ENERGY MANAGEMENT SYSTEM INTEGRATED TO GSM PROTOCOL

R.Leena Rose[1],M.Chithra[2],R.Praveen[3], M.Shanmugam[4] & V.Vikram [5]

[1](Assistant professor , Department of Electrical and Electronics Engineering, Sree Sakthi Engineering college, Coimbatore -641 104, Tamilnadu, India.)
[2](UG scholar, Department of Electrical and Electronics Engineering, Sree Sakthi Engineering college, Coimbatore -641 104, Tamilnadu, India., Chithramurugan2699@gmail.com)
[3](UG scholar, Department of Electrical and Electronics Engineering, Sree Sakthi Engineering college, Coimbatore -641 104, Tamilnadu, India, jtpraveen111@gmail.com)
[4](UG scholar, Department of Electrical and Electronics Engineering, Sree Sakthi Engineering college, Coimbatore -641 104, Tamilnadu, India, Shanshanmugam28117@gail.com)
[5](UG scholar, Department of Electrical and Electronics Engineering, Sree Sakthi Engineering college, Coimbatore -641 104, Tamilnadu, India, vikramvap36@gmail.com)

Abstract-- *Electricity plays an important role in developing countries. Increasing population leadsto electricity demand as high. This increase in Demands electricity can be met by smart monitoring system. The electricity produced from non-renewable source of energy is 67% in India. In the year 2100, it is estimated that all of earth non-renewable source of energy will be completely used. Power consumption can be reduced to great extent by proper monitoring of domestic appliances. Smart power monitoring system plays a two-way communication between the consumers and distributors. Smart power monitoring uses Arduino, PIR sensor, Wi-Fi (ESP8266) and cloud platform as a service to store and analyze data. The solution aims at saving power by constantly notifying the power consumed by the consumer and the user to cut down the mains or home appliances through mobile application when it not in use it saves a lot of resources and money. Hence then alert signal is received by the user, if the power consumption reaches 90% of subsidy. The fault complains in home also send through mobile application. To minimize the unmeasured usage of electricity by creating awareness of smart power meters.*

Keywords --Arduino ,PIR Sensors , Cloud Platform, Wi-Fi(ESP8266).

I. INTRODUCTION

In existing system monthly Smart power meter, which utilizes the feature of embedded system(i.e.,) combination of software and hardware. To introduce smart concept, the Arduino and other controller, GSM, Wi-Fi modem are interfaced. By the use of GSM and Wi-Fi modem the consumer as well as the distributor will get the used energy reading in the form of text messages when it reaches the threshold value which we have already set. Then through the Wi-Fi modem, the user can check the regular usage of electricity through webpage and message.

Smart power monitoring system enables the electricity board to read the meter reading monthly without a person visiting each house. The continues meter reading was monitored and recorded in permanent memory location of Arduino. The smart power system continuously records the reading and live meter reading can be displayed on the webpage and also message will be received by the required user at the end of the day.

Power supply of the house can be disconnected when needed. Today mobile phones are the most important part in humans' lives. By use of this smart gadget, human can do many works with or without internet. Through this home become smarter and more luxurious.

The Existing domestic Energy meter reading systems which was how exist havemany problems, such as difficulty in construction, too narrow bandwidth, too low rate, poor real time, not two way communication quickly etc. To solve above problems, this paper uses the wireless technology for

Automatic Meter Reading system. The development of android system is increasing rapidly and this project, will extend the android platform into household objects,to control electrical switches like fan, ac, lights, etc., the android app Wi-Fi is used. The Wi-Fi act as both receiver and transmitter by interfacing with Arduino. Then relay is connected to Arduino, SMPS board and power meter. The PIR human motion sensor is also connected to Arduino digital pins and it senses the human motion and transmit the off command to relay when human motion is absent.

The system features real time demand side management using composite design methodology (CDM). It comprises the metering and cloud server cluster units. The work introduced ACS712 Hall Effect current sensor, Arduino Uno (with ATmega328 chipset), and SIM800L GSM modules to achieve the system functionalities. The design description on editor run-time environment enabled direct debugging in the open source Integrated Development Environment (IDE).

The approach was evaluated through selected case studies and usability experiments. With the latter, the suitability of the system provided an efficient means of monitoring energy consumption with minimal errors. The results showed that when the meter was switched - ON with no load, an output of 0.00kWh was read. The SMPS (Switch Mode Power Supply) is connected to Arduino and it convert the ac to DC signals. Smart power monitoring system is more efficient and effective for power consumption than existing system. Here energy consumption data was only logged but not saved. In proposed system energy consumption was monitored and saved by alerting the consumers when energy exceeds 100 units and also by turning OFF the unnecessary loads automatically.

II. LITERATURE SURVEY

[1] The conventional meter is not suitable for accurate meter readings and involves large man power to take the meter readings ,analysing the data and generating the bill amount. This leads to misreading of the energy consumed and results in great economic loss to the consumers as well as to the utility providers. With the advent in technology and ever increasing human population has created a demand of generation of electricity at higher rates. This has created an imbalance between the generation, distribution and consumption of electricity. The conventional meter reading systems involves man power to visit to the consumers pace and generates bill amount according to energy consumed. The absence of the consumers creates a difficulty for the operator to revisit the consumer place again thereby wasting a lot of time, resource Lake of payment of the bill generated creates situation where the operator has to manually disconnect the electrical supply. It is a prolonged process and also very problematic to manage these situations.

[2] This work presents the efforts on optimizing energy consumption by deploying an energy management system using the current IoT component/system/platform integration trends through a layered architecture. LoBEMS (LoRa Building and Energy Management System), the proposed platform, was built with the mind set of proving a common platform that would integrate multiple vendor locked-in systems together with custom sensor devices, providing critical data in order to improve overall building efficiency.The actions that led to the energy savings were implemented with a rule set that would control the already installed air conditioning and lighting control systems. This approach was validated in a kindergarten school during a three-year period, resulting in a publicly available dataset that is useful for future and related research. The sensors that feed environmental data to the custom energy management system are composed by a set of battery operated sensors tied to a System on Chip with a LoRa communication interface.

These sensors acquire environmental data such as temperature, humidity, luminosity, air quality but also motion. An already existing energy monitoring solution was also integrated. This flexible approach can easily be deployed to any building facility, including buildings with existing solutions, without requiring any remote automation facilities.

[3] Arduino and GSM based smart energy meters for advanced metering and billing system is able to read and send data via wireless protocol using GSM technology through GSM modem, capable of managing the meter as well as the line connections. For GSM module uses network coverage of the SIM. Smart energy meter uses SMS or Wi-Fi to send power to the cloud, so that user can access the data room module apps and website. Using cutting the edge technology smart energy meter will save money, labour, efforts and time and the at the time it will effectively monitor the electricity consumption, usage and fraud. Its save easy to use and user friendly.

[4] The meter describes that the during peak hours, and to manage the demand of electricity, we need to borrow from neighbouring states. To overcome this issue the Intelligent

Energy Meter with Home Automation is used and reduces power wastage in house hold appliances with proper monitoring and control. The intelligent energy meter which can reduce the electricity cost by 25-30%. The GSM module for updation of energy consumed by consumer via Arduino and also turn ON/OFF the appliances IoT via switching mechanism.

[5] The model describes strong explanatory power with respect to energy efficiency, and shows that automated meter reading (AMR) devices, direct program costs, and incentive costs all have a positive influence on energy efficiency effects The system provides potential research directions, in particular, the need to consider interactions between different demand side programs and different types of information technologies that are emerging as part of the smart grid.

[6] The android mobile devices are interface with home automation system. This mobile phone and system can communicate long-range via Wi-Fi. This Application can be loaded and interfaced with other compatible devices. By using comfortable GUI application, we can operate all the electrical appliances at home through on/off command and also the user can see the result on Android application from anywhere. For home automation for luxurious life this design is good.

[7] Alternative power quality monitoring and control, based on voltage parameter light weight assessment implementation in smart meters, allow market –correlated service and real time network operation.

The signal analysis framework for simplified power quality in most of smart meter. voltage characteristics made available with reporting rate high is efficiently used by public electricity networks with negligible impact on cost and addressed in a novel design of smart meters, the smart grid synchro-SCADA for further applications.

[8] The comprehensive and extensible framework to solve the load disaggregation problem for households. This examines both the modelling of house appliances as Hidden Markov models (HMMS) and based on segmented integer quadratic constraint programming (SIQCP) to disaggregate the household power to the appliance level. This consistent with the Australia smart meter infrastructure minimum functionality. The existing smart meters to generate device level load model for smart grids.

[9] Power meter conception data may contain user's privacy. The users have many smart metering schemes and operating centres in reality. This supports data privacy, fault tolerance and range-bases filtering. Specifically, the lifted EIGamal encryption to aggregate user's consumption report at the gate way to reduce communication overhead, while supporting for tolerance of malfunctioning smart meters effectively. The properties of this scheme and evaluate its in terms of security and efficiency.

[10] The share of plug load and few studies on plug level energy usage and consumption in building is increasing. This device has inbuild capability to measure and report energy use (or) control input over the network and create awareness about energy devices. Energy consumption make the control smarter place and make better decision using this Internet of things

III. PROPOSED METHOD

3.1 HARDWARE DISCRIPTION:

The smart power monitoring using IOT system is described in figure 1. Power meter, ESP8266 Wi-Fi, GSM, PIR sensor and relay are connected to Arduino.

Power consumed by home is monitored every second by power meter and send to Arduino.

The Arduino gathers the power value and sends to cloud through Wi-Fi. Relay has three high voltage terminal which connect to the device to control. Three voltage pins which connect to Arduino.

If the user wants to cut the supply a provision is provided with software application, the information passes to Arduino controller to switch off the relay.

GSM is developed by European telecommunication standards. If the power consumption reaches threshold value, alert message is sent to a registered number which is predefined already and also sends the SMS at the end of day for the required user.

An electricity meter or power meter is a device that measures the amount of electric energy consumed by a residence, a business, or an Electrically Powered device.

The power consumed by the load is monitored and collected data is sent to Arduino. PIR Sensor allows to sense motion, almost always used to detect whether human has moved in or out of the sensor range. Sensors are small, in-expensive, low power, easy to use and don't wear out.

PIR sensor which is connected to Arduino UNO always monitors the motion of particular room, if any human motion didn't occur it sends the alert to Arduino.

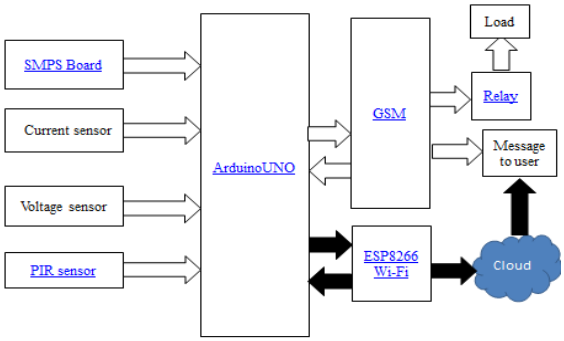


Fig.1

Block diagram of Smart Power Monitoring System Using IOT

3.2 ARDUINO UNO:

The Arduino Uno is a microcontroller board based on the ATmega328(datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and are set button.

It contains everything needed to support the microcontroller simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started.The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter.

Fig 2. Arduino uno

3.3 ESP8266(Wi-Fi):

ESP8266 is an UART-Wi-Fi transparent transmission module with ultralow power consumption, specially designed for the needs of a new connected world. It offers a complete and self-contained Wi-Fi networking solution, allowing it to either host the application or to offload all Wi-Fi networking functions from another application processor.

ESP8266 has powerful on-board processing and storage capabilities that allow it to be integrated with the sensors and other application specific devices through its GPIOs with minimal development up-front and minimal loading during runtime. Its high degree of on-chip integration allows for minimal external circuitry, and the entire solution, including front-end module, is designed to occupy minimal PCB area. ESP8266 Serial Wi-Fi Wireless Transceiver Module is suitable for Uno, Mega 2560 and Nano. The ESP8266 Wi-Fi Module is a self-contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your Wi-Fi network.

The ESP8266 is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor. This module has a powerful enough on-board processing and storage capability that allows it to be integrated with the sensors and other application specific devices through its GPIOs with minimal development up-front and minimal loading during runtime.

Its high degree of on-chip integration allows for minimal external circuitry, including the0front-end module, is designed to occupy minimal PCB area. The ESP8266 supports APSD for VoIP applications and Bluetooth co-existence interfaces, it contains a self-calibrated RF allowing it to work under all

operating conditions, and requires no external RF parts.The applications of ESP8266 are Smart power plugs, Home automation, Wi-Fi location-aware devices, Industrial wireless control, Security ID tags.

Fig 3.ESP8266(Wi-Fi)

3.4 PIR SENSOR:

PIR sensor detects a human being moving around within approximately 10m from the sensor. This is an average value, as the actual detection range is between 5m and 12m.PIR are fundamentally made of a pyro electric sensor, which can detect levels of infrared radiation. For numerous essential projects or items that need to discover when an individual has left or entered the area. PIR sensors are incredible, they are flat control and minimal effort, have a wide lens range, and are simple to interface with.

PIR sensors have a 3-pin connection at the side or bottom. One pin will be ground, another will be signal and the last pin will be power. Power is usually up to 5V. Sometimes bigger modules don't have direct output and instead just operate a relay which case there is ground, power and the two switch associations. Interfacing PIR with microcontroller is very easy and simple. The PIR acts as a digital output so all you need to do is listening for the pin to flip high or low.

The motion can be detected by checking for a high signal on a single I/O pin. Once the sensor warms up the output will remain low until there is motion, at which time the output will swing high for a couple of seconds, then return low.

If motion continues the output will cycle in this manner until the sensors line of sight of still again. The PIR sensor needs a warm-up time with a specific end goal to capacity fittingly. This is because of the settling time included in studying nature's domain. This could be anyplace from 10-60 seconds.

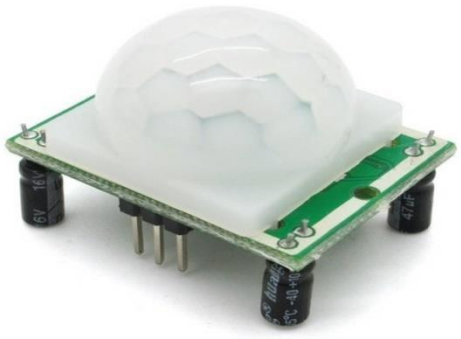
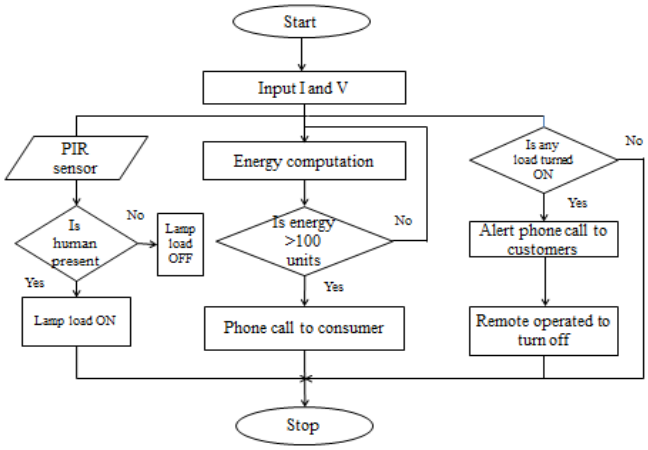


Fig 4.PIR sensor

IV.FLOW CHART



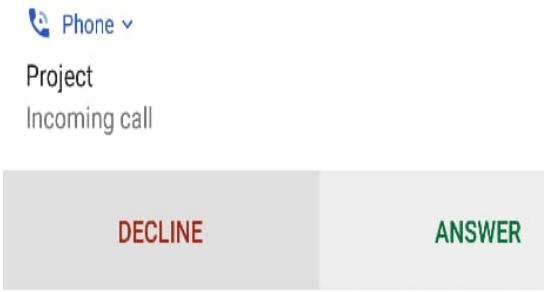
The system input 230V is given to relay, relay act as a controller and it is connected to the SMPS board Arduino power meter and PIR sensor. Arduino work as both transmitter and receiver and it is interfaced to the PIR sensor, power meter, relay, Wi-Fi, GSM and SMPS board. SMPS board is used to convert AC to DC supply.

In this figure the relay is connected before the power meter to reduce the power consumption by the user the PIR motion sensor is used for automatic ON/OFF of the load where the human motion is absent. Then the GSM (Global System for Mobile Communications) and Wi-Fi is used to transmit two-way communication between the distributer and consumer.

The GSM is used sending SMS (Short message service) at the end of the day to the customer who required daily. Through this Wi-Fi and IoT (Internet of Things) all home appliances are connected or interfaced with the cloud and through the application we can control all home appliances. Smart Power Monitoring system reduces the cost and power consumed by the user automatically.

V. RESULT AND DISCUSSION

Case 1: Alert Phone call to consumers when energy exceeds 100 units

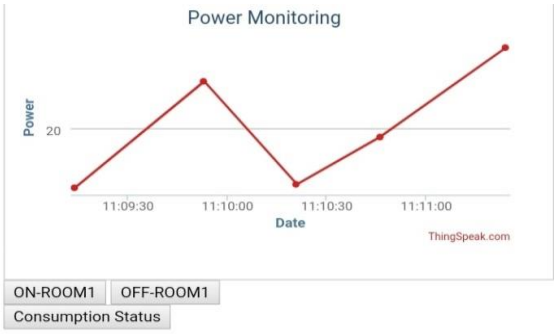


Case 2: Alert Phone call to consumers when energy exceeds 100 units

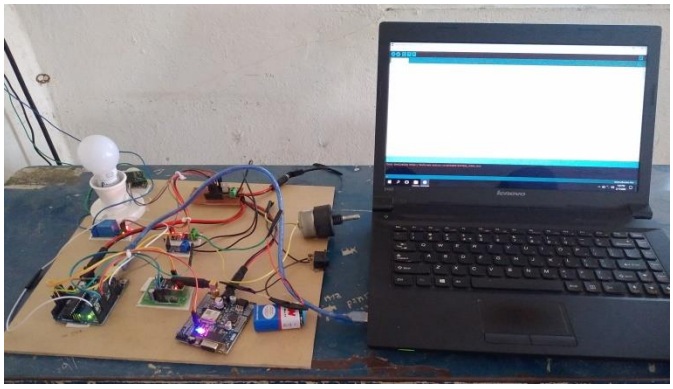
ON CONDITION

OFF CONDITION

Case 3: Remote control through mobile when failed to turn OFF



HARDWARE SETUP:



Hardware Setup of Smart Power monitoring System

VI .CONCLUSION

We analyzed and interpreted different sets of consumption data of various households. Their daily behavior patterns are graphed. We controlled and operated the Rooms in a individual home globally by an application. Although there has been much opposition to smart meters due to privacy and health concerns. A home energy management system enables consumers to bring together interactive devices to create an advanced metering infrastructure. Together, this intricate system can help manage energy. Thus this system was programmed to reduce electricity use. This can cut down costs to a great extent. Additionally, this interactive feature can help utility companies to push for energy management and conservation in future.

REFERENCES

[1] **"**Design of Smart Energy Meter With Power Theft detection and a novel of billing payment" published by A.Aswin,S.Senthilmurugan in 2019.

[2] "LoBEMS-IOT for Building and Energy Management Systems" published by Bruno Mataloto in 2019.

[3] "Review on Smart Electric Metering System Based on GSM/IOT" published by Sameena, Yasmeen Bhat in 2019.

[4] "Intelligent Energy Meter With Home Automation" published by Roji Thomas Mathew in 2018.

[5] "The Effects of Smart Metering and Program Investments on Demand Side Management performance in the US Electricity sector" Published by Jacqueline Corbett in 2018.

[6] "Electric Switch ON/OFF System Using Android APP Via Wi-Fi" Published by RashmiShirwadkaret in 2016.

[7] "Syncretic Use of Smart meter for Power Quality Monitoring in emerging networks" Published by M.Albu in 2016.

[8] "An Extensible Approach for Non Intrusive Load Disaggregation with Smart Meter Data" Published by Weicong Kong in 2016.

[9] "Differentially Private Smart Metering With Fault Tolerance and Range Based Filtering" Published by Jianbing Ni in 2016.

[10] "IOT Based Smart Power Metering" Published by AratiKurde in 2016.

BIBLIOGRAPHY:

Chithra.M Currently pursuring B.E under the stream of Electrical and Electronics at Sree Sakthi Engineering College Coimbatore affiliated to Anna University Chennai.

Praveen.R Currently pursuring B.E under the stream of Electrical and Electronics at Sree Sakthi Engineering College Coimbatore affiliated to Anna University Chennai.

Shanmugam.M Currently pursuring B.E under the stream of Electrical and Electronics at Sree Sakthi Engineering College Coimbatore affiliated to Anna University Chennai.

Vikram.V Currently pursuring B.E under the stream of Electrical and Electronics at Sree Sakthi Engineering College Coimbatore affiliated to Anna University Chennai.