AUTOMATION IN UTILIZATION AND CONTROL OF ELECTRICITY

A PROJECT REPORT

Submitted by

DEEPIKA M (17BCS006)

GOWTHAM R N(17BCS017)

SHALINI R (17BCS040)

In partial fulfilment for the award of the degree

Of

BACHELOR OF ENGINEERING

IN

COMPUTER SCIENCE AND ENGINEERING

KUMARAGURU COLLEGE OF TECHNOLOGY

COIMBATORE-641 049

(An Autonomous Institution Affiliated to Anna University, Chennai)

ANNA UNIVERSITY: CHENNAI 600 025

MAY-2021

KUMARAGURU COLLEGE OF

TECHNOLOGY

COIMBATORE 641 049

(An Autonomous Institution Affiliated to Anna University, Chennai)

BONAFIDE CERTIFICATE

Certified that this project report **"AUTOMATION IN UTILIZATION AND CONTOL OF ELECTRICITY"** is the bonafide work of

"**DEEPIKA M (17BCS006)**

GOWTHAM R.N (17BCS017)

SHALINI R (17BCS040)"

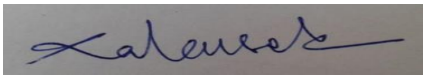
who carried out the project work under my supervision.

SIGNATURE

Dr.P.Devaki,

HEAD OF THE DEPARTMENT

Department of Computer Science and Engineering,
Kumaraguru college of technology,
Coimbatore - 641049



SIGNATURE

Dr.R.Kalaiselvi,

PROJECT GUIDE

Department of Information Science and Engineering,
Kumaraguru college of Technology,
Coimbatore - 641049

The candidates with University register number **17BCS006, 17BCS017,17BCS040** were examined in the Project Viva-Voce examination held on …25.05.2021……

Internal Examiner External Examiner

DECLARATION

We affirm that the project work titled

"AUTOMATION IN UTILIZATION AND CONTROL OF ELECTRICITY"

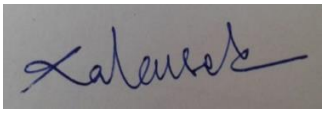
being submitted in partial fulfillment for the award of B.E Computer Science and Engineering is the original work carried out by us. It has not formed the part of any other project work submitted for the award of any degree or diploma, either in this or any other University.

DEEPIKA M (17BCS006)

GOWTHAM R.N (17BCS017)

SHALINI R (17BCS040)

I certify that the declaration made above by the candidates is true.



Dr.R.Kalaiselvi,

Assistant Professor,

Department of Information Science and Engineering,Kumaraguru College of Technology,

Coimbatore – 641 049.

ACKNOWLEDGEMENT

We express our profound gratitude to the management of Kumaraguru College of Technology for providing as with the required infrastructure that enabled us to successfully complete the project.

We extend our gratefulness to our Principal, **Dr.D.Saravanan,** for providing us the necessary facilities to pursue the project.

We would like to acknowledge **Dr. P. Devaki,** Professor and Head, Department of Computer Science and Engineering, for her support and encouragement throughout this project.

We thank our project coordinator **Dr.L.Latha** and guide **Dr.R.Kalaiselvi,** Professor, Department of Information Science and Engineering, for their constant and continuous effort, guidance, and valuable time.

Our sincere and hearty thanks to staff members of Department of Computer Science and Engineering of Kumaraguru College of Technology for their well wishes, timely help and support rendered to us during our project. We are greatly indebted to our family, relatives, and friends, without whom life would have not been shaped to this level.

- DEEPIKA M
- GOWTHAM R.N
- SHALINI R

TABLE OF CONTENTS

CHAPTER 1

AUTOMATION IN UTILIZATION AND CONTROL OF ELECTRICITY

ABSTRACT:

Technological growth in internet and communication technologies helps in achieving efficiency in all sectors. Energy provides an incentive for the development and growth of the nation and in recent days, smart meters play an important role in the same by aiding in power consumption calculation in a cost-effective design. The smart meters are electronic device that stores information such as consumption of usage, voltage and current levels. The main focus of this paper is to discuss the design of an IoT based economical smart meter. Through periodic alerts of power consumption by smart systems, the consumer can be made conscious about avoiding the unnecessary usage. When the usage alert is sent in every fortnight customer could plan accordingly to save the electric energy. Additionally, consumer is provided a facility to set their power consumption need for a month. When the usage goes close to threshold, an alert message is sent. Repeated alert messages are sent when the usage is very close to the threshold. When the usage exceeds the same the power supply is cut down. This helps the customer to plan their requirement properly and leads to a good economic power saving globally. The proposed system includes fault detection to avoid theft where a vibration sensor is utilized to detect the theft and in response, a message is sent to the user to let them know about any deceiving activity.

KEYWORDS:

Internet of Things (IOT), Short Message Service (SMS), Smart meter, Power consumption, Fault detection.

Introduction:

Power management for systematic use of electricity is one of the predominant problems. The development in technology leads the requirement of power and escalate the power demand. As automation increases in industries and houses, these power demands also increases tremendously.

Wireless sensor network technology has given a great potential in the process of management, control, and collection of data. All kind of data such as video, audio, structured, unstructured can be collected through measuring units and sending wirelessly to a control system for operation and management. In recent years, the utilization of wireless sensor networks (WSNs) is encouraged in the domains such as health monitoring, environmental monitoring, and industrial monitoring in order to reduce the energy consumption.

Internet of Things (IoT) is a widely used technology that comprises sensing as well as communication capabilities. IoT enabled devices can be used to monitor various physical, electrical or environmental parameters depending on the need. The data collected can be analysed and used to solve different problems related to everyday life process. IoT enabled power monitoring devices can help us to solve this problem by providing granular information about electricity consumption.

In present Indian scenario, conventional electric meters supplied by electricity suppliers measure power consumption of the whole place where it has been deployed. Consumer has no control to monitor power utilization whenever they wish. This is due to the lack of storage feature in the conventional meters. Moreover, as there is no facility provided with conventional meters for communication, the customer cannot receive the data or information from it. Currently, power consumption has no limits to every home or industry. This leads to a significant unnecessary usage of non-renewable energy.

Using the smart electricity power meters, the power consumption can be automatically measured, logged and analysed. This will help to promote energy awareness in the society. The power consumption data will be securely transmitted over the internet to the server, to avoid limitless consumption by providing necessary alerts thus by saving power for future. This system can be integrated with the existing convectional meter hence providing with a cost-effective smart meter with fault detection based on Internet of Things (IOT).

CHAPTER 2

2. LITERATURE REVIEW:

2.1 INTRODUCTION:

There are several domains in which IoT has its significant role and contributions. When IoT is involved in energy related sectors, the energy management becomes more efficient and easier due to the non-intervention of human. Installing a smart meter helps the user to get rid of estimating bills by allowing him to control and reduce energy consumption. Smart meter is an intelligent digital device that is designed to replace the traditional electricity meter and it can be equipped with a display screen that shows the exact energy usage in real-time. Smart meters offer two-way communication between the meter and the system.

Power management for systematic use of electricity is one such predominant problem. The technology develops the requirement of power and escalate the power demand. These power demands happen in both domestic and industrial division. As it is witnessed that more and more home appliances and consumer electronics are installed, energy consumption tends to grow rapidly.

IoT enabled power monitoring devices can help in solving the problem of providing granular information about electricity consumption to users. In present Indian scenario, conventional electric meters supplied by electricity suppliers measure power consumption of the whole place where it has been deployed. Consumer has no control to monitor power utilization often. One of the drawbacks with these meters is lack of storage feature that fails to store the data needed as well as it fails to the analyse data.

Due to truancy of the communication facility in the meter, power consumption must be noted down manually for billing. This process is prone to human error and non-accuracy. When the smart electricity power meters are used, the power consumption can be automatically measured, logged and analysed efficiently. This leads in promoting energy awareness in the society. The power consumption data can also be securely transmitted to the authoritative electricity board so that it helps in avoiding manual billing as well as the probability of human errors.

2.2 LITERATURE REVIEW OF JOURNALS:

1. IOT Based Smart Power Management System Using WSN

Pallavi et al., presented an effective implementation of IoT in monitoring home appliances. Wireless sensor networks based real time power management system was used to monitor and control the power consumption of electrical appliances in a home. To calculate the power consumption of electrical appliances, current sensor and voltage sensor is placed at the electrical load to sense the current and voltage. This data was transmitted through Zigbee protocol wirelessly to the Ethernet shield. The data transmitted is monitored and controlled remotely using IOT technology. This provides users to have a flexible control mechanism remotely through the secured internet web connection. The proposed system helps the user to control the electric appliances automatically and remotely using smart phone or personal computer. The main drawback of this system is that there means of security for the smart meter such as an alert system. A smart meter system using IOT has been presented here which monitors and controls the power consumption. This system allows the users to know their power usage remotely on the website.

2. WIRELESS SENSOR NETWORK APPLICATION: SMART METER USING SMART CARD:

Sai et al., framed a system with smart meter module that consists of a micro controller interfaced with passive rfid module and ZigBee module which in turn connected to the master module with 802.11 ethernet interface. Using smart technology, smart meters are coupled with passive rfid, ZigBee and smart meter which will behave like a post-paid mobile phone where passive rfid is used to pay electricity bills and recharge. This work precisely describes about how a smart meter's work and how smart meter is useful in paying bills wirelessly. The disadvantage of this system is that the user cannot monitor their energy consumption by which they can reduce their consumption and there is no security provided for the smart meter such as an alert system. A smart meter system using smart card is created which a pre-paid and postpaid meter. This system uses ZigBee module and rfid module to perform the same.

3.IOT Based Energy Meter Reading System with Automatic Billing:

Kishore Kumar et al., reported the design and development of smart meter monitoring and controlling system in real time. The main goal of this work is to reduce cost and save more energy. Also reduces manpower requirement and time consumption. Customers can know their utilization of electricity then and there. This strategy allows two path exchanges amongst utility and purchaser and gives different capabilities that are if the customer neglects to pay the power charge the vitality power supply would be cut off from the utility side and once the bill is paid the vitality supply is re-established**.** To avoid the further consumption of power, there is a feature to set a limit for each household and if the limit exceeds, methods are used to cut down the appliances according to the user convenience both automatically and manually. A smart metering system present in this paper is a IOT based system with fault detection. It uses EEPROM to store the data from the meter which indeed is used by the user to monitor their energy consumption.

4. Implementation of IOT based Electricity Controlled Prepaid Energy Meter Monitoring and Bill Payment System:

Mohan et al., demonstrates their smart prepaid energy meter where at the time of installation of the device, staff will generate a unique identification number for each device. Staff will then integrate this unique number into the device and will also create a user account for the customer which consists of customer name, email, mobile number and address. The newly registered device and user will be linked together. After successful installation of device and verification of the user details, customer will be given a password for checking the status of their device with the help of email. User must recharge this device from a web app designed for this device in order to continue supply of electricity. Once the balance of this device becomes zero, this will stop the offering of electricity after 24 hours, within that 24-hour user will start receiving notification regarding balance status of the meter after a definite interval until customer pays bill. The main aim of this system is to bring transparency of billing and usage between the customer and the electricity board. Customer will tend to use less amount of power because of the prepaid nature of the billing system. The main lay back of this system is there the users cannot monitor their electricity usage and they have no insight on their timely power consumption. The system presented in this paper is an Arduino uno based using IOT. It is a prepaid smart meter billing system.

5. IOT Based Smart Energy Meter Billing Monitoring and Controlling the Loads:

Subba Rao et al., has discussed a plan and improvement of a keen observing and controlling framework for energy meters continuously. With the end goal to monitor the energy, consequently, diminish creation cost, the Remote Meter Reading System is created. Remote smart energy meters were designed and structured with prepaid appropriation framework. The proposed framework basically monitors the vitality necessities and status of utilization of intensity. This framework can screen the status and transmit data to webserver. If the condition gets different, to a concerned expert's phone number and also amount to be paid by customer at the end of month automatically will be sent as a SMS through GSM. The web page designed which we will utilize is secret phrase ensured by adding username and password along with secured API keys. The framework will run with ARM processor utilized in the usage of sensor module and other respective condition. The framework provides a total, ground-breaking, minimal effort and offers a method for screening and controlling the appliances remotely in a home or building. The main disadvantage of the system here is that there is no security feature provided for the smart meter where the user will get to know if any fault occurs with the same. The smart meter in this paper is IOT based system. It uses GSM for the communication between the used and the meter and a web page is provided so that the user can monitor their usage.

6. IoT Based Smart Energy Management in Residential Applications:

Rakibul et al., presented a simple, compact, low-cost and secure power monitoring and controlling system with Wi-Fi capability which not only ensures transparency of data but also provides flexibility to the users by offering the feature of remotely controlling their home appliances. Power consumption and its respective cost is calculated automatically and then the data is sent to a server in a periodic manner. To carry out the task, NodeMCU has been utilized, that has the combinational functionality of both microcontroller and Wi-Fi modules. Through the microcontroller function, constant readings of energy meter are collected and saved in NodeMCU. The collected data is sent to a remote server on the internet via Wi-Fi. This system also offers the functionality of controlling the appliances remotely over the Internet. Besides, electricity suppliers can produce bills from the server data automatically, making it possible solution. This paper also proposes and analyses individual sub-metering of home appliances of high rating to observe and control their energy consumption. The add-ons of this presented system can be also integrated with the existing prepaid meters of the market, preventing its major drawbacks by providing added functionality. The main disadvantage of this system is that the smart meter no security to oppose any fraudulent activity which might happen. The smart meter system is based in IOT which uses NodeMCU as a microcontroller. A web page is provided through which the user can monitor and control the smart meter.

7. Design of Embedded based automated meter reading system for real time processing:

Nayan Gupta et al., has proposed an embedded technology-based approach for automated energy meter reading system which updates the reading in website on regular interval. The design of an AMR system comprises of straightforward and low-cost wireless GSM energy meter and an internet interface related to it for automating billing and managing the collected data. The readings are sent to the centrally located ARM microcontroller-based station. From ARM microcontroller, GSM is used to send it to webserver. Protection from tampering is also provided. The system model consists of three different units: home communicable unit, central controlling unit and web server. EPROM is used for storing the reading. One of the advantages is that it is applicable to both prepaid and post-paid meters. The described smart meter system in this paper uses an ARM 7 microcontroller. A web page is used for monitoring the energy consumption. It uses RF link and a GSM module for sending the data from the smart meter to the web page.

8.IoT Based Smart Energy Management System:

Abhilasha et al., have developed a smart energy management system based on IOT in which appliances like fan and bulb are controlled wirelessly and that supported to collect humidity and light intensity information. These inputs are used towards controlling the appliances intelligently and record the power consumption in cloud server. This system is a smart energy management system consisting of an Arduino microcontroller, raspberry pi3, Wi-Fi shield and modules like light intensity sensor, hall sensor and ambient temperature sensor. The graphical picturization of the power consumption versus time for each appliance with varying environmental conditions is stored in cloud server. This information is displayed in a webpage using HTML in cloud server. The downside of this system is that there is no alert system provided regarding the power consumption on a timely bass and there is no mention of security in this system. An IOT base energy meter has been developed in this paper which takes into consideration the temperature, light intensity, and humidity for controlling the appliance usage. It uses Arduino microcontroller and Raspberry PI3 to calculate the energy consumption. Clod is used to store the information.

9.Smart Energy Meter:

Patrick Mapulane et al., presented a smart energy meter for automatic metering and billing system. The meter reading system with automatic functions that are Predefined by microcontroller and GSM short message service (SMS). The Global System for Mobile Communications (GSM) module requires a Subscriber Identity Module (SIM) card to activate communication between the mobile phones and the network. Customers can recharge and control loads remotely. Utility companies also have remote access to the system such as fault diagnosis as well as communicating with clients. The proposed energy meter system (EMS) transmits data like consumed energy in kWh and secure a bill over a GSM mobile network. Other controls include that the system provides an Accurate domestic power consumption, safely and with a relatively fast update rate. This system faces a disadvantage with the safety and no security of the smart meter is provided which may lead to fraudulent activity. And there is to alert feature which will help the consumer to have an insight about their electricity usage. Also, no user interface is provided for monitoring of energy consumption. A smart energy meter has been designed using GSM module. This system is developed using Arduino and an LCD is used to view the data from the meter using keypad or cellphone once the GMS connection with the sim has been established.

10. Iot Based Smart Energy Meter Monitoring and Billing System:

Manisha et al., have proposed a system that provides a platform for consumer to monitor the meter reading through Thing Speak and control the energy consumption and supports in recording the energy meter billing. This system includes power supply, Esp8266 Wi-Fi module, Atemga328p Micro-controller, LCD display, Relay and Switch. The billing can be done automatically. Theft detection is provided, and overall cost of the system is less. The major drawback of this system is that there is no steps taken to intimate the users about any unethical activity which may take place. A smart meter which gives a trouble-free energy consumption monitoring has been developed based on IOT. This system implemented using Almega328P microcontroller and ESP8266 Wi-Fi module.

11. IOT Based Intelligence of Electric Meter:

Intelligent energy meter reading and bill generation using Arduino Mega, and Ethernet Shield has been proposed by Aditi et al. The generated bill is sent to the consumer through SMS using GSM900. Disconnection of the power supply is also done wirelessly by the controller if any problem occurs from consumer side. A graph of date vs pulse count is generated and displayed on the website so that user can know their day wise pulse count. The mentioned system fails in providing security for the meter which is a major disadvantage. Also there no alert feature through the SMS to inform the user about their consumption. A smart energy meter has been designed using Arduino Mega and Ethernet Shield. It is an IOT based system where power consumption is calculated and displayed in LCD and in case of any problem the power supply is stopped wirelessly.

12. IoT based Smart Talking Energy Meter (ISTEM)

Syed et al., described about Arduino UNO microcontroller-based architecture of smart talking energy meter using IoT. The main aim of this system is power optimization, power theft detection and providing the energy consumption information to user where the user can monitor the energy consumption in units from a page through mobile app by providing device IP address. Theft detection unit is connected to vitality meter which will notify when meter tampering takes place in energy meter by LED blink. Then, the theft detected message will be displayed on the LCD terminal and a voice output also generated to alert consumers. This system consists of microcontroller unit, theft detection unit and Wi-Fi unit, APR unit and sensing unit. The disadvantage of this system is that there to no way to alert the user if they have extensively used their electricity and there is no threshold set to reduce the electricity consumption. Another downside is that there is no user interface. The system mentioned in this paper is implemented using Arduino uno microcontroller. This is an IOT based design where the data of energy consumption is displayed in LCD and any alert is voiced using a speaker.

CHAPTER 3

PROBLEM DEFINITION:

3.1 EXISTING SYSTEM:

3.1.1 EXISTIONG SYSTEM:

As of now, India has a smart meter penetration of barely 1% – around 3 million smart meters are operational, compared with ~270 million traditional meters. This is much lower than in mature markets such as the US (65-75%), France (60-70%), and China (40-55%). Only the conventional meters are in popular use. North side of India has been given smart meter installation comparatively high.

3.1.2 DISADVANTAGES OF THE EXISTING SYSTEM:

As we know the convectional meters are the ones which are mostly in use today, which has many drawbacks. To start with there are a lot of chances for human error as they must do the billing manually. Next is that there is no provision to store the data about the energy consumption hence this data cannot be analyzed to provide the user with information. Furthermore, security for the energy meter is not provided. Also, alert feature is not available hence the user will have no knowledge if they have consumed immense amount of electricity.

Now with the available smart meters in India, they are of great and attractive design but it costs way more that that of an convectional meter which is not feasible for all to buy and use.

3.2 PROJECT CONSTRAINTS:

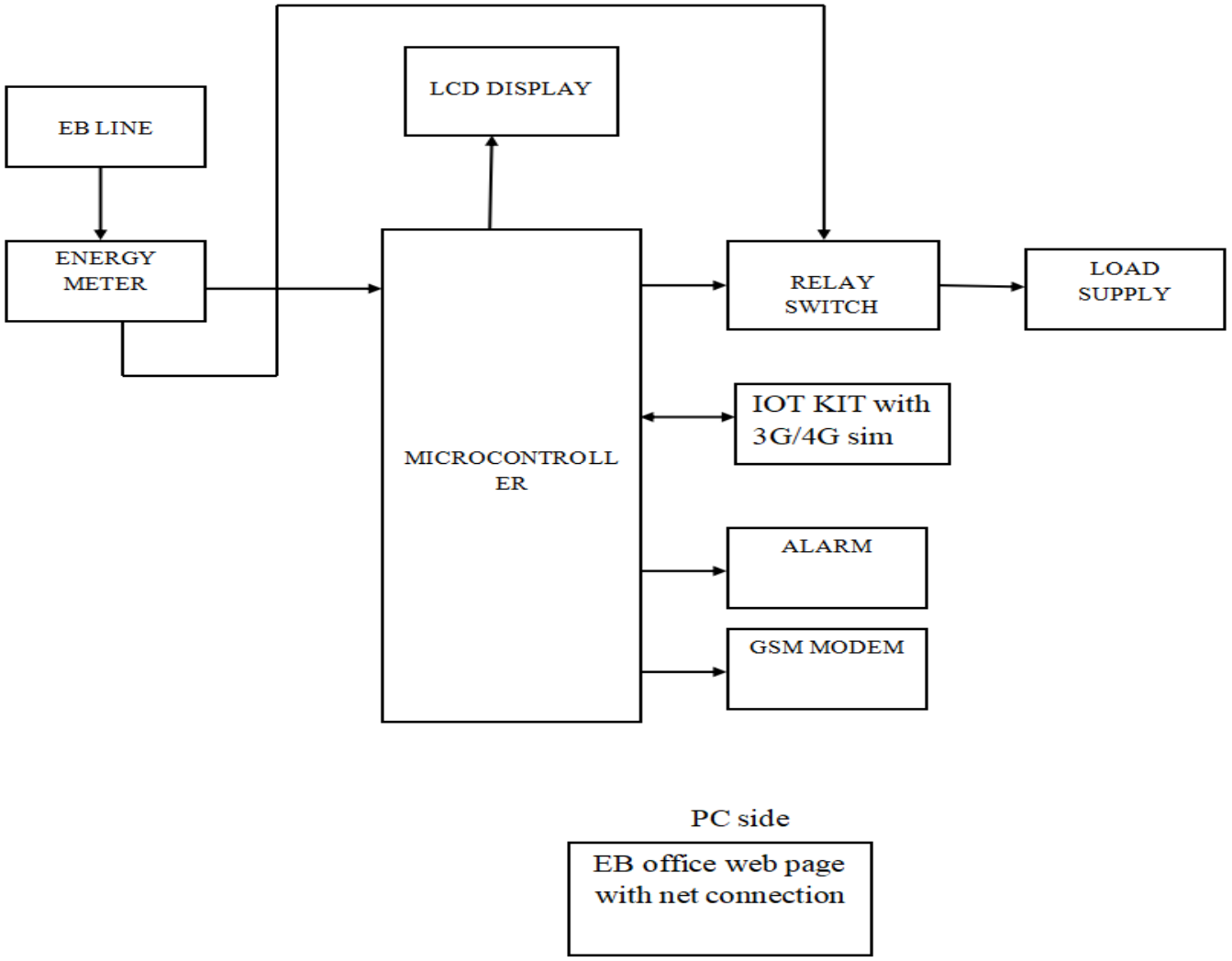
- The design, deployment and maintenance of the smart meters lead to spend tremendous amount of money
- Zigbee transmission standard fails to send data over a long distance so as the accuracy in reading not get good.
- Sensors may also be subject to highly caustic or corrosive environments, high humidity levels , dirt and dust.

CHAPTER 4

4.1 PROPOSED SYSTEM:

The proposed approach is a cost-effective design that provides the customer with the vital information about their electricity consumption from time to time. Some of the major objective of this system is to monitor, optimize the power usage and to reduce the consumption. This is done with the help of alert function. The alert feature here uses a GSM module to send alert messages. With the aid of this feature the consumer will get the total energy reading and the respective amount in the form of text message, Consumers will also receive notification when they are about to reach their set threshold value. Furthermore, they get a text message 15 days once regarding their energy usage. This will indeed help in conservation of electricity. Apart from GSM modem, ESP8266 Wi-Fi module is used to transfer the energy data from the meter so that the consumer can monitor his power consumption reading in graphical presentation. There is the feature where the threshold value can be set which aids in giving the capacity to terminate the power supply if the unit consumed exceeds the mentioned threshold. The proposed system comes up with a technical twist to the traditional energy meters with the help of the IOT technology. Besides, there are some other issues that must be addressed such as meter tampering that causes economic loss to the consumer. To overcome this, a vibration sensor has been incorporated in this system so that if any fraudulent activities related to the smart meter takes place the consumer can be alerted through SMS instantly.

4.1.1 FLOW CHART:



CHAPTER 5

LIST OF MODULES:

This chapter provides a detailed explanation about all the.

5.1 MODULE:1

1. HARDWARE DESIGN MODULE:

The hardware design includes Convectional meter, SMPS (S witching Mode Power Supply), Current measurement circuit, GSM (Global System for Mobile Communication), Vibration sensor, Relay unit, Arduino microcontroller, ESP8266 Wi-Fi Module, Load (100 W BULBS) and LCD.

Connection Explanation:

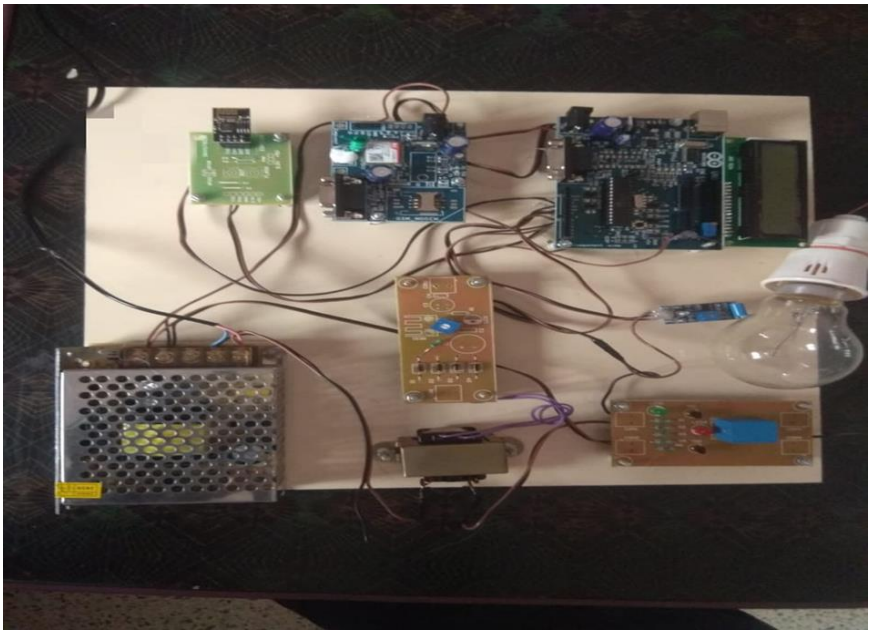
- The devices used in the hardware module are power supply, Wi-Fi module, Relay unit,Vibration sensor, Micro-controller and Energy meter.
- All these hardware devices take DC power supply as input. SMPS has been used for power supply. Its function is to 'step down' the 240V Alternating Current (AC) to Direct Current (DC) required to energize all other components.
- SMPS provides power to vibration sensor, Microcontroller, relay unit, Current Transformer and to Wi-Fi module.
- SMPS unit has been energized through external adapter and SMPS unit separates the total power from incoming power.
- 100 W Electric Load (Bulb) has been used to cancel the energy consumption.

The load has been connected to the energy meter’s sensor unit (current transformer) which measures the consuming current parallel to the load and gives it as an analog input to microcontroller in Amps.

- Arduino accepts analog input and interprets the code, then converts the ampere into watts to calculate the units consumed.

- The number of units consumed multiplied by each unit charge will be used to calculate the electricity charges that will be sent to the customer's phone as well through GSM. The LCD connected to the microcontroller will show the units consumed in watts, timer in seconds and the amount once coded successfully.

- Vibration sensor attached to the energy meter helps to identify any attempt happens to harm. The energy meter



5.2 MODULE 2:

2. ALERT MODULE:

A set of alerts have been set that is to be sent to the user through SMS with the help of GSM module. The set alerts are:

- The user will be alerted 15 days once upon their power consumption and the corresponding cost till date.

- Next the user set their power threshold value to use electricity efficiently. If they have reached their set threshold, they will receive an alert indicating the same.

- After 5 minutes post receiving the threshold alert, the power will be cut off automatically which will also be alerted to the user.

- During any fraudulent activity, the vibration sensor will detect the same and the system will send a theft detection alert to the user.

5.3 MODULE 3:

3. INTERFACE MODULE:

As an interface, Thingspeak, an IOT platform has been used.

ThingSpeak is an IoT analytics platform service that allows the designer to aggregate, visualize and analyze live data streams in the cloud. Thing Speak provides instant visualizations of data posted by the IOT devices to Thing Speak. It can send sensor data privately to the cloud, analyze and visualize the data. It can trigger actions too.

Process of establishing an interface:

- Micro-controller is connected to Interface via API keys created in the IOT Server.
- Data is securely transmitted over REST and MQTT API's.
- Data will be updated frequently (every minute) in order to obtain high accuracy.
- Graphs labels have been created and analyzed on various parameters (i.e.) such as Current, Voltage, Amount, Unit.

CHAPTER 6

6.1 SYSTEM ARCHITECTURE

The main architecture of the proposed system can be deciphered into two main section; The physical is the hardware subsystem, and another is the software interface. Further, this system uses Wi-Fi communication to converse among both the sections over the internet.

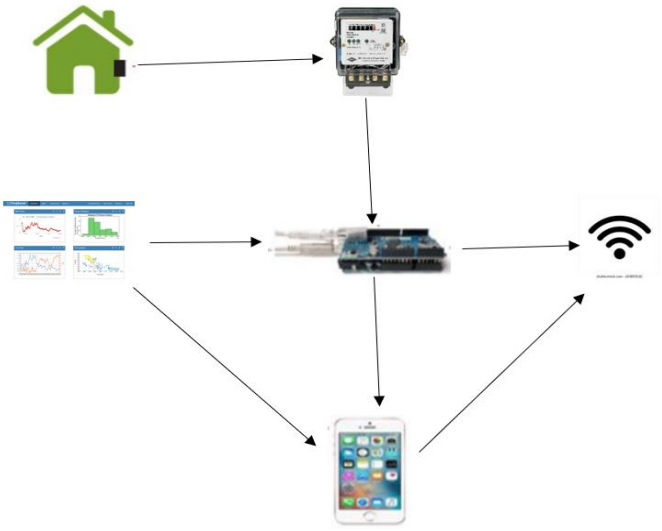


Fig 1 Architecture of a Proposed Smart Energy Meter

6.1.1 HARDWARE SUBSYSTEM:

The hardware comprises of Arduino microcontroller, 16*2 LCD display, power Supply, SMPS, Vibrant sensor, Relay unit, ESP8266 Wi-Fi module, GSM, Load(100-watt bulb) and LCD.

Arduino Microcontroller - It is a microcontroller board which is based on Microchip ATmega328P microcontroller and is developed by Arduino.cc. It has 6 analog I/O pinas and 14 digital I/O pins. The board is programmed using Arduino IDE through type B USB cable to dump the code.

SMPS - Switched Mode Power Supply is an electronic power supply which is used to convert electrical power using a switching regulator.

Vibration sensor - It is a device which is used to measure the vibration i.e., acceleration of a motion of an object. A transducer has been included in this device which converts mechanical force due to vibration into an electrical current using piezoelectric effect.

GSM - Global System for Mobile communications (GSM) is a hardware device which used GSM mobile telephone technology to send data to a remote network.

Regulated Power Supply - The power supply comprises a substantial main and a dissipative arrangement controller circuit. The controller circuit consists of a solitary Zener diode or a three terminal direct arrangement controller to offer the required yield voltage.

Relay module - It is an electrical switch which is used to control the power supply to a device. It is operated by electromagnet which indeed is activated by a separate low-power signal from a microcontroller.

ESP8266 Wi-Fi module - It is a low-cost device with a full TCP/IP stack. it has microcontroller capabilities. It is a system on a chip with 2.4GHz range. It has a processor of 32-bit RISC microprocessor core running with 80MHz. It is a very crucial component as it aids the communication between the hardware and the user interface. It sends the data from the smart energy meter to the user interface.
16*2 LCD - It is an electronic display module that uses liquid crystals which produces a visible image. It is a 16x2 LCD display which displays 16 characters per line in 2 lines.

Load - A 100-watt bulb is used a load to calculate the energy consumption.

Voltage sensor - It is a sensor that is used to measure the voltage consumption in an object. It can determine AC or DC voltage level. Here the voltage sensor is present in the Transformer unit of Hardware design.

Current sensor - This sensor is used to measure the current utilized by a device such as. As such of voltage sensor, current sensor is also inbuilt in the Transformer unit of Hardware design.

6.1.2 SOFTWARE SYSTEM:

Arduino Uno - The Arduino Integrated Development Environment (IDE) is a cross-platform application that is written in C and C++. It is used to write and upload programs to Arduino compatible boards that has a functional and operational actions of processing the system.

IOT Server - Thingspeak.com is used as the Cloud server. It is used to store and retrieve data from the meter, analysis of current usage and many more.

CHAPTER 7

7.1 IMPLEMENTATION AND RESULTS:

Working of this device is based on the technology IoT. As shown in Fig 2 the Meter will be connected to Arduino and to other subsequent components. The center piece being the Arduino board offers the connection between the different components of the system. The Arduino UNO is based on the AT mega 328p processor. It is a core part of the system used for the principal operations that are necessary carried out and receive tampering detection inputs from the tampering circuit. The load represents the devices that require the electricity to operate. The AC supply is connected to the system through the transformers Power supply, Wi-Fi module, Relay unit,Vibration sensor and SMPS are interconnected to each other and require only DC to activate actions. Because of this, SMPS has been used.SMPS unit separates the total power and provides 5v DC to each vibration sensor, Microcontroller and to Wi-Fi device and 12 v DC to relay unit. Arduino is programmed such that it accepts analog input from the meter, as well as from vibrant sensor (security circuit) and provides output signal to the GSM to offer alerts through texts in all the possible handled ways. Arduino hence then receiving the current(amps) value from the circuit, it will involve in an action to convert the ampere value to units to calculate the units consumed. Formula used for the conversion is as follows

Firstly, amps to watt conversion will be carried out,

Watts = Amps x Volts ---- (Eq 1)

The converted watts will then be converted to units,

1 unit = 1kWh or 1000 Wh ---(Eq 2)

The number of units calculated by multiplying each unit charge is used to find electricity charges. The proposed system has been designed to send frequent alerts through GSM to the registered mobile number used in coding functionality.
The LCD connected to the microcontroller will also show the units consumed in watts, timer in seconds and the amount which will update on a timely basis.

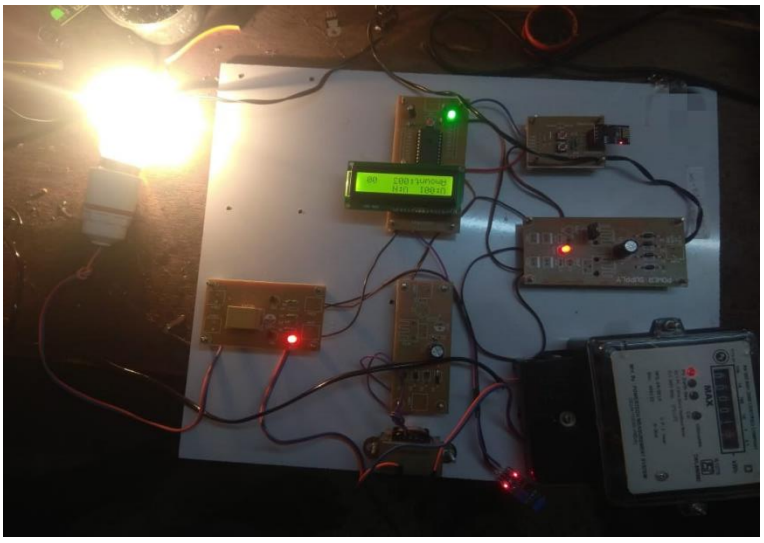


Fig 2

The processed readings of the power consumption are then sent over the Wi-Fi to the remote cloud through the ESP 8266 Wi-Fi Module. The remote cloud server is connected to the microcontroller through API Key and will sync the values automatically. Relative graphs have been designed which clearly depicts the consumption of current, unit, amount and the voltage dropped on a day basis.
The following are the results which are truly encouraging and accurate.
Assumptions we made are,
Load used is 100w bulb in all the cases,

(i) The consumption and the corresponding amount charge after one hour of usage. It could be made 15 days once when implemented in real time. The Load used is expected to use approximately 100 w of power in an hour and the result is as expected.

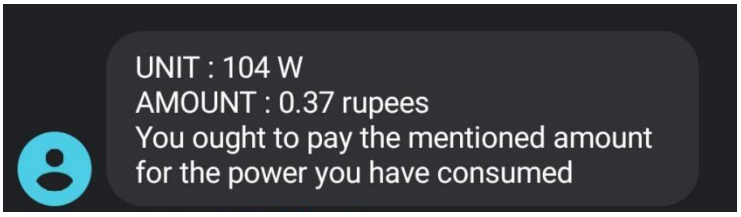


Fig 3 Consumption alert

(ii) We set a threshold value of 80 W for the Load we used and the alert we received is about after one hour and in some minutes which is accurate.

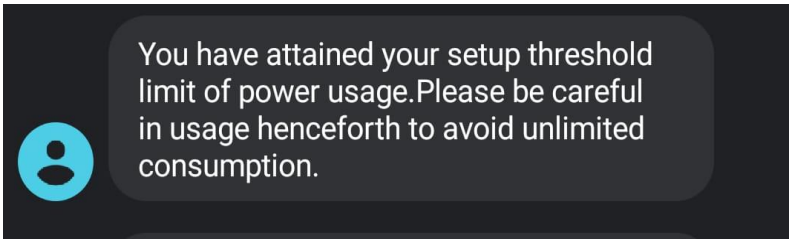


Fig 4 Threshold alert

(iii) The system is subjected to tampering voluntarily and the security alert has received on time through GSM.

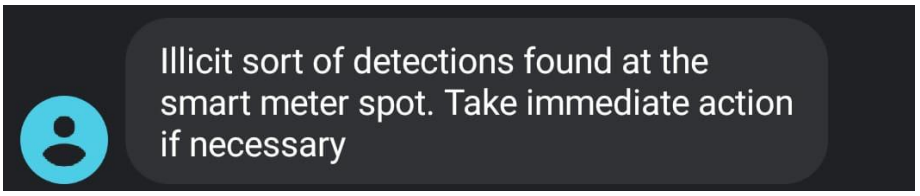


Fig 5 Security alert

(iv) Post threshold alert, cut-off alert has been received in some time which is as expected as it to be.

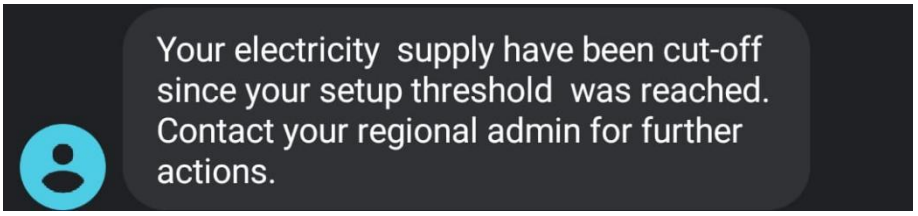


Fig 6 Cut-off alert

(v) The following are the graphs that we generated by receiving values from the microcontroller over the Internet. These values will get updated on a timely basis every day.

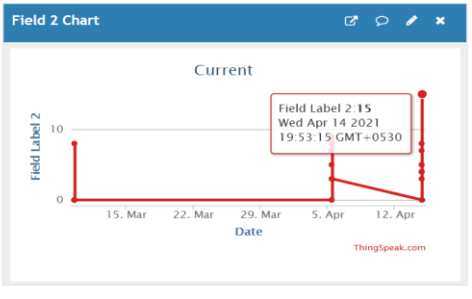


Fig 7 Current value graph(ams)

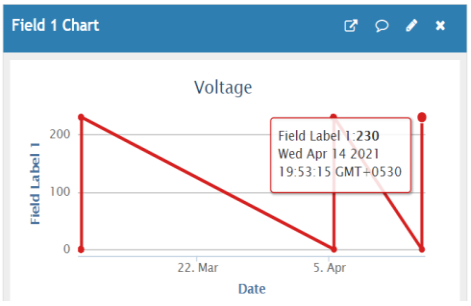


Fig 8 voltage value graph(volts)

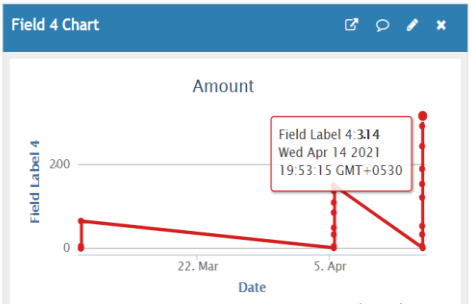


Fig 9 amount value graph(rs)

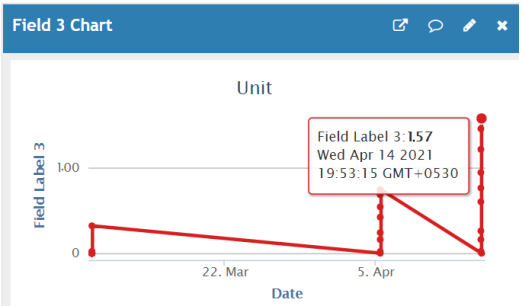


Fig 10 unit value graph(unit)

7.2 CONCLUSION AND FUTURE SCOPE:

In the era of smart city advancement, designing strategies which helps in effectively administering energy consumption and avoiding energy wastage is very significant. The main cause for the design of IOT based E-meter is to minimize the power consumption in house. In this paper, integration of IoT with energy management system has been demonstrated to create a more effective and intellectual system compared with the conventional energy management system. The proposed system is cost effective since there are only add-ons which can be integrated with the existing meters. Frequent alerting system and setup threshold functionality will help in all the possible ways to reduce power consumption firmly. The Project has achieved the following objectives: -

1. Ease of accessing information for users from energy meter through IoT.
2. Theft detection at consumer end in real time.
3. LCD shows energy consumption units

Therefore, the presented design in this paper, possesses high potentiality and feasibility in the energy metering system in India.

In this presented system, IOT energy meter consumption is Accessed using internet and frequent alerting has been implemented which helps consumers to avoid unlimited use of electricity and creates an awareness every month. In future, the following objectives Can be achieved to enhance the system. We can make a system which can also send SMS to then Concern meter man of that area when any occurrence of meter tampering at consumer end. We can besides send the GPS location of the meter to the Electricity board when theft detected.

CHAPTER 8

8.1 REFERENCE:

[1] Pallavi Ravindra Joshi, Prof. M S khan, "IOT Based Smart Power Management System Using WSN", *IRJET*, Volume: 04 Issue: 06, pp. 2395-0072, June 2017, https://www.irjet.net/archives/V4/i6/IRJET-V4I6133.pdf

[2] A.V.N.R. Sai Shiva, Arun Kumar Yadav, "Wireless Sensor Network Application: Smart Meter Using Smart Card", *International Journal of Advances in Science Engineering and Technology*, Volume- 1, pp. 2321-9009, Jan 2014, http://iraj.in/journal/journal_file/journal_pdf/6-34-139045871951-54.pdf

[3] P.C. Kishore Kumar, J. Antony Veera Puthira Raja, B. Ebenezer Abishek, S. Vishalakshi, G. Vidhya, "IOT Based Energy Meter Reading System with Automatic Billing", *International Journal of Engineering & Technology*, pp. 431-434, August 2018, https://www.researchgate.net/publication/327232916_IOT_Based_Energy_Meter_Reading_System_with_Automatic_Billing

[4] Mohan Naik R, Harish, Dipreeth, Krishna Lokre, Sandeeep, "Implementation of IOT based Electricity Controlled Prepaid Energy Meter Monitoring and Bill Payment System", *IJERT*, Volume 06 – Issue 15, ISSN : 2278-0181, 05-01-2019, https://www.ijert.org/implementation-of-iot-based-electricity-controlled-prepaid-energy-meter-monitoring-and-bill-payment-system

[5] A. Subba Rao, Sri VidyaGarige, "IOT Based Smart Energy Meter Billing Monitoring and Controlling the Loads", *IJITEE*, Volume-8 Issue-4S2, ISSN: 2278-3075, March 2019, https://www.ijitee.org/wpcontent/uploads/papers/v8i4s2/D1S0075028419.pdf

[6] Md. Rakibul Hasan, Eklas Hossain, Hossain Mansur Resalat Faruque, Tipu Sultan, "IoT Based Smart Energy Management in Residential Applications", *ICASERT*, DOI: 10.1109/ICASERT.2019.8934523, May 2019, https://www.researchgate.net/publication/343987157_IoT_Based_Smart_Energy_Management_in_Residential_Applications

[7] N. Gupta and D. Shukla, "Design of Embedded based automated meter reading system for real time processing", *2016 IEEE Students' Conference on Electrical, Electronics and Computer Science (SCEECS)*, Bhopal, 2016, pp. 1-6, doi: 10.1109/SCEECS.2016.7509328, https://ieeexplore.ieee.org/document/7509328

[8] Vignesh Mani, Abhilasha, Gunasekhar, Lavanya, Suresh Sankaranarayanan, "IoT Based Smart Energy Management System", *International Journal of Applied Engineering Research*, Volume 12, Number 16, pp. 5455-5462, 2017, https://www.ripublication.com/ijaer17/ijaerv12n16_05.pdf

[9] Patrick Mapulane, Tshepang Letshwiti, Mompati Molibe, Oagile Gaogane, Keaboka M. Sethebe, N.M.J. Ditshego, "Smart Energy Meter ", *RDAIS*, SSN: 2521-2292, June 2019, https://www.researchgate.net/publication/334032017_Smart_Energy_Meter

[10] Manisha Tejwani, Prachi Rane, Moin Syed, Oyesh Patel, Pragyan Pandey, "Iot Based Smart Energy Meter Monitoring and Billing System", *International Journal of Innovative Technology and Exploring Engineering*, Volume-9 Issue-6, pp. : 2278-3075, April 2020, http://www.ijitee.org/wp-content/uploads/papers/v9i6/F4301049620.pdf

[11] Prof. Mrs. Aditi Kamble, Tejas J Sawant, Manthan A More, Prachi V Thorat, Geeta Bhalerao, "IOT Based Intelligence of Electric Meter", *International Journal of Latest Technology in Engineering, Management & Applied Science*, Volume VIII, Issue IV, pp. 2278-2540, April 2019, https://www.ijltemas.in/DigitalLibrary/Vol.8Issue4/83-87.pdf

[12] A. Syed Mustafa, Soumya Shree, Afreen Bokhari, P. Anitua, S. Babitha, Nadiya Sayedi, "IoT based Smart Talking Energy Meter(ISTEM)", *International Journal of Research in Engineering, Science and Management*, Volume-2, Issue-4, pp. 2581-5792, April-2019, https://www.ijresm.com/Vol.2_2019/Vol2_Iss4_April19/IJRESM_V2_I4_62.pdf

[13] M. Venkatesan, "IOTs Based Stepper Motor Control using *ARDUINO", Research journal of Science and Engineering Systems*, Volume-3, Issue-3, pp.131-138, March 2018, http://www.rjsces.com/journal_admin/resource/uploads/attachment/attachment_02052018092255_Rn1Irkbi2f.pdf

[14] H. M. Zahid Iqbal, M. Waseem, Tahir Mahmood, "Automatic Energy Meter Reading using Smart Energy Meter", *International Conference on Engineering & Emerging Technologies*, March 2014, https://www.researchgate.net/publication/277141436_Automatic_Energy_Meter_Reading_using_Smart_Energy_Meter

[15] Mayur Rawte, Shrishti Sharma, Praveen Lalwani, "Smart Prepaid Energy Meter based on Internet of Things", *International Journal of Computer Applications*, Volume 171 – No.2, pp. 0975 – 8887, August 2017, https://www.ijcaonline.org/archives/volume171/number2/rawte-2017-ijca-914985.pdf

[16] Win Adiyansyah Indra, Fatimah Bt Morad, Norfadzlia Binti Mohd Yusof, Siti Asma Che Aziz, "GSM-Based Smart Energy Meter with Arduino Uno", *International Journal of Applied Engineering Research*, Volume 13, Number 6, pp. 3948-3953, 2018, https://www.researchgate.net/publication/325544979_GSM-Based_Smart_Energy_Meter_with_Arduino_Uno

[17] P. Nivetha, K. Raghavi, T. Priyadharshini, R. Kalaiselvi, “An overview of plant environment monitoring system”, *International Journal on Applications in Information and Communication Engineering*(ISSN: 2394-6237), Volume-3, Issue-1, pp.35-40, 2017, http://aetsjournal.com/journal_issues/An-Overview-Of-Plant-Environment-Monitoring-System.pdf

[18] R. Priynaka, R. Soundarya, P. Sri Sowmiya, R. Kalaiselvi, “A survey on indoor air quality monitoring and controlling system”, *International Journal on Applications in Information and Communication Engineering*(ISSN: 2394-6237), Vol 3, Issue 1, pp.56-60, 2017, http://aetsjournal.com/journal_issues/A-Survey-On-Indoor-Air-Quality-Monitoring-And-Controlling-System.pdf

CHAPTER 9

APPENDIX

Microcontroller-Code:

```
#include<EveryTimer.h>
EveryTimer timer;
#define period 1000

#include<LiquidCrystal.h>
LiquidCrystal lcd(13,12,11,10,9,8);

#include <SoftwareSerial.h>
SoftwareSerial mySerial(2, 3); // RX, TX

#define amps A0
#define relay A1
#define vib A2

char s;

int  volt_value = 230;
int amps_value = 0;
int  unit = 0,amount = 0,cal = 1;
int sec = 0,sec1=0,c;

int a=0,b=0;

void Msg_Send();
void Msg_Send1();

void setup()
{
```

```
  // put your setup code here, to run once:
  timer.Every(period,action);
  pinMode(amps,INPUT);
  pinMode(relay,OUTPUT);
  pinMode(vib,INPUT);

  mySerial.begin(9600);


  digitalWrite(relay,LOW);
  //digitalWrite(alarm,HIGH);

  Serial.begin(9600);
  lcd.begin(16,2);
  lcd.setCursor(4,0);
  lcd.print("EB IOT");
  delay(2000);
  lcd.clear();
  Msg_Send3();
}

void loop()
{
  timer.Update();
//  volt_value = 230;
  amps_value = analogRead(amps)/10;
  if(amps_value <= 2){amps_value = 0;}

  if(sec >= 10)
  {
    unit = (volt_value/100)*amps_value;
    b = b+unit;
    sec=0;
  }


   lcd.setCursor(0,0);lcd.print("V:");
```

```
    if(volt_value < 9){lcd.print("00");lcd.print(volt_value);}
    else if(volt_value < 99){lcd.print("0");lcd.print(volt_value);}
    else if(volt_value < 999){lcd.print(volt_value);}
    lcd.print("v");

    lcd.setCursor(8,0);lcd.print("I:");
    if(amps_value < 9){lcd.print("00");lcd.print(amps_value);}
    else if(amps_value < 99){lcd.print("0");lcd.print(amps_value);}
    else if(amps_value < 999){lcd.print(amps_value);}
    lcd.print("mA");



    lcd.setCursor(0,1);lcd.print("U:");
    if(b < 9){lcd.print("000");lcd.print(b);}
    else if(b < 99){lcd.print("00");lcd.print(b);}
    else if(b < 999){lcd.print("0");lcd.print(b);}
    else if(b < 9999){lcd.print(b);}
    lcd.print("W");

    if(digitalRead(vib) == HIGH){lcd.clear();lcd.setCursor(0,0);lcd.print("  THEFT
DETECT ");delay(2000);lcd.clear();Msg_Send1();}

    if(sec1 >= 180){sec1 = 0;Msg_Send();}
    c = b*2;
    if(b >= 100 && b <= 120){b = 121;Msg_Send();}

    lcd.setCursor(8,1);lcd.print("S:");
    if(sec1 < 9){lcd.print("00");lcd.print(sec1);}
    else if(sec1 < 99){lcd.print("0");lcd.print(sec1);}
    else if(sec1 < 999){lcd.print(sec1);}

    senddata();
    delay(1000);

}

void senddata()
```

```
{
  Serial.print('*');

  if(volt_value <= 9){Serial.print("00");Serial.print(volt_value);}
  else if(volt_value <= 99){Serial.print("0");Serial.print(volt_value);}
  else if(volt_value <= 999){Serial.print(volt_value);}

  if(amps_value <= 9){Serial.print("00");Serial.print(amps_value);}
  else if(amps_value <= 99){Serial.print("0");Serial.print(amps_value);}
  else if(amps_value <= 999){Serial.print(amps_value);}

  if(b <= 9){Serial.print("000");Serial.print(b);}
  else if(b <= 99){Serial.print("00");Serial.print(b);}
  else if(b <= 999){Serial.print("0");Serial.print(b);}
  else if(b <= 999){Serial.print(b);}

  if(c <= 9){Serial.print("000");Serial.print(c);}
  else if(c <= 99){Serial.print("00");Serial.print(c);}
  else if(c <= 999){Serial.print("0");Serial.print(c);}
  else if(c <= 999){Serial.print(c);}
  delay(100);
}

void action()
{
  sec++;
  sec1++;
}



void serialEvent()
{
  while(Serial.available() > 0)
   {
    s = Serial.read();
   }
```

```
  if(s == '2')
  {
    digitalWrite(relay,HIGH);
    delay(2000);
  }

  else if(s == '1')
  {
    digitalWrite(relay,LOW);
    delay(2000);
  }
  Serial.println(s);
}


void Msg_Send()
{
  lcd.clear();
  //Serial.println(inputString);

     lcd.setCursor(0, 0);
     lcd.print("Sending msg.....");
     mySerial.print("AT");
     delay(1000);
     mySerial.print("\x0d\0x0a");
     delay(2000);
     mySerial.print("AT+CMGF=1");
     delay(1000);
     mySerial.print("\x0d\0x0a");
     delay(1500);

 //number 1.....

         mySerial.print("AT+CMGS=\"7358873896");
         lcd.setCursor(0, 1);
         lcd.print("7358873896");
         mySerial.print("\"\r");
```

```
        delay(2000);
        mySerial.print("UNIT : ");mySerial.println(b);
        mySerial.print("AMOUNT : ");mySerial.println(c);
        if(b >= 100){Serial.print("YOU HAVE ATTAINED YOUR TARGET
THRESHOLD.PLEASE BE CAREFULL HERE AFTER");}
        delay(2000);
        mySerial.print("\x0d\0x0a");
        delay(1500);
        mySerial.print("\x0d\0x0a");
        delay(1500);
        mySerial.print("\x1A");
        delay(5000);



      lcd.clear();

}

void Msg_Send1()
{
  lcd.clear();
  //Serial.println(inputString);

    lcd.setCursor(0, 0);
    lcd.print("Sending msg.....");
    mySerial.print("AT");
    delay(1000);
    mySerial.print("\x0d\0x0a");
    delay(2000);
    mySerial.print("AT+CMGF=1");
    delay(1000);
    mySerial.print("\x0d\0x0a");
    delay(1500);

 //number 1.....

        mySerial.print("AT+CMGS=\"7358873896");
```

```
        lcd.setCursor(0, 1);
        lcd.print("7358873896");
        mySerial.print("\"\r");
        delay(2000);
        mySerial.print("THEFT DETECTING AT EB");
        delay(2000);
        mySerial.print("\x0d\0x0a");
        delay(1500);
        mySerial.print("\x0d\0x0a");
        delay(1500);
        mySerial.print("\x1A");
        delay(5000);


       lcd.clear();

}

void gsm_init()
  {
    lcd.setCursor(0,0);
    lcd.print("GSM INIT....");
    mySerial.println("AT");
    delay(1000);
    mySerial.print("\x0d\0x0a");
    delay(1000);
    mySerial.println("AT+CMGF=1");
    delay(1000);
    mySerial.print("\x0d\0x0a");
    delay(2000);
    mySerial.print("AT+CNMI=2,2,0,0,0");
    delay(1000);
    mySerial.println("\x0d\0X0a");
    delay(3000);
    lcd.clear();
  }
```

```
void Msg_Send3()
{
  lcd.clear();
  //Serial.println(inputString);

     lcd.setCursor(0, 0);
     lcd.print("Sending msg.....");
     mySerial.print("AT");
     delay(1000);
     mySerial.print("\x0d\0x0a");
     delay(2000);
     mySerial.print("AT+CMGF=1");
     delay(1000);
     mySerial.print("\x0d\0x0a");
     delay(1500);

  //number 1.....

          mySerial.print("AT+CMGS=\"7358873896");
          lcd.setCursor(0, 1);
          lcd.print("7358873896");
          mySerial.print("\"\r");
          delay(2000);
          b=2;
          mySerial.print("UNIT : ");mySerial.println(b);
          c=100;
          mySerial.print("AMOUNT : ");mySerial.println(c);
          mySerial.print("YOU HAVE UTILIZED THIS AMOUNT OF ELECTRICITY");
          delay(2000);
          mySerial.print("\x0d\0x0a");
          delay(1500);
          mySerial.print("\x0d\0x0a");
          delay(1500);
          mySerial.print("\x1A");
          delay(5000);
```

```
        lcd.clear();
    }
```

Interface Code:

```
//name of mail : gowtham1.17cs@kct.ac.in
//password : Info@2020

#include <ThingSpeak.h>
#include <ESP8266WiFi.h>
#define BLYNK_PRINT Serial
#include <ESP8266WiFi.h>
#include <BlynkSimpleEsp8266.h>

WidgetTerminal terminal(V0);

// Network Parameters
const char* ssid     = "IOT";
const char* password = "123456789";

char auth[] = "EChRXgAxtiBfq18UcCLTA0SQ2WiaillA";

// ThingSpeak information
char thingSpeakAddress[] = "api.thingspeak.com";
unsigned long channelID = 1322921;
```

```
char* readAPIKey = "6Q3D32VYD9M2GR6N";
char* writeAPIKey = "W99LJN9YRJR96BHN";


unsigned int val,val1,val2,val3,a[20];
unsigned int m=0,count=0;

// Field to write ultrasonic data
unsigned int dataFieldOne = 1;
unsigned int dataFieldTwo = 2;
unsigned int dataFieldThree = 3;
unsigned int dataFieldfour = 4;

unsigned long lastConnectionTime = 0;
long lastUpdateTime = 0;
WiFiClient client;
void receive_();

void setup()
{
  // put your setup code here, to run once:
  Serial.begin(9600);
  connectWiFi();
  Blynk.begin(auth, ssid, password);
}
```

```
void loop()
{
  Blynk.run();
  receive_();

  write2TSData( channelID, dataFieldOne, val, dataFieldTwo , val1,
     dataFieldThree , val2, dataFieldfour , val3);



  terminal.print("watts = ");terminal.println(val2);
  terminal.print("amount = ");terminal.println(val3);
  terminal.println();
  delay(500);
  terminal.flush();
}

int connectWiFi()
{

    while (WiFi.status() != WL_CONNECTED)
    {

        WiFi.begin( ssid, password );
        delay(2500);
    }
```

```
    ThingSpeak.begin( client );
}

int write2TSData( long TSChannel, unsigned int TSField1, int field1Data,
     unsigned int TSField2, int field2Data, unsigned int TSField3, int field3Data,
     unsigned int TSField4, float field4Data)
{

  ThingSpeak.setField( TSField1, field1Data );
  ThingSpeak.setField( TSField2, field2Data );
  ThingSpeak.setField( TSField3, field3Data );
  ThingSpeak.setField( TSField4, field4Data );
  int writeSuccess = ThingSpeak.writeFields( TSChannel, writeAPIKey );
  return writeSuccess;
}

void receive_()
{
    while(Serial.available())
    {
        char data;
        data = Serial.read();

        a[m]=data;
          if(a[0] == '*')
          {
```

```
          if(m<=14)
          {m++;}
         }
      }
      if(m > 1)
      {
        val = (a[1] - 0x30)*100 + (a[2] - 0x30)*10  + (a[3] - 0x30);
        val1 = (a[4] - 0x30)*100 + (a[5] - 0x30)*10 + (a[6] - 0x30);
        val2 = (a[7] - 0x30)*1000 + (a[8] - 0x30)*100 + (a[9] - 0x30)*10 + (a[10] -
    0x30);
        val3 = (a[11] - 0x30)*1000 + (a[12] - 0x30)*100 + (a[13] - 0x30)*10 + (a[14]
    - 0x30);
        m=0;
      }
}



BLYNK_WRITE(V1)
{
  int button = param.asInt(); // read button
  if (button == 1)
  {
    Serial.print("1");
  }
  else
  {
```

```
    Serial.print("2");
  }
}
```