IOT BASED ENERGY MONITORING AND CONTROLLING OF HOME APPLINCES WITH THEFT DETECTION AND PREPAID BILLING

MR. NISHANT PRAMOD ADAKE
UG Students. D.Y.Patil Technical campus, Talsande
Department of electrical engineering

MR. ASHWIN ASHOK BHORE
UG Students. D.Y.Patil Technical campus, Talsande
Department of electrical engineering

MISS. PRIYANKA PANDURANG CHAVAN
UG Students. D.Y.Patil Technical campus, Talsande
Department of electrical engineering

MISS. PRAJAKTA SANJAY TAKALE
UG Students. D.Y.Patil Technical campus, Talsande
Department of electrical engineering

ABSTRACT

Across the nation, the demand for energy is outpacing supply. Whereas the generation of Electricity is limited. Hence the effective management of existing energy generation is essential. You cannot manage what you cannot measure. Energy monitoring serves an effective guidance for energy management. The system discussed in the paper monitors and controls the electrical appliances.

Electrical appliances (e.g.,T.V. fan, air conditioning units, heating appliances, bulbs) can be monitored and controlled using IOT technology from overall the world. The system includes a smart device application, a cloud-based database, an Application Programming Interface (API) and a hardware development is proposed. The usage energy data from each unit to be controlled and stored in a cloud based database that can be analyses and recorded for energy conservation and analysis.

On the other hand, Government electricity revenue is worm-eaten by power theft, incorrect meter reading and billing. The paper suggests system as primary solution helps to finding theft and prepaid billing.

KEY WORDS: Arduino, Android, Wi-Fi (ESP8266), Internet of Things(IoT), Theft detection, Prepaid.

INTRODUCTION

The Internet of Things is a network of physical objects (such as connected devices and smart devices), embedded with electronics, software, sensors and network connectivity that enables these objects to collect and exchange data. IoT is commonly used for smart home, data acquisition, smart energy monitoring, industrial automation, and various platforms.

The system introduced in this paper is designed to visualize and monitor the power consumption online on a smart phone using mobile application. The Internet of things (IoT) devices not only monitors but also controls the electronic, electrical and various mechanical systems which are used in various types of infrastructures. Also energy management and monitoring has a significant role for the proper utilization and better energy management. A power theft, incorrect meter reading and billing, reluctance of consumers towards paying electricity bills on time results loss of electricity revenue in large amount. The system possesses theft detection and prepaid billing.

LITERATURE REVIEW

Conventional meter reading system results big amount of labor cost due to the requirement of human operators in more number also the increases in the development of residential and commercial buildings not only time consuming but also adds much efforts.

In recent decades, the rapid growth in industrial sector has been seen also the accretion in population demands more electrical energy. To satisfy this growth in demand, energy management is mandatory. Energy monitoring is primarily a management technic. That uses energy information as a basis to eliminate waste, control level of energy use and improve the existing operating procedure.
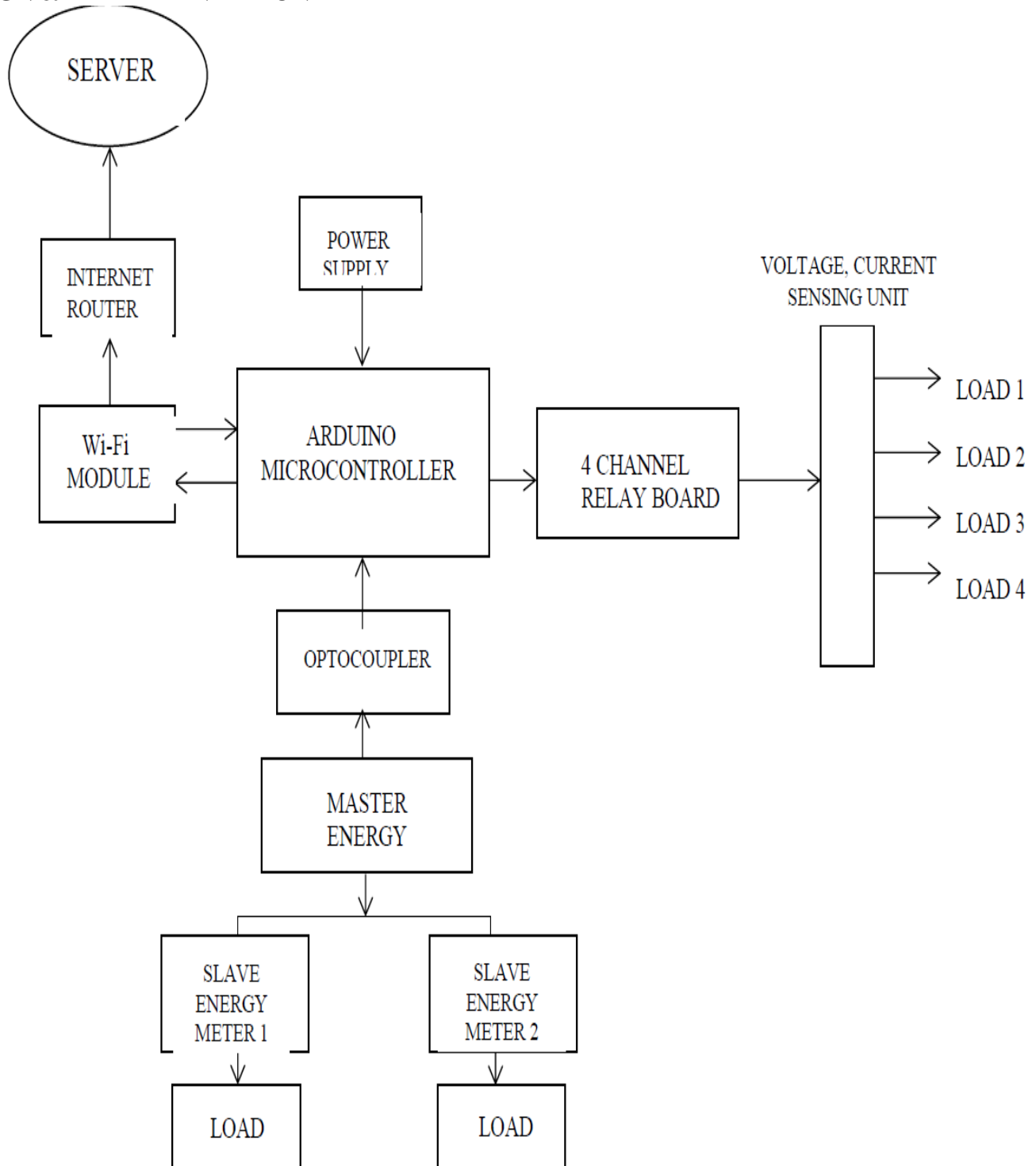
DESIGN & IMPLEMENTATION

Fig: Architecture of proposed system

Above figure gives the idea about the system operation. The four different loads i.e. different appliances are connected to four channel relay, operated using Wi-Fi and through an android application. These appliances are connected through Arduino Uno with its input/output pins. These devices are connected with local Wi-Fi module esp 8266. And the data is uploads to the server through internet router.
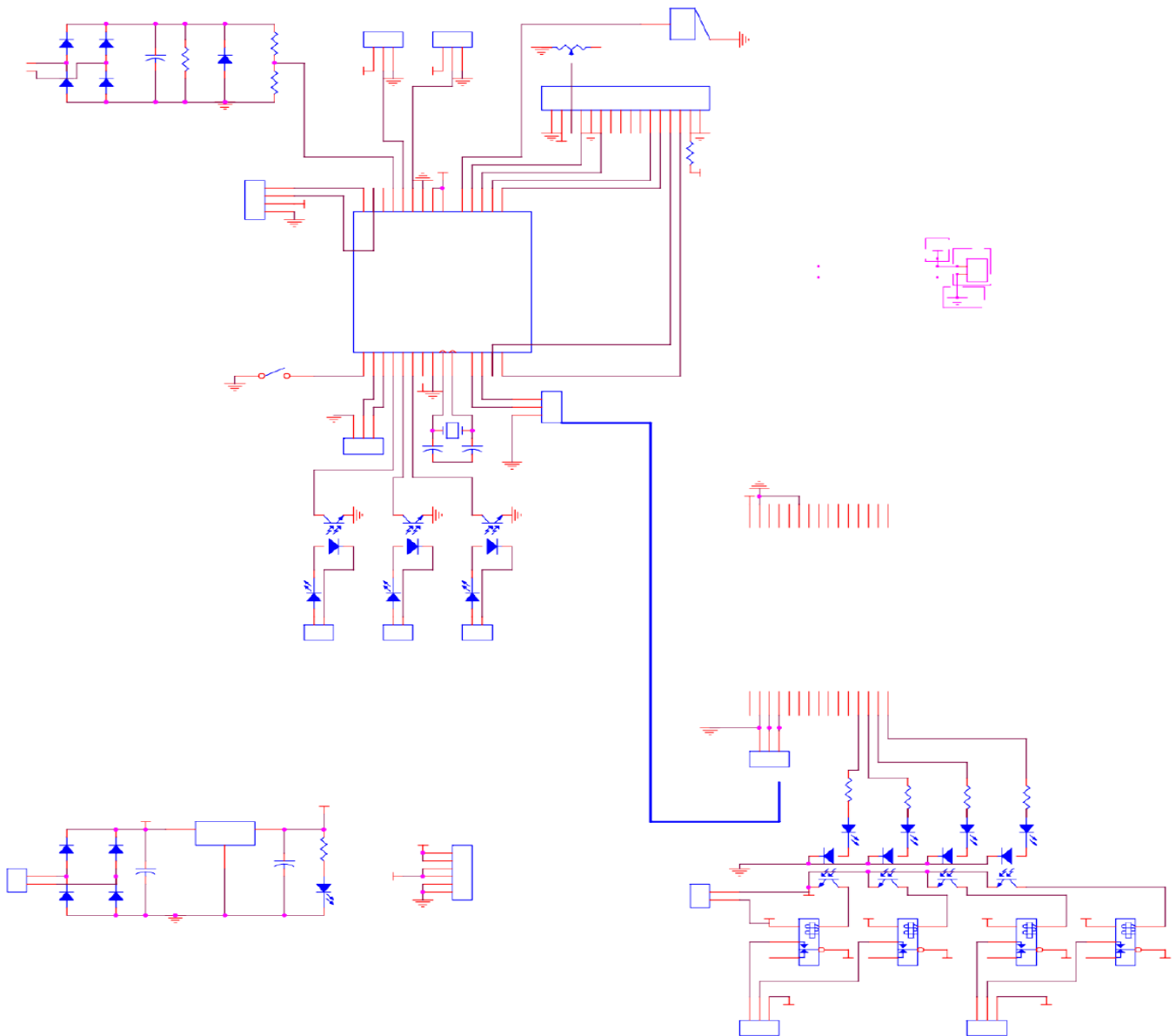
WORKING

Fig: System design

ESP8266 Node MCU Wi-Fi module:

ESP8266 itself a self-contained Wi-Fi networking solution offering as a bridge from existing microcontroller to Wi-Fi and is also capable of running self-contained applications. The data exchange is possible between the IOT and esp module is done via router or hotspot.

Arduino UNO (ATmega328):

Arduino microcontroller has been used for propose system, it is an open-source development platform in which hardware and software are easy to use. ESP Node MCU8266 is serially connected to arduino.

Analog energy meter:

An energy meter measures the amount of electrical energy supplied to or produced by a home or building. The most commonly used energy meter is kilowatt hour meter. Instantaneous power is calculate by taking the product of the instantaneous current and voltage. This instantaneous power is then integrated against time to give energy used by the consumers. The energy consumption is calculated by using the output pulses

of energy meter. The load is said to consume 1 unit of electricity when the internal counter of microcontroller counts up to 3200 pulses.

In proposed system Meter pulses, taken out from each energy meter i.e. master meter and slave meter1 & slave meter2, are given to the digital input pins no. 4, 5,6 of arduino uno respectively. Atmega IC328 compares the value of counts of master meter say M_m with the sum of counts of slave meters say M_s.The logic used here is very simple. If the counts are equal i.e. $M_m=M_s$,then there is no theft. If there is the difference between the two counts i.e.$M_m>M_s$.it concludes that there is a theft. The message is shown on the LCD screen that whether the energy theft is occurred or not. Also the buzzer connected at 19th pin of arduino enables in event of theft.

Opto-coupler:
PC817 opto-coupler is preferred for proposed system. It is an electronic device which is designed to provide electrical isolation coupling between its input and output. It eliminates the effects of electrical noise by power irregularities and interferences such as rapidly changing voltages, high voltages.

Relay:
4-channel 5v optical isolated relay module is used in which each channel needs a 15-20mA driver current. It can be used to control various appliances and equipment with large current.
Current sensor:

LCD 16*2:
LCD (Liquid Crystal Display) screen is an electronic display module. A 16*2 LCD means it can display 16 characters per line and there are 2 such lines. Each character is displayed by 5*7 pixel matrix. This LCD consists of two registers namely, command and data.

SOFTWARE DESIGN
Orcad capture 9.2:
 OrCAD is a suite of products for PCB Design and analysis that includes a schematic editor. Capture includes a component information system (CIS), that links component package footprint data or simulation behavior data, with the circuit symbol in the schematic.

MIT AI2 App Developer:
APP Invertor is a cloud based utility for developing mobile applications for android phones. It is free utility and log in can be done using your Gmail Id. MIT AI2 COMPANION APP is developed by Google. By using MIT AI2 can develop code in our laptop and further it will run our respective mobile

Arduino Software:
The **Arduino integrated development environment (IDE)** is a cross-platform application (for Windows, macOS, Linux) that is written in the programming language Java. It is used to write and upload programs to Arduino board.

The proposed system consists of four sections viz energy monitoring, theft detection, controlling and prepaid section.

The program, feeded to IC possesses prepaid system also. Program is coded in such way that customer have to recharge the energy meter first, and then only user can use the electricity. Refill of the balance is done through mobile app. Here app used is "MIT AI2 companion" the design and action is done by the MIT APP INVENTOR website.

The balance diminishes as per the units of energy consumption. The buzzer also get triggered when residual balance is about to finish. The data regarding remaining balance and units is also displayed on LCD screen.

ESP8266 itself a self-contained Wi-Fi networking solution offering as a bridge from existing microcontroller to Wi-Fi and is also capable of running self-contained applications. The data exchange is possible between the IOT and esp module is done via router or hotspot.

The voltage and current across the appliances are get sensed via current sensor and voltage sensing unit. And feed the data to analog input pin no.25, 24, and 23 of esp module respectively. This data is uploaded to webpage or cloud.

RESULT
4. PROJECT PROFILE
4.1 Hardware circuit:
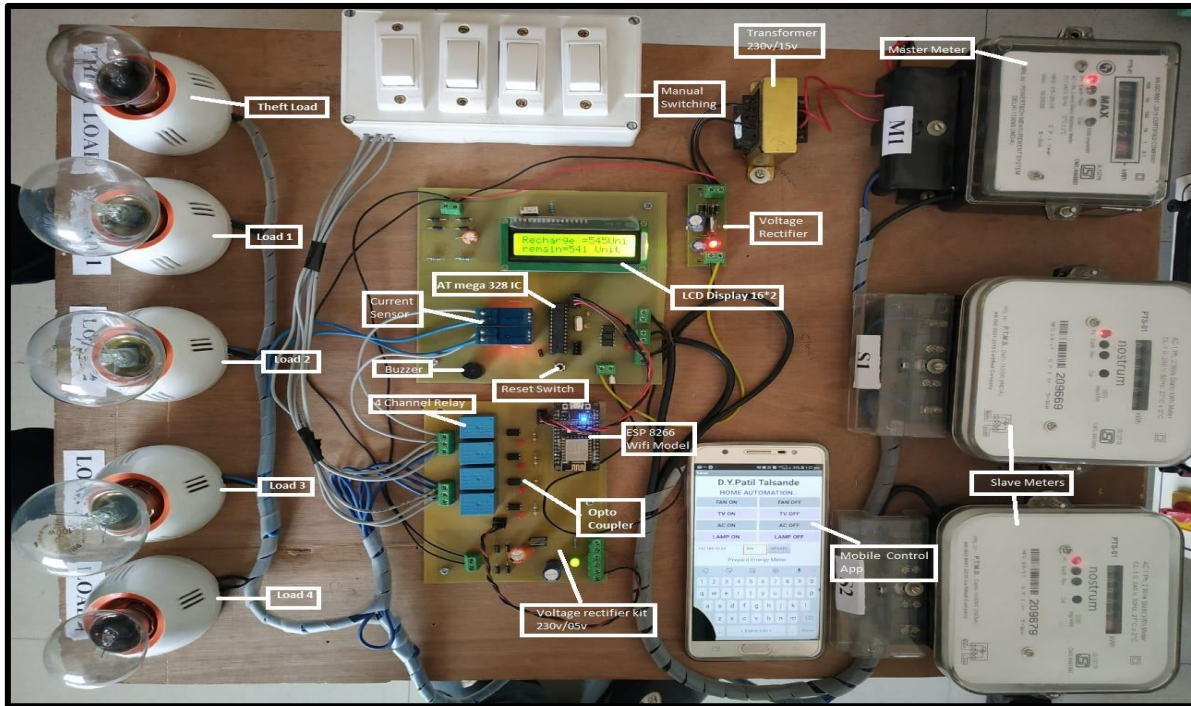
Fig

4.2 Results:

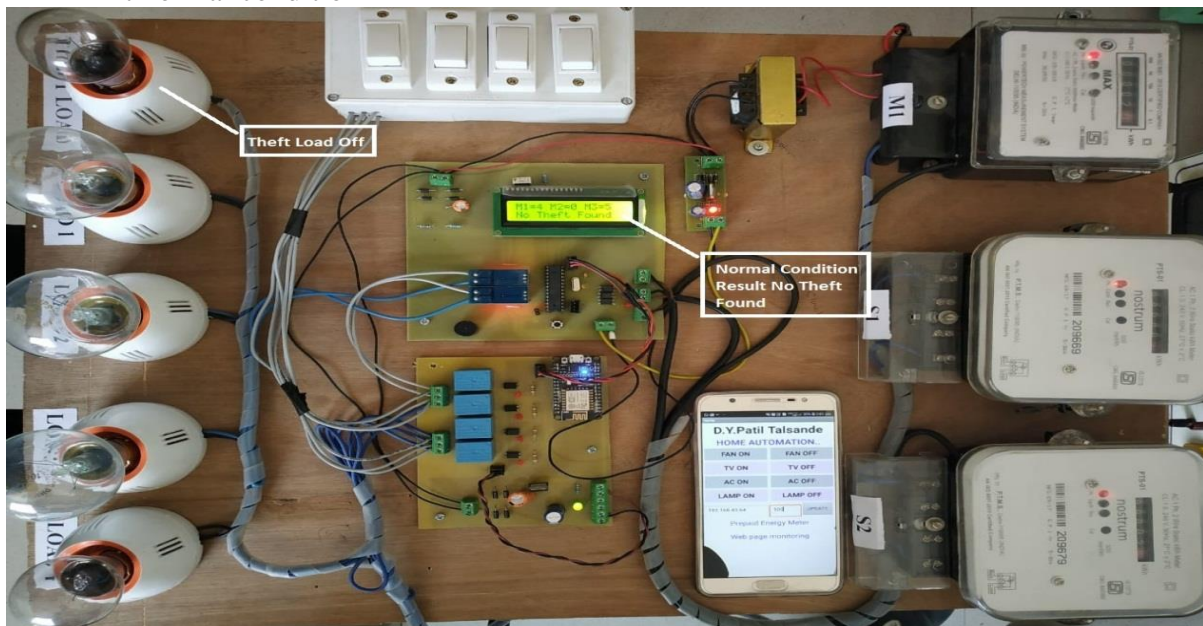   1)   **Theft detection**
- At normal condition

Fig 4.2: System without theft

At normal condition, When there is no theft found by the system the Display shows Result "No Theft Found" on LCD screen.

- At theft condition
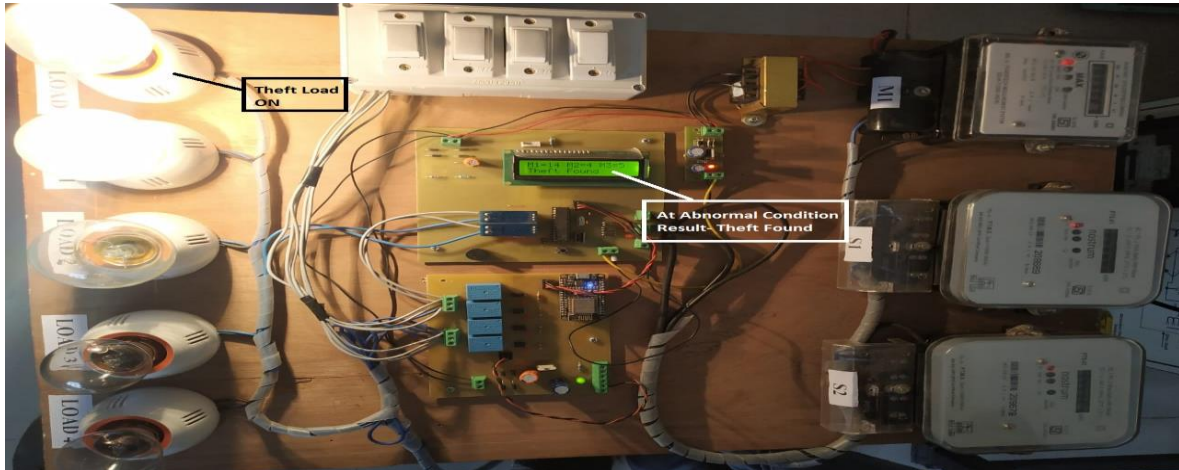
Fig 4.3: System with theft found

At abnormal condition, When there is theft found by the system then Display shows Result "Theft Found" on LCD screen.

2)   Automation

In this proposed system for controlling, monitoring and prepaid billing android application is used. Frist we have to connect android mobile to Wi-Fi module through hotspot connectivity. After establishing connection we can control applications using window shown in fig
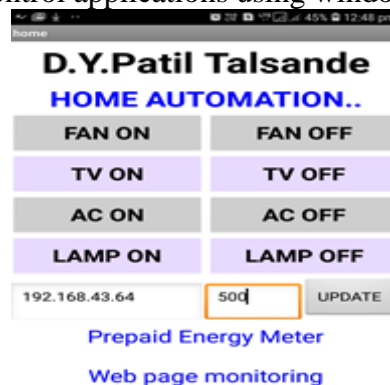

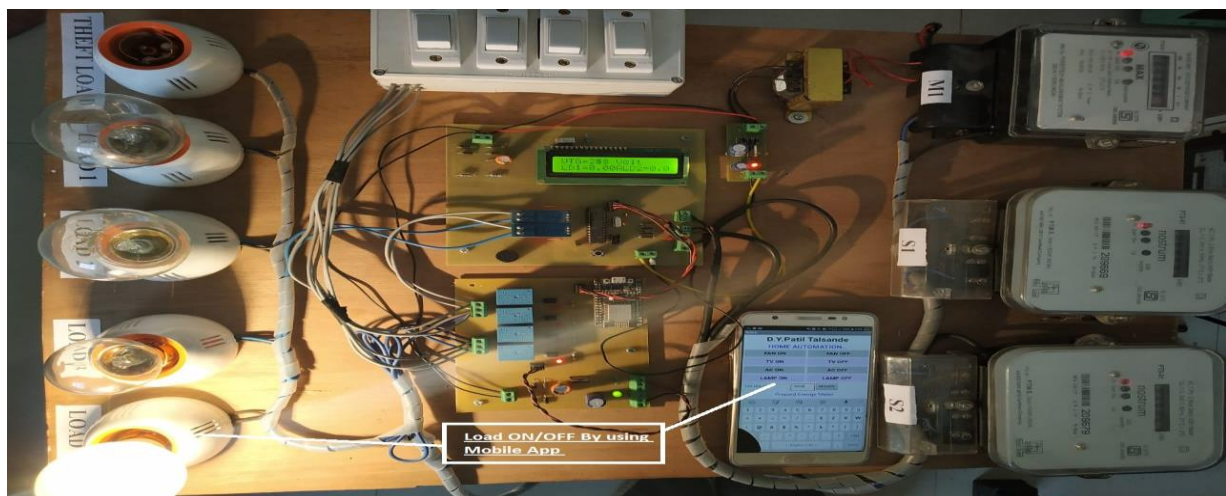
Fig 4.4: Front window of android application

Fig 4.5: Controlling of load through application

In automation system we are controlling the switching of load through mobile application.

3) Energy monitoring

Fig 4.6: Energy monitoring

We can continuously monitor voltage, currents, units uploaded to server with date and time from anywhere.

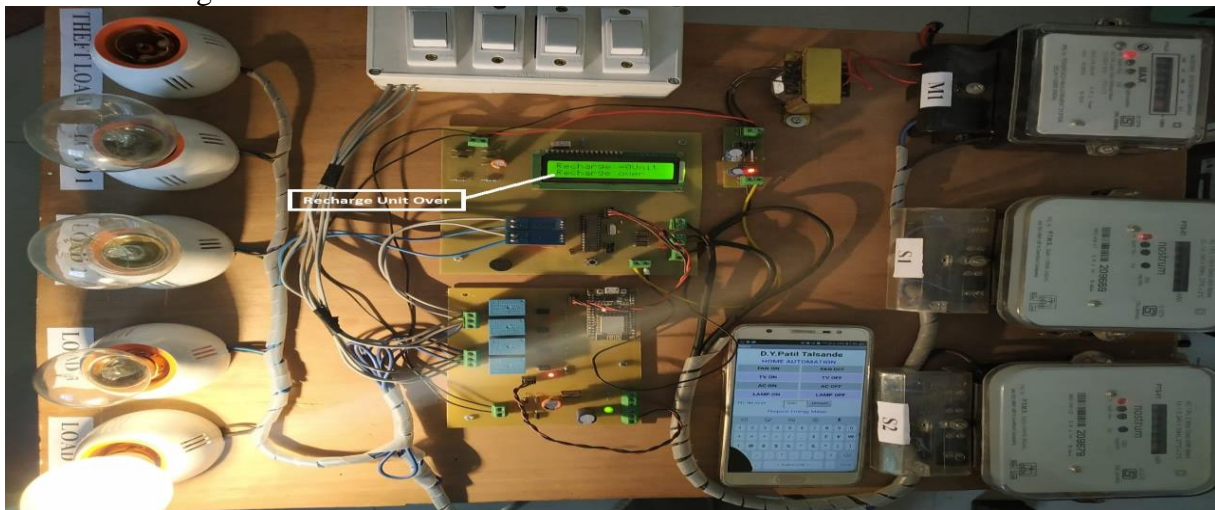**4) Prepaid billing**

- Recharge Over Condition

Fig 4.7: System with recharge over condition

After ending the recharge of unit LCD display shows "Recharge Over" message and buzzer makes a sound..

- After Recharge condition

Fig 4.8: System with after recharging

After successfully recharge through the android application, shows amount "Remaining units" on the LCD screen.

CONCLUSION

In this prototype of the IoT based energy monitoring and controlling of home appliances with theft detection and prepaid billing is introduced. The system is suitable for real time energy monitoring and controlling of electrical appliances also provides safety from energy theft, it can be developed for the future electricity billing system.

The system can implement at commercial residential buildings to immune distribution lines from unauthorized tapping. This system enable the utilization to eliminates the threats in conventional billing, reduce labor cost & make it more reliable, quicker and safer.

The controlling & monitoring system allows the user to control appliances. As well as monitoring systems gives information of energy consumption of each load anytime from anywhere.

User can see units consumed also control the appliances using IOT which serves as an extra advantage. The data stored in cloud gives consumption of power in detailed manner in a particular day, month or year. By this way, they can manage energy by knowing where they consume energy more. Hence this project serves as an effective tool for energy monitoring & management.

FUTURE SCOPE

The further development of this prototype can be very useful for industrial sector. By the means of monitoring the various electrical parameter viz Power factor, frequency, harmonic content etc. can be measured & data can be stored & shown to owner.

The information provided very faithful for the electrical audit of that firms, allows one for finding solution to makes system more economic. This project can be increases revenue of the Govt. by detecting the unauthorized tampering in the power lines. The project may be further extended by adding an additional feature of payment of the electricity bill from home itself using prepaid banking cards or such techniques.

ACKNOWLEDGEMENT

REFERENCES

I.   https://en.wikipedia.org/wiki/Internet_of_Things
II.   Pavitra.D., Ranjith Balkrishnan. "IoT based Monitoring and control System for Home Automation.", Proceedings of 2015 IEEE Global Conference on Communucation Technologies(GCCT 2015)
III. Kumar Mandula, Ramu Parupalli, CH.A.S.Murty. "Mobilebased Home Automation using Internet of Things(IoT)" , IEEE 2015 International Conference on (ICCICCT)
IV.   P.Siva Nagendra Reddy, K.Tharun Kumar reddy, P.Ajay Kumar Reddy, Dr.G.N.Kodanda. "An IoT based Home Automation Using Android Application" IEEE International Conference on Signal Processing, Communication, Power and Embedded System(SCOPES)-2016
V.   Prof. P.R.Jawale, Mr.V.S.Ghayal, Mr.D.M.Shende, Ms.S.N.Ghogale. "Prepaid Energy Meter using Arduino and GSM Module" IJERT Special Issue National Conference "CONVERGENCE 2017"
VI.   S.Balamurugan, D.Saravanakamalam. "Energy Monitoring and Management using Internet of Things" 978-1-5090-4679-9/17©2017IEEE