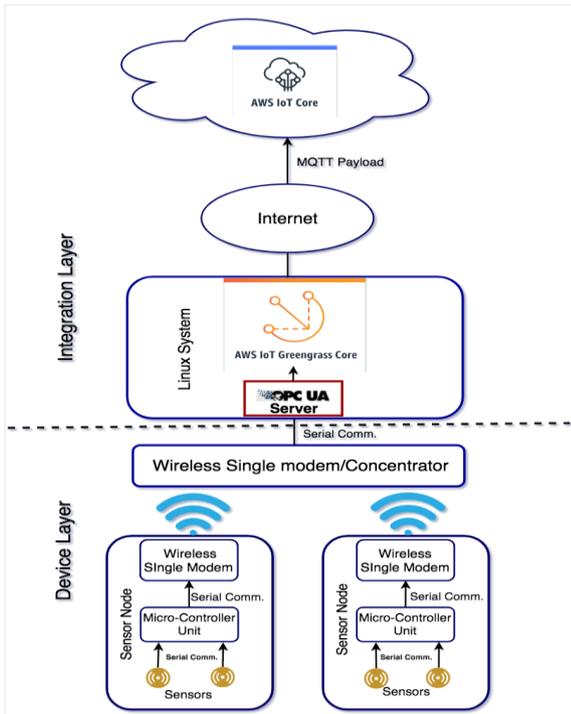


Figure. 5 Proposed retrofitting architecture [4]

E. Smart Cities

In this paper [5] a detailed review is represented of the concept of applications of IoT for smart cities. The concept of internet of things is very vast and playing a versatile role in human life. Smart cities are those that use internet of thing to facilitate the humans by performing different functions in a city like lightning, traffic control, connecting multiple cities, energy management etc. The following figure illustrates the actual application for smart cities.

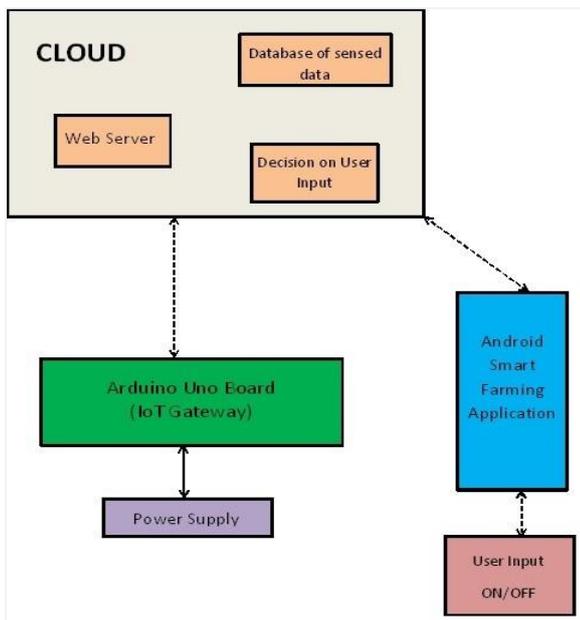


Figure. 6 System Diagram [6]

F. IoT in agriculture

In agriculture internet of things playing versatile role, a farmer can monitor his/her crops remotely and can take actions. In this paper a system is proposed which facilitate farmers to overcome their problems like water wastage, insects’ attacks, and weather conditions. Monitoring weather conditions is the major factor to improve yield of the efficient crops. In this paper [6] a system is developed which can monitor weather conditions like temperature, humidity, moisture and even the movement of animals which may destroy the crops.

This system also helps the farmers to utilize the water level sensibly. The development of this system includes microcontroller, sensors and the purpose is to allow taking decisions on watering the plants. The presentence of the animals likes cows, monkeys, dogs is very common in the crops if we hire a person for monitoring is very costly. This system also overcomes this problem, it use motion sensor to sense the presentence of animals and a notification message is sent to the farmer and he can take action easily. The system architecture consist of microcontroller board, Arduino R3, sensors LM 35 temperature sensor ,humidity, moisture and motion sensor, a Wi-Fi module and a GSM module. All those activities that takes place on board are controlled by Arduino board. Sensors sense the physical parameters and change the analogue values to digital. The cloud which is linked with this system include a Web Server, a database and a decision logic, in database data is maintained which is received from IOT Gateway after that decision logic decides that action is needed or not.

G. IoT in Retail Systems

In present trend of shopping at shopping malls rapidly increasing. Peoples get their essentials like clothes, food etc. and they face many problems during shopping due to huge rush, they have to wait for bill payments, In this paper [7] a system is developed to overcome these problems. The system is consists of Radio frequency identification (RFID) tag, LCD display, android application, Wi –Fi and cloud, all these have specific usage during smart shopping.

Firstly all products that are in a shopping mall are tagged with RFID, then trolleys are enabled with RFID detection system, required products of customers will be put into trolley and then code is detected using RFID after code detection name and cost of the product will be displayed on the LCD then data is pushed to the amazon cloud and then data sent to the android app of the customer. This system also provides facility to their users to check availability or unavailability of any product in the shopping mall.

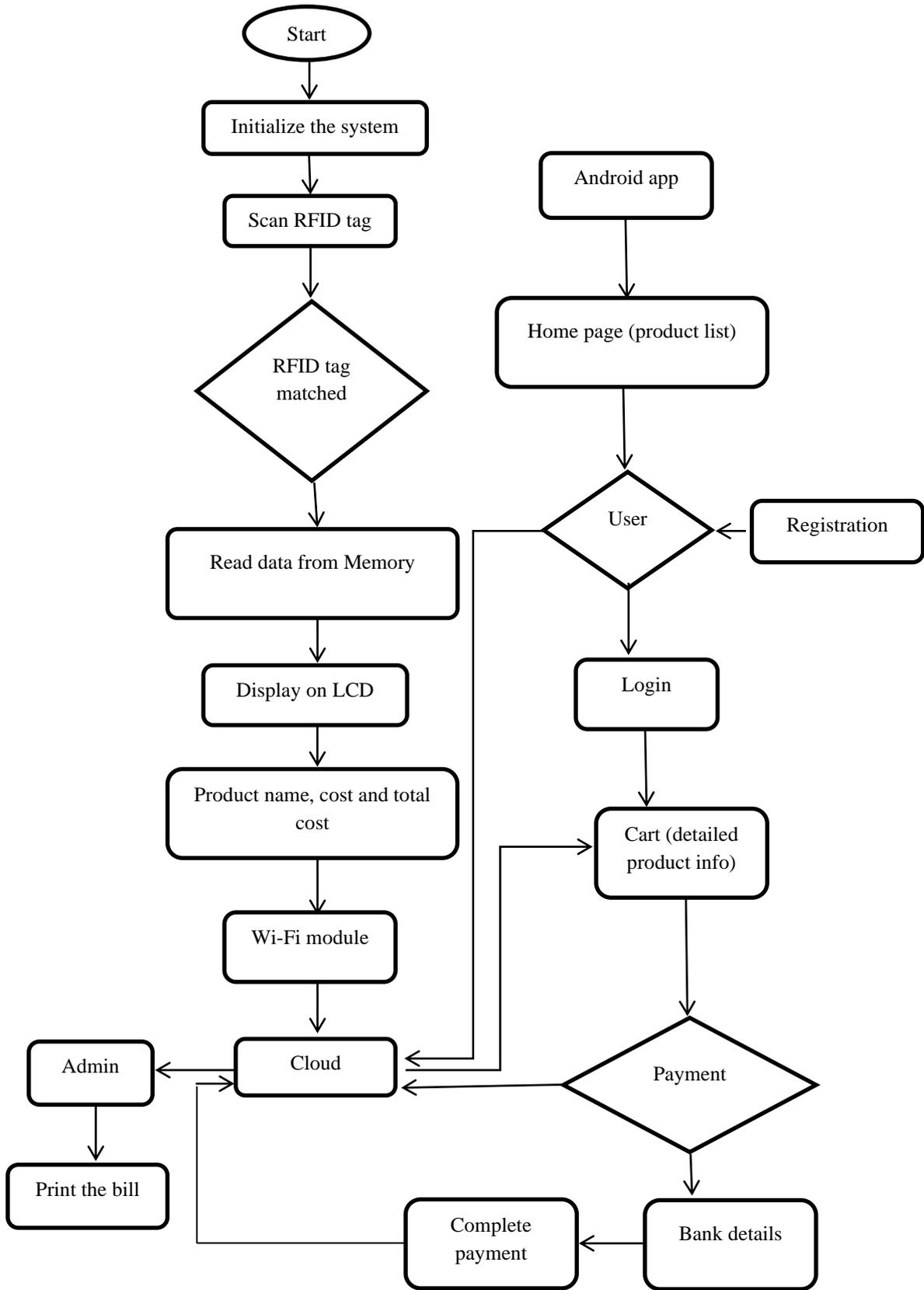


Figure. 7 IoT in Retail Systems Diagram [7]

H. IoT in energy Engagement

In this paper [8] a system is proposed to provide information regarding meter reading, power cut and the alert system when energy consumption exceeds beyond the

mentioned limit using internet of things. Implementation of this work is to reduce the human dependency over the electrical appliances. This system also provide facility to give information about pre-intimation of power shut down

using Arduino micro controller and GSM (Global system for mobile communication) module. This idea is proposed to reduce the human interaction to collect the monthly

reading and to overcome the technical problems. The functional block diagram of the hardware module is given below.

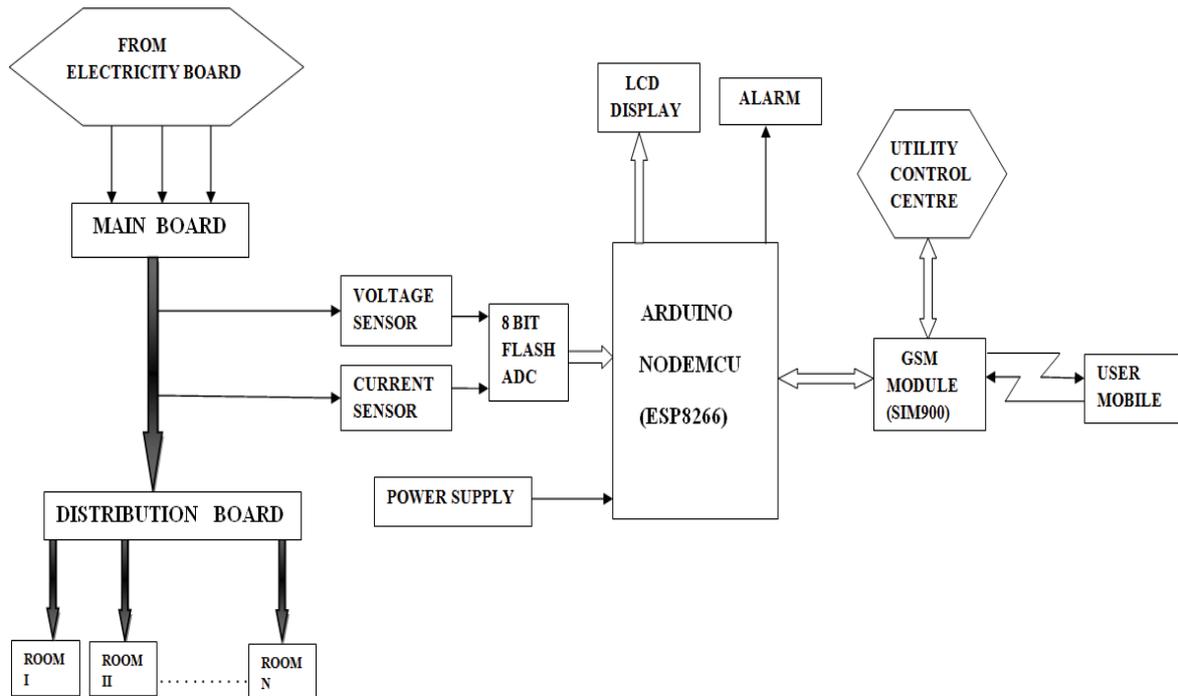


Figure. 8 Functional Block Diagram [8]

I. IoT in Healthcare

In this paper [9] different ideas are presented that how we can integrate IoT devices in medical and healthcare. Here two categories are discussed related to emergency and operational services with the help of internet of things. In designing process of system that handles emergency and operational services many challenges encountered like reliable communication, security, scalability, integration, low power devices etc. This system focuses two types of health care systems that are emergency and operational services and different devices used for these two ZigBee Wireless IEEE802.15.4, wireless Sensor devices, 6Low Pan’s and Hadoop Framework. The Hadoop handle the challenges that are discussed above. In emergency services this system the various body sensors are deployed these sensors will detect different data such as blood pressure, sugar pressure, body temperature, heartbeat, sleep habits, sweating percentage and physical body movements (walking, running, swimming etc.). In operational services this system provide assets control and monitoring in hospitals, inventory management in pharmacies.

J. IoT in poultry and Farming

IoT is actually being used widely by us today. Lopez Research LLC stated “The Internet of Things will help some business gain efficiencies, harness intelligence from a wide range of equipment, improve operations and increase customer satisfaction. IoT will also have a profound impact on people’s lives. It will improve public safety,

transportation and healthcare with better information and faster communications of this information”.

This paper [10] also highlights the IOT solution for monitoring the temperature and humidity conditions in a poultry farm houses. The main reason to develop the system is to examine temperature and humidity conditions remotely, in worst conditions this system help to control temperature and humidity. This system uses a data base and a mobile application to access data from database and generates alerts in mobile application in abnormal conditions. This system is affordable and easy to use, user can save time and labor cost by getting notification on smartphone the system is based on user requirements and can be shown in fig.

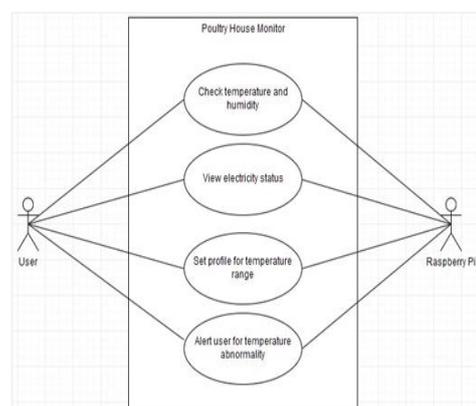


Figure. 9 Poultry House diagram [10]

The Raspberry Pi micro controller is the core device that is used in this system. The system continuously monitor the

situation at the poultry house, this system perform the following activities.

1. Detect the availability of electricity
2. Read the temperature
3. Connect the cloud database for real time reading
4. Send data to mobile phone via mobile application
5. Notification in abnormal condition

3. Importance and Challenges

In this section challenges and importance of IoT is discussed that gives the answer the of the statement “why internet of things”

- ❖ Internet of things reduces labor cost and time while working in industry or any organization.

"Some businesses have been uneasy about the IoT as there has not been a very clear definition of it up until now but it's at an inflection point-the cost of both devices and connectivity is down, the reality and value of how and what is can deliver is clearer, and all these things combined are acting real enabler for business in many sectors"

Steve Dunbar, IoT commercial director, Microsoft

- ❖ Communication between two or more object is very concerned today, internet of things have ability to provide communication everywhere at any time
- ❖ Automation is the key point today that is due to internet of things.
- ❖ The term Artificial intelligence is more populated due to IoT. IoT have ability to collect more data and decision is easy with more data.

No doubt internet of things playing a unique role in human life but also facing many challenges such as data protection and security challenges, authenticity problem, globalization, privacy issues, connectivity problems standardization, social issues and legal issues.

4. Conclusion

In this survey paper, the concept of internet of things and application are discussed in details. This paper is based on application on internet of things such as IoT in homes, cities, agriculture, industry, healthcare, wearable, energy optimization and poultry and farming. Benefits and challenges in present and future also discussed

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