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Smart Residence Energy Optimization System

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ABSTRACT- As we know that, Energy is a very important aspect for any household, industries, agriculture, etc. Increasing cost and demand of energy has led many organizations to find smart ways for monitoring, controlling and Saving energy. Managing the energy efficiently and conserving it intelligently for appliances is very much important. The energy usage is directly affected with Coal, Oil and so towards power generation. The emerging technologies of IoT and Big Data can be utilized to better manage energy consumption in residential, commercial, and industrial sectors. This System represents Energy Management for smart homes. People cannot control and manage the energy and also cannot monitor the light bill. So, the project will be helpful to calculate the monthly billing. Also the consumer will be able to monitor that which appliance is consuming more energy. Based on this the consumer can control the usage of the energy.

INTRODUCTION-

Using energy efficiently in smart homes saves money, enhances sustainability and reduces carbon footprint at large .Consequently, the need for smart energy management is on the rise for smart homes and for smart cities in general. However, the lack of low cost, easy to deploy, and low maintenance technology has somewhat limited a large-scale deployment of such systems. The sheer quantity of data collected throughout different cities of a country presents multiple challenges in data storage, organization, and analysis. Internet of Things (IoT) technology and Big Data are natural candidates to address these challenges. IoT technologies can provide a ubiquitous computing platform to sense, monitor and control the household appliances energy consumption on a large scale. This data is collected using many different wireless sensors installed in residential units. Similarly, Big Data technology can be utilized to collect and analyze large amounts of data. Data analytics on this data using business intelligence (BI) platform plays an essential role in energy management decisions for homeowners and the utility alike. The data can be monitored, collected and analyzed using predictive analysis and advanced methods to actionable information in the form of reports, graphs and charts. Thus, this analyzed data in real-time can aid home owners, utilities and utility eco-systems providers to gain significant insights on energy consumption of smart homes. The energy service providers can use the power consumption data available with analytics engine to provide flexible and on-demand supply with appropriate energy marketing strategies. The consumers, being aware of their consumption behavior and having a close interaction with the electricity utilities, can adjust and optimize their power consumption and reduce their electricity bills. In order to have an effective cost saving system, it is important to monitor and control the operation of residential loads depending on the aggregate power consumption over desired period, the peak power consumption, the effect of weather/atmospheric conditions and consumption slab rates. This is where the combination of IoT technology, Big Data analytics and BI comes into play for implementing energy management solutions on a local and national scale. Finally, as an additional advantage, the use of IoT also enables seamless remote access control of home devices where the customers get online access to the ON/OFF usage pattern of in home appliances via a personal computer or a mobile phone. Energy management in the context of smart homes spans the three areas namely; Smart devices, Wireless Sensor Networks (WSN), and Home Energy Management System (HEMS). This system presents the design and implementation of an EMS that addresses these shortcomings. In addition to this, the proposed system is empowered with analytics and Business Intelligence (BI) that provides a meaningful perspective on the collected data through dashboard visualization and reporting. Moreover, using Big Data based data storage technology ensures the system scalability on a national level, thus catering energy management services to both home owners as well as utility providers.

LITERATURE SURVEY-

1] K. Dittawit and F. A. Aagesen, "Home energy management system or electricity cost savings and comfort preservation," 2014 IEEE Fourth International Conference on Consumer Electronics Berlin (ICCE-Berlin), Berlin, 2014, pp. 309-313.

Increasing cost and demand of home energy has led to find the smart way for managing the use of energy. The leading technologies of Internet of Things and Big Data can be utilized to better manage Energy consumption in residential, commercial, and industrial areas. This paper presents an Energy Management System for smart home which analyzes the usages and history of each household equipments. In this system, each device is interfaced with control block. The devices

can be controlled and monitored through mobile device. Data from each device is collected and transformed to the server for further analysis.

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Smart energy management is a key research area and many strategies that enable control between household appliances and multi-power switching have been examined. However, a limitation of such strategies is that they enable automatic control of household appliances to avoid electricity interruptions and employ renewable energy sources to reduce electricity costs. For proper energy management to be realised, an algorithm needs to be developed that will control and enable the renewable power sources utilisation and automatically limit heavy loads which are in use during peak hours. These include high-consumption stoves, water and space heaters that should adhere to the set limit (automated distributed load limiting mechanism). Therefore, cost-effectiveness of energy and avoidance of electricity interruptions is realized. This paper examines smart energy management systems for residential use that have been implemented and we propose a model that results in the management of energy consumption of household appliances during peak hours based on availability of renewable power sources. Moreover, a smart algorithm that will switch between the various power sources to improve the Distributed Energy Resource (DER) and increase the profit of DER is discussed, as well.

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Electric Energy Utilities are under pressure from annual increases in customer demand. In the past, utilities used system expansion to meet this rise in demand. Economic restrictions now prevent utilities from expanding existing transmission and distribution systems while a growing concern in greenhouse gas (GHG) emissions has prevented the expansion of fossil fuel generation facilities. With the elimination of past solutions a new philosophy must be adopted. . After the HEMS model the consumer demand, it will begin to optimize costs. Through proprietary algorithms (and after receiving energy cost information from the utility) the HEMS will be able to schedule flexible loads to periods of lower energy costs. Another way an HEMS reduces costs is through heating and cooling management. For example, a sudden change in ambient temperature could cause an unmanaged heating unit to respond immediately. This could create a high demand during a period of high energy costs. An HEMS is cost aware, and it would restrain the heating unit, spreading this response out over a few hours. A slower response to a change in ambient temperature may still provide a comparable level of comfort to the consumer; with a lower cost. Department of Information Technology, Sanjivani College of Engineering, Kopargaon

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Recently smart home energy management systems(SHEMS)have been developed very fast. The relevant techniques enable SHEMS to support network controlling via demand responses, maybe including peak shaving and load shifting, as well as some ancillary services. This paper reviews the concept of SHEMS and looks into its background. It highlights SHEMS 'major components, and comparatively analyzes various technological approaches. It also discusses some of the concerns and challenges, and suggests a framework for future systems. SHEMS has been in existence in the energy sector for several decades. The key functions of such systems are to monitor, control, and optimize the flow and use of energy[1]In general, SHEMS has formidable applications in the generation, transmission and distribution systems of the electrical network. Significant among the applications include supervisory control and data acquisition with energy management system functionalities. SHEMS is important development of recent for residential customers. Demand response, demand side management, peak shaving and load shifting which are considered to offer solutions to the network operator have further boosted the drive for more robust and intelligent SHEMS.

PROBLEM STATEMENT

As we know that, Energy is a very important aspect for any household, industries, agriculture, etc. Increasing cost and demand of energy has led many organizations to find smart ways for monitoring, controlling and Saving energy. Managing the energy efficiently and conserving it intelligently for appliances is very much important. The energy usage is directly affected with Coal, Oil and so towards power generation. The emerging technologies of IoT and Big Data can be utilized to better manage energy consumption in residential, commercial, and industrial sectors. This System represents Energy Management for smart homes. People cannot control and manage the energy and also cannot monitor the light bill. So, the project will be helpful to calculate the monthly billing. Also the consumer will be able to monitor that which appliance is consuming more energy. Based on this the consumer can control the usage of the energy.

MOTIVATION

As we are using energy in many ways. with the help of energy we are using many appliances because of it we are getting more cost and We don't have any idea from which appliance we are getting more cost, which device consume more energy. so, with the help of this project we are able to know which device consume more energy, from which devices we are getting more cost. With the help of this project we can also able to control, manage this all devices. We can predict the energy consumption status.

OBJECTIVE OF THE WORK

• To manage and control the energy consumptions.

• To generate the monthly billing of the energy used.

• To monitor power consumption data of each house devices, also control through remote control services

• To generate the graph for the energy consumption and the information of the same to the consumer so that the user can get to know which appliance is consuming more energy.

SYSTEM DEVELOPMENT

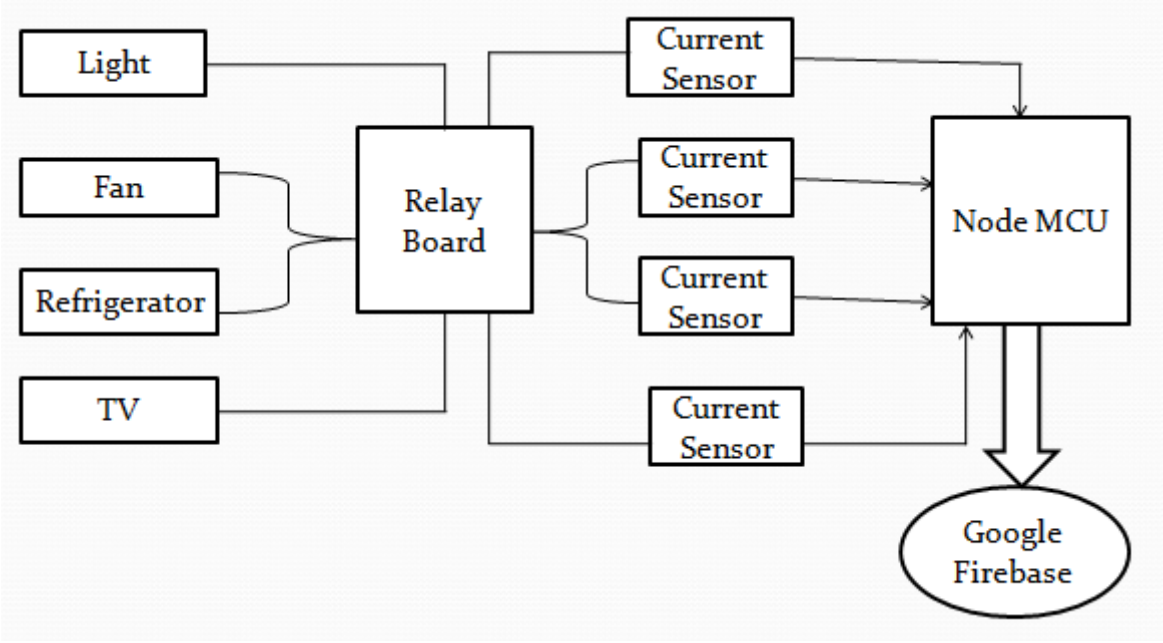

Fig.1:System Architecture

In this system, we are using various home appliances like light, fan, refrigerator, etc. This home device connected to the relay board. Relay board are computer boards with an array of relays and switches. They have input and output terminals and are designed to control the voltage supply. Relay boards provide independently programmable, real-time control for each of several on board relay channels. Current sensor connects to the other end of the relay board. Each home appliances need a separate current sensor. If we are taking four home appliances then we have to take four current sensors. Sensors are use to sense the data. In this system, we are using current sensor, voltage sensor. Current sensor are use to sense the current of the devices and voltage sensor are use to sense the voltage of the devices. Sensor sense the data and collect the data from the appliances or devices and give it to the node MCU. Then current sensor is given data to Node MCU(Microcontroller Unit). Node MCU is an open source software and hardware development Environment that is built around a very inexpensive System-on-chip(SOC) called the ESP8266. The ESP8266, designed and manufactured by Espresif Systems, contains all crucial elements of the modern computer: CPU, RAM, networking(wifi). Sensors collect the device status and report it to the microcontroller periodically. The microcontroller is a high end single SoC on the edge that collects the information from the sensors and forward it to the Google Firebase. Google Firebase is use for analytic purpose. The graph is generated here and it will display to PC or mobile. Pc act as a server in which all data is store. We can control the system by using remote controller which is used in mobile.

1. Sensors(Current and Voltage Sensor):

A current sensor is a device that detects electric current in a wire, and generate a signal proportional to that current. The generated signal could be analog voltage or current or even a digital output. The generated signal can be then used to display the measured current in an ammeter, or can be stored for further analysis in a data acquisition system, or can be used for the purpose of control A voltage sensor is used to monitor, calculate and determine the voltage supply. This sensor can determine the AC or DC voltage level. The input of this sensor can be the voltage whereas the output is the switches, analog voltage signal, a current signal, a current signal, an audible signal.

2. Relay board:

Relay board are computer boards with an array of relays and switches. They have input and output terminals and are designed to control the voltage supply. Relay boards provide independently programmable, real-time control for each of several on board relay channels. The relay board is what powers the switching mechanics on your electronic devices. It contains a power supply circuit, regulatory circuitry and of course the relays that you need to turn parts or all of your device on and off – or to switch them between states.

3. Microcontroller:

Microcontroller Microcontrollers are used in automatically controlled products and devices, such as automobile engine control systems, implantable medical devices, remote controls, office machines, appliances, power tools, toys and other embedded systems. The microcontroller is a high end single SoC on the edge that collects the information from the sensors and forwards it to the servers for further processing via MQTT broker. The microcontroller is programmed to collect the temperature, humidity and power consumption data from the sensors.

4. Google Firebase:

Google Firebase is a Google-backed application development software that enables developers to develop iOS, Android and Web apps. Firebase provides tools for tracking analytics, reporting and fixing app crashes, creating marketing and product experiment. Firebase offers a number of services, including: Analytics – Google Analytics for Firebase offers free, unlimited reporting on as many as 500 separate events. Analytics presents data about user behavior in iOS and Android apps, enabling better decision-making about improving performance and app marketing. Authentication – Firebase Authentication makes it easy for developers to build secure authentication systems and enhances the sign-in and on boarding experience for users. This feature offers a complete identity solution, supporting email and password accounts, phone auth, as well as Google, Facebook, GitHub, Twitter login and more.

Firebase offers a number of services, including:

Cloud messaging – Firebase Cloud Messaging (FCM) is a cross-platform messaging tool that lets companies reliably receive and deliver messages on iOS, Android and the web at no cost.

Realtime database – the Firebase Realtime Database is a cloud-hosted NoSQL database that enables data to be stored and synced between users in real time. The data is synced across all clients in real time and is still available when an app goes offline.

Crashlytics – Firebase Crashlytics is a real-time crash reporter that helps developers track, prioritize and fix stability issues that reduce the quality of their apps. With crashlytics, developers spend less time organizing and troubleshooting crashes and more time building features for their apps.

Performance – Firebase Performance Monitoring service gives developers insight into the performance characteristics of their iOS and Android apps to help them determine where and when the performance of their apps can be improved.

Test lab – Firebase Test Lab is a cloud- based app-testing infrastructure. With one operation, developers can test their iOS or Android apps across a variety of devices and device configurations. They can see the results, including videos, screenshots and logs, in the Firebase console.

CONCLUSION

The system calculate the monthly billing. Also the consumer will be able to monitor that which appliance is consuming more energy. Based on this the consumer can control the usage of the energy. This system also generate the graph of the energy consumption by home appliances and devices.

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