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Smart Grid System Using IoT

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ABSTRACT- Smart Grid is a flexible Electric Grid, Communication and IT systems that can monitor the flow of energy from production areas to utility areas (even down to the level of electrical equipment) and control the flow of energy or reduce load to keep pace with real or near generation. Real-time smart Grids can be achieved through effective transfer and distribution systems, system functionality, customer integration, and renewable integration. Intelligent grid solutions help to monitor, measure, and control the flow of energy in real-time which can contribute to the detection of losses and thus take appropriate technical and administrative measures to capture losses. Electricity is an important invention otherwise life on Earth would not be possible. It is therefore clear that there is a need to measure the electricity used. A wattmeter is achieved, but a person from TNEB should visit each customer's house to measure energy consumption and calculate customer debt. So it requires a lot of manual labor and is time-consuming. We aim to build an IoT-based power meter for each TNEB customer. So the proposed energy meter measures the amount of energy used and uploads it to the Thitspeak cloud the affected person can view the reading. Power reading is sent to the cloud using ESP 8266, a Wi-Fi module. Power readings in a digital wattmeter are read using coupler opt and transmitted digitally to Arduino. So it automatically performs the process of measuring domestic energy use using IoT and thereby enables remote access and digitalization for each TNEB custome**r.**

KEYWORDS- Smart Grid, Internet of things (IOT) Smart Grid, Data Security, Smart Buildings, Communication Technologies, Raspberry Pi.

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 [1-2]. Central Processing Unit is considered the heart any IOT based system. It is CPU which is concerned with managing all interfaces among sensors and controllers and taking appropriate decision as per the algorithm. 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 [3-4]. 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 into a form compatible for transmission, and convert the received information into a form recognizable by controllers using smart devices equipped with embedded technology [5]. Information technology, on the other hand, is concerned with handling all the process on data like storing the data, efficient transmission and reception of data, encoding and decoding the data for security purposes. Data transmission rate and energy requirements to transmit data are the two important factors that must be considered for an 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.

Implementation of smart grid (SG) is the first requirement of fulfilling the dream of the smart city. A smart grid+ is basically concerned with generation and distribution of electricity under controlled and monitored environment [6-8]. A smart grid is based on communication between various sensors and controllers supported by IOT technology. By using smart meters in houses which are connected through IOT consumer can view their daily energy consumption or even can limit their daily energy consumption. Demand of electricity does not remain uniform throughout the year. By using SG owner can control the generated energy as per the requirements. By using suitable analytic techniques owner can search the area of distribution losses in form of theft and can control distribution losses of energy. Smart Grid can detect any tempering with smart meter which will come into the knowledge of owner and consumer for their further action. Even by using appropriate sensors and controllers the near future requirement of electricity can be estimated and generation of electricity can be planned accordingly. Due to continuous improvement in technology of achieving smart sensors and controllers, miniaturized embedded devices, large and reliable data handling capability and due to improved communication network available smart grid implementation can be considered as the biggest application of IOT. A large number of architecture are available for implementing Smart Grid using IOT [9-11].

II. RELATED WORKS

A. Existing System

Prior to performing any research or review work, it is important to study in detail the workings of the others to get a concrete idea about our work. The literature review of the related workings in similar fields is being discussed and a general comparative conclusion is drawn about the workings of ours with the others. The SG infrastructure is the backbone of the smart city and electric mobility. A detailed overview of the workings of the SG architecture along with the distributive network model is the major highlighted area of research [12,13]. The SG architecture serves the flow of power within the grid model via various management techniques. The development of efficient management techniques plays an important role in the delivery of optimum output to each of the endpoints, especially during peak hour times [14,15]. The management techniques are comparatively is a part of MAS (multi-agent system). The MAS is sectioned into various categories and is installed at various levels of the SG Network to monitor the state of the flow of power within the grid [16, 17]. The comparative study of each agent of the MAS is essential to know about their working principle and area of application [18]. The integration of the electric vehicle and its charging infrastructure is one of the major areas of research. The various methods and management techniques used for the integration reveal the efficiency of the grid network. The IoE, unlike IoE, is one of the primary methods that monitors and controls the flow and distribution of equal amounts of energy within the SG.

III. PROPOSED METHODOLOGY

Implementation of smart grid requires installation of smart digital electric meter in house of consumer. Meter is smart in the sense that it is interfaced with a central processing unit through sensors. Interfacing is required for exchanging of data between meter and CPU. Smart meters are fitted with LED so generally a photo detector is used for the purpose of interfacing between meter and CPU. Device that is used as CPU is either Arduino or raspberry pi. The main difference between Arduino and Raspberry pi lies in the construction and operations that can be performed by two. Arduino is just a motherboard of microcontroller. Memory, Wi-Fi module need to be connected with Arduino for its operation. However Raspberry pi is a minicomputer with supported devices in addition to microcontroller board. It uses Linux operating system for its operation. As Raspberry pi can handle multiple tasks at a time as compared to Arduino. After exchanging the reading of meter between Raspberry pi and electric meter it is processed by Raspberry pi for further analysis as per the requirements of applications. One application can be to display the meter reading in LCD display. Other application can be send the reading of meter on mobile phone by using the Wi-Fi module of Raspberry pi. Mobile phone can send the control signals to Wi-Fi module of Raspberry pi for to control the working of meter through some relay. Monitoring and analysis of meter can also be also be performed by a processing unit installed on the owner side. It is achieved by installing another Raspberry pi processor which is connected to Raspberry pi processor at consumer side through internet. Control signals can be generated by either consumer or by owner to monitor and control the working of meter. Furthermore mini grid can be designed in houses as well for remotely controlling various household devices.

A. The Proposed Design of SG is Presented in Fig(1)

For providing efficient service to mobility, it is essential to have an efficient architecture. Figure 1 shows the SG architecture which provides optimal energy to various applications like commercial and industrial, and residential smart cities. The SG architecture is divided into two categories, (i) Urban mobility and (ii) Underground mobility. The combination of these two categories will create smart city architecture. Integration of all the systems which are present in the architecture provides a reduction and optimization of energy with maximum transportation facility.

- Underground Mobility System: It provides an energy-efficient transport solution, and its main objective is to opti- mise the use of energy by providing maximum output. To achieve the main objective, the following methods could be adopted [19]:
  - Monitoring trains directly should feed on the same line and accommodate energy in the traction line.
  - Bi-directional communication method required for both power and data to provide primary network supply.
  - Need backup energy storage in electro-mechanical devices to ensure supply during high demand.

By adopting the above methods, it will be possible to store sufficient amount of energy, especially during the regenera-tive braking and would allow a good global energy saving.

- Surface Mobility System: This system is very important with smart city, especially for transport services, the main issue is storing energy. To deal with this issue, the energy integration system is being proposed using electro-mechanical and electro-chemical energy can be efficiently stored and managed [18].

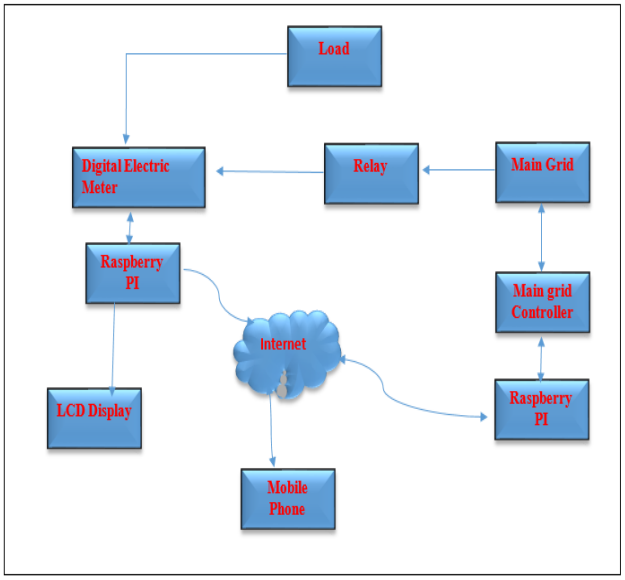

Figure 1: Smart Grid System

IV. CHALLENGES AND OPPORTUNITIES IN IMPLEMENTING SMART GRID USING IOT

It is a very common situation that whenever a new technology is implemented various sorts of problems are to be encountered by society. It brings various challenges to its implementation. If society is able to meet the challenges technology will survive otherwise it will be obsolete. Various challenges and opportunities to implement a smart grid using IoT are as follows: -

- The power delivery system has to be strong enough in terms of protocol, delay, and bandwidth. Otherwise, it will be very easy to hack the complete system.
- The devices connected at each of the stations or levels must be very strongly encrypted. They are the powerhouse of data storage. Cyberattacks on those devices might lead to loss of important data
- Networking among the whole system plays a major role in communication. The protocols used in the networking should be strong enough and the authorized person should be allowed to handle it. Otherwise, it might lose control over the data flow.
- Communication networking and wireless sensor networking: In IOT based systems sensors and controllers are installed at various locations ranging from within the house to various distant places. These sensors or controllers are connected either through wired networks or wireless networks. An appropriate networking scheme depending upon the power to be transmitted, processing capabilities, data transmission rate, and volume of data to be transmitted is required to be adopted. Compatibility with different protocols for communication networking and wireless sensor technology is a big challenge while implementing a smart grid using IoT.
- Skilled professionals: As IoT technology is in a growing stage so it is very difficult to find professionals who are acquainted with the completion of installing smart grid. It is an opportunity for professionals to be acquainted with networking, embedded system design, power generation, and distribution technologies for implementing smart grids.

V. CONCLUSIONS

Iot is giving the solution for many real time problems. But selecting the right product and working with IoT is the biggest challenge in the IT wing to design any application. If we overcome the problems with IoT then any application designing is simple. The Smart Grid system can be operated from anywhere with help of networking technology. On joining the process in research and development in Smart Grid.

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