*Received Date: 9th November, 2022*
*Accepted Date:20th March, 2023*

# Smart Centralized Metering System for Commercial Building

**Krijan Shrestha[1*], Mitalesh Kumar Yadav[2], Pooja Aslami[3], Ram Ishwor Pandit[4] & Prof. Dr. Indraman Tamrakar[5]**

*[1]Dept. of Electrical Engineering, Pulchowk Campus, IOE, TU. Email: shresthakrijan98@gmail.com*
*[2]Dept. of Electrical Engineering, Pulchowk Campus, IOE, TU. Email: mithileshyadav7478@gmail.com*
*[3]Dept. of Electrical Engineering, Pulchowk Campus, IOE, TU. Email: pooja.aslami@jacks.sdstate.edu*
*[4]Dept. of Electrical Engineering, Pulchowk Campus, IOE, TU. Email: 072bel329pandit@pcampus.edu.np*
*[5]Dept.of Electrical Engineering, Pulchowk Campus, IOE, TU. E-mail:imtamrakar@ioe.edu.np.com*

***Abstract*—In commercial building, there are many shops in different floors. These shops are rented to different people and the electrical energy consumed by each shop has to be read every month. In conventional metering system, the meter reader has to go the metering panels in different floor which is time consuming and there is problem of raising the bill amount from the shop keepers in time and human error in meter reading. This paper presents a possible solution which is named as Smart Centralized Metering System for commercial building. The proposed system collects the data from each meter sends the data via wireless communication to a central server where monitoring and analysis of the data will be easily made. It will poll each and every individual shop automatically regularly in order to get the meter reading of the corresponding shop. If a particular shop did not pay the bill, power supply to the particular shop can be turned off from the server room. A proto type hardware of the scheme isfabricated and tested successfully.**

***Keywords* —Main Distribution Board(MDB), Xampp Server, Centralized Metering System,Wireless Communication**

## I. INTRODUCTION

In commercial building like shopping malls, there are many shops in different floors. These shops are rented to different persons and consumption of electricity by each shop in a month need to be metered. Fig.1 shows the conventional metering system of measuring the electricity consumed by different shops in different floors.

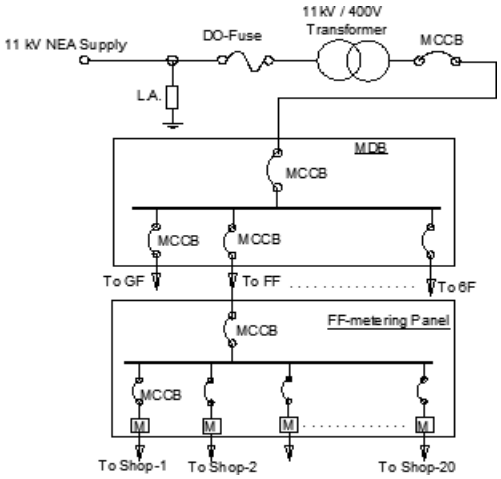


*Fig.1. Conventional metering system*

In the conventional system, the building has a Main Distribution Board (MDB) which distributes power to different floor metering panel. The floor metering panel has energy meters of all the shops of that floor. Every month, the meter readers has to read many numbers of meters in different floor panels, which is very time consuming and there is problem of raising the bill amount from the shop keepers in time and human error in meter reading. This paper presents a smart centralized metering system for a commercial building like shopping mall.

## II. PROPOSED SCHEME

Fig.2 shows the single line diagram of the proposed smart centralized metering system.

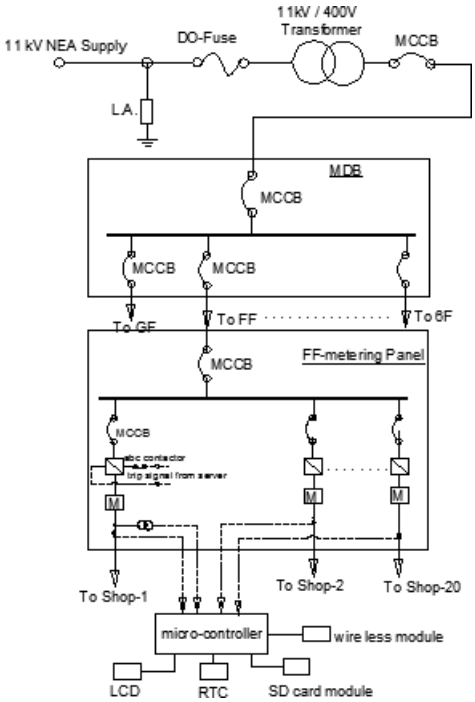


*Fig.2. Single line of proposed centralized metering system*

In the proposed scheme, the floor metering panel has circuit breaker, abc contactor, Current transformer(CT) and Potential Transformer(PT) in each circuit going to each shop. The data from CT and PT is send to a micro-controller and the micro-controller computes the energy consumed by each shop. The information

* Corresponding Author

from the micro-controller is send to a central server via wireless communication, where monitoring and analysis of the data are done. If a particular shop did not pay the bill in the time, power supply to that particular shop can be turned off from the server room by sending trip signal to the abc contactor.

## III. Simulation results

Before fabricating the proto-type hardware, the proposed scheme is simulated in the Proteus software to determine technical feasibility and parameters of the various components to be used in the scheme. Fig.3 shows simplliflied part of the Proteus simulation model showing the details of DC power supply unit, Voltage measurement unit and current measurement unit.

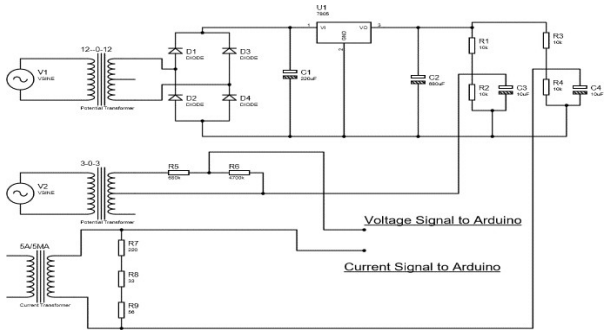


*Fig.3. Proteus simulation model showing the details of DC power supply unit Voltage measurement unit and current measurement unit.*

*a. DC Supply Unit*

The uppermost part in the fig.3 is the DC supply unit . This unit consists of 12-0-12 step down transformer, bridge rectifier, capacitor, resistors and IC 7805. The input ac supply is 220 , the output from the step down transformer is rectified by bridge rectifier. The rectified dc signal is filtered with 220 µF capacitor to get nearly constant dc. Then the dc signal is sent to 7805 IC (voltage regulator) which gives the output voltage of 5V, which is further filtered to get perfect constant dc voltage of 5V. The 5V output dc signal is passed through the voltage divider circuit consisting two equal resistors of 10k ohm each that divides the signal . Finally the divided 2.5 V dc is supplied to the voltage and current measurement unit for the lifting the voltage and current signals.

*b. Voltage Measurment Unit*

The middle part of the fig.3 is the voltage measurement unit. This unit consists of 3-0-3 potential transformer, two resistors (one of 680k ohm and other of 4700k ohm). With 220V ac input voltage, the potential transformer gives an output of 3V ac which gets divided by the resistors. Then the output voltage is 1.73 V which is added with 2.5 V dc supplied and the resulting signal is sent to the Arduino for the calculation process.

*c. Current Measurement Unit*

This unit consists of 5A/5mA current transformer and burden resistor of 309 ohm.

*d. Keypad menu program*

Program for keypad control is made to create more selection options. The flow chart of the keypad menu program is given in fig.4

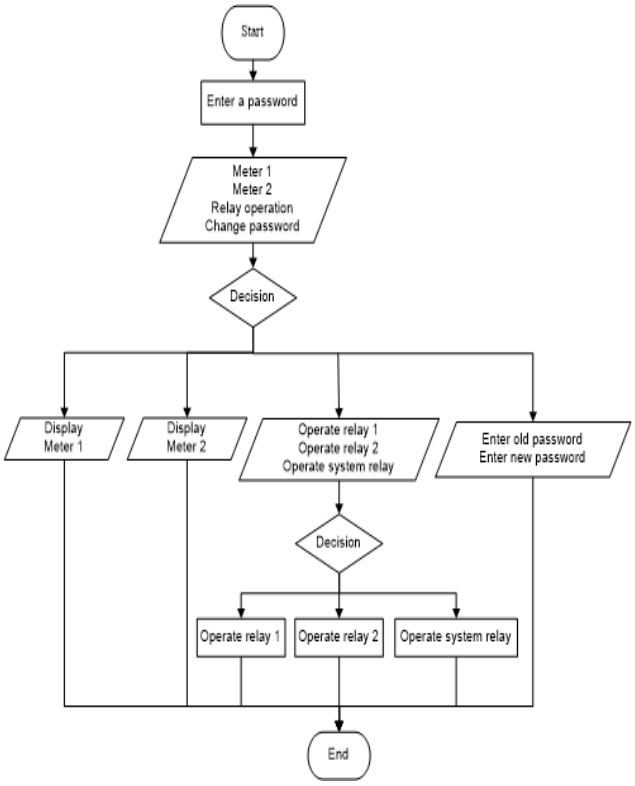


*Fig 4 flowchart of keypad menu program*

*e. Energy and cost calculation*

Using the values of current, voltage obtained from CT and PT, the energy consumption is calculated and its equivalent cost is calculated using specified tariff rate by electricity distributors and displayed in LCD using library file 'liquidcrystal.h'. The flow chart of the designed program is shown in fig.5

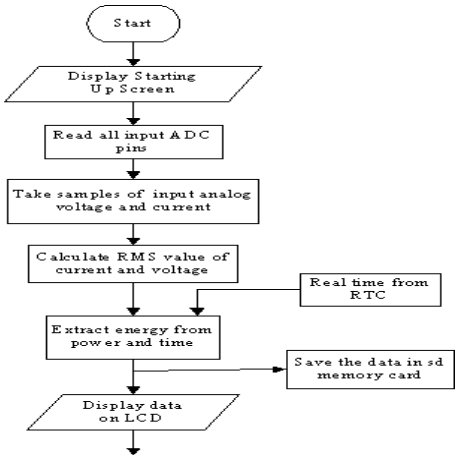


*Fig. 5. Flowchart of energy calculation program*

*f. Flowchart of SD Card Module*

SD card is programmed to save all the real time value in the .csv File format and its flow chart is shown in Fig.6.

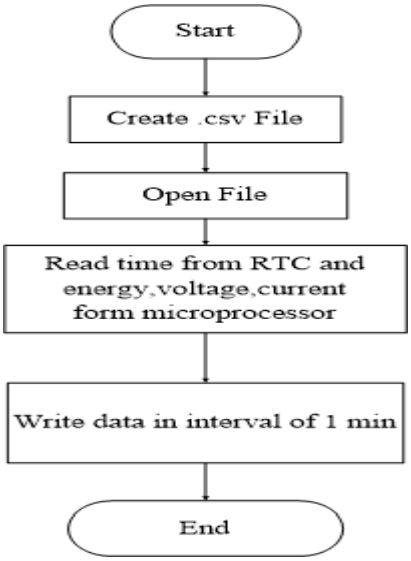


*Fig. 6. Flow chart for SD card programming*

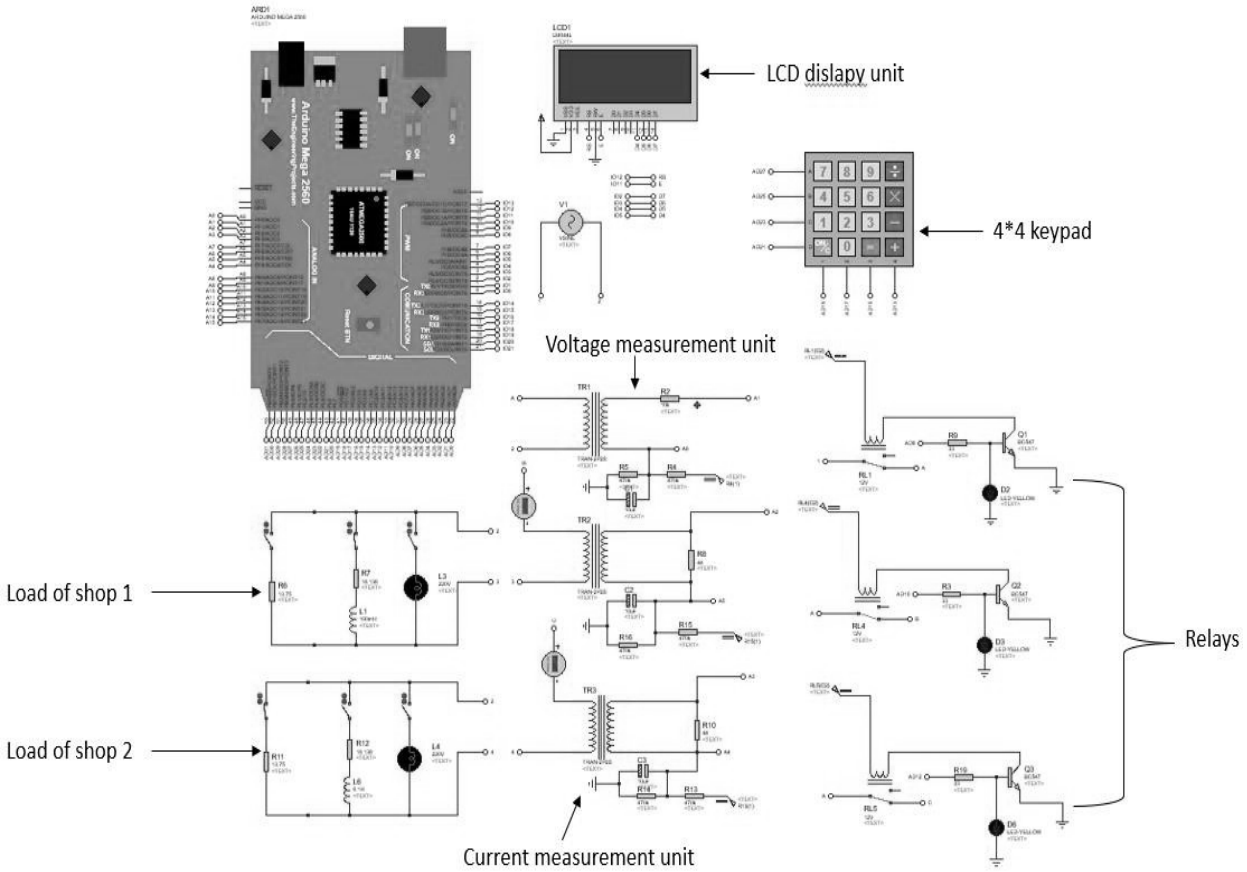


*Fig. 7. Complete Simulation design model of the proposed scheme in Proteus*

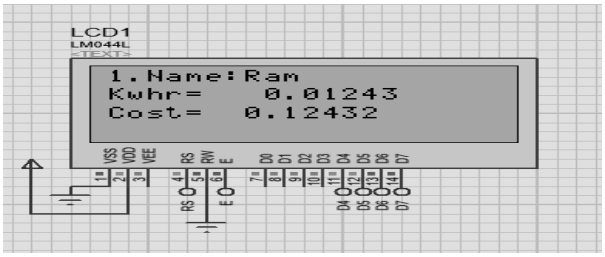


*Fig.8. Simulation results from Proteus*

Fig.7 shows the complete simulation design model of the proposed scheme in Proteus. The designed model consists of loads for shop 1 and 2, voltage measurement unit, two current measurement units for both shops, relay unit consisting of three relays, a keypad, LCDdisplay unit and Arduino board. There are different types of loads i.e. Capacitive, resistive and inductive loads connected in parallel. Fig.8 shows the simulation results.

## IV. HARDWARE RESULTS

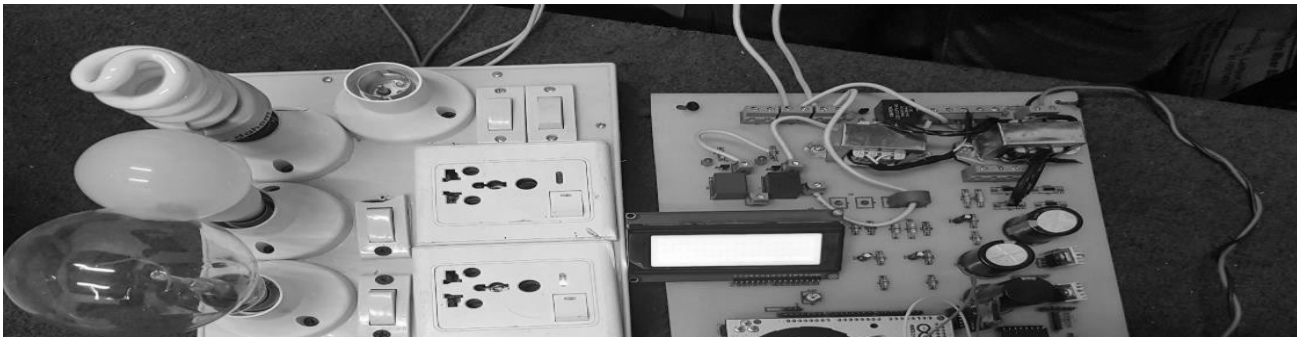

*Fig.9. Photograph of fabricated proto type hardware of the proposed scheme*

Fig.9 shows the photograph of the fabricated proto type hardware of the proposed scheme. The stored information is send to owner PC using Xampp server and Wifi-Module. In this server there are two sections one for customers and one for owner/ admin. Fig.10 shows the energy displayed on LCD. Fig.11 to Fig.13 shows the display selection options through keypad menu.

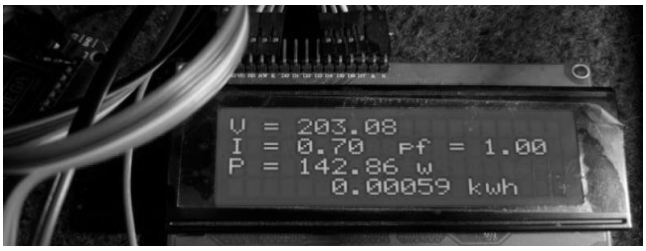


*Fig.10 Energy display in LCD*

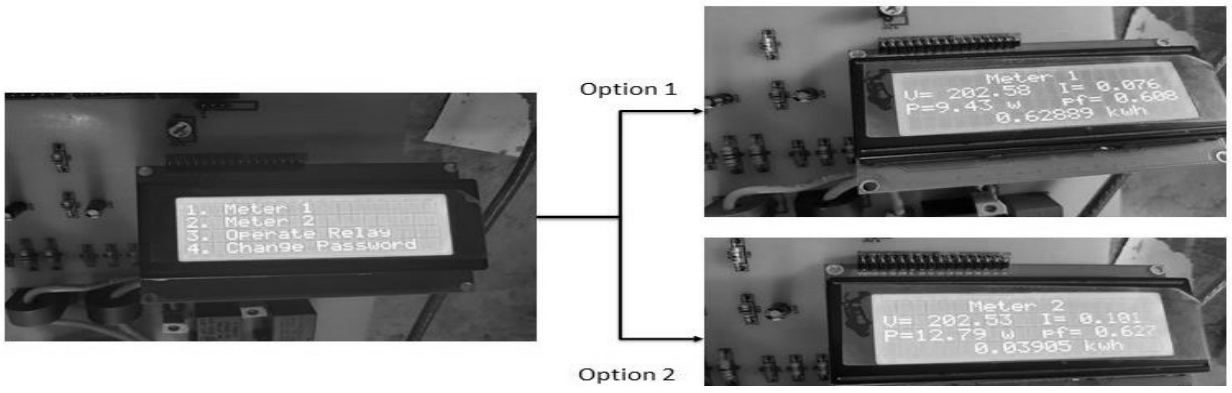


*Fig.11 Display selection options through key pad menu*

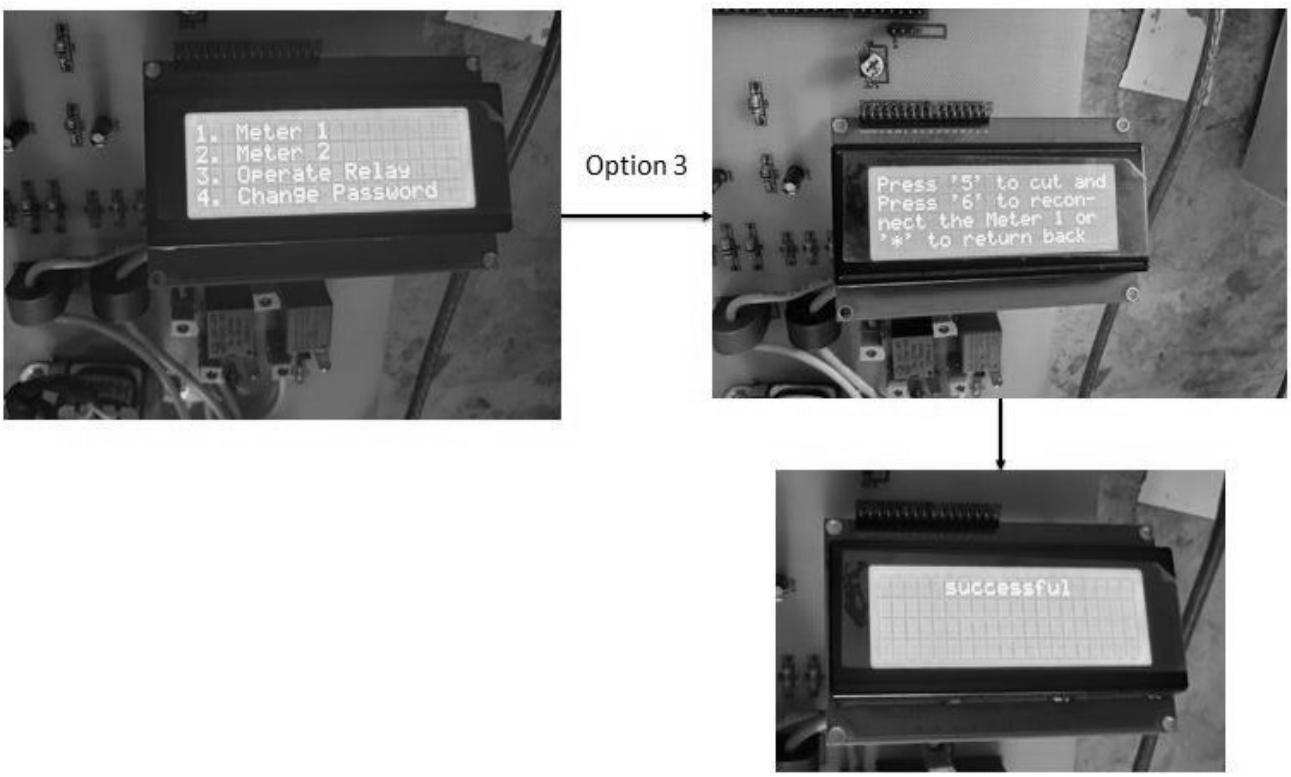


*Fig.12 Display selection options through key pad menu – Relay operation command*

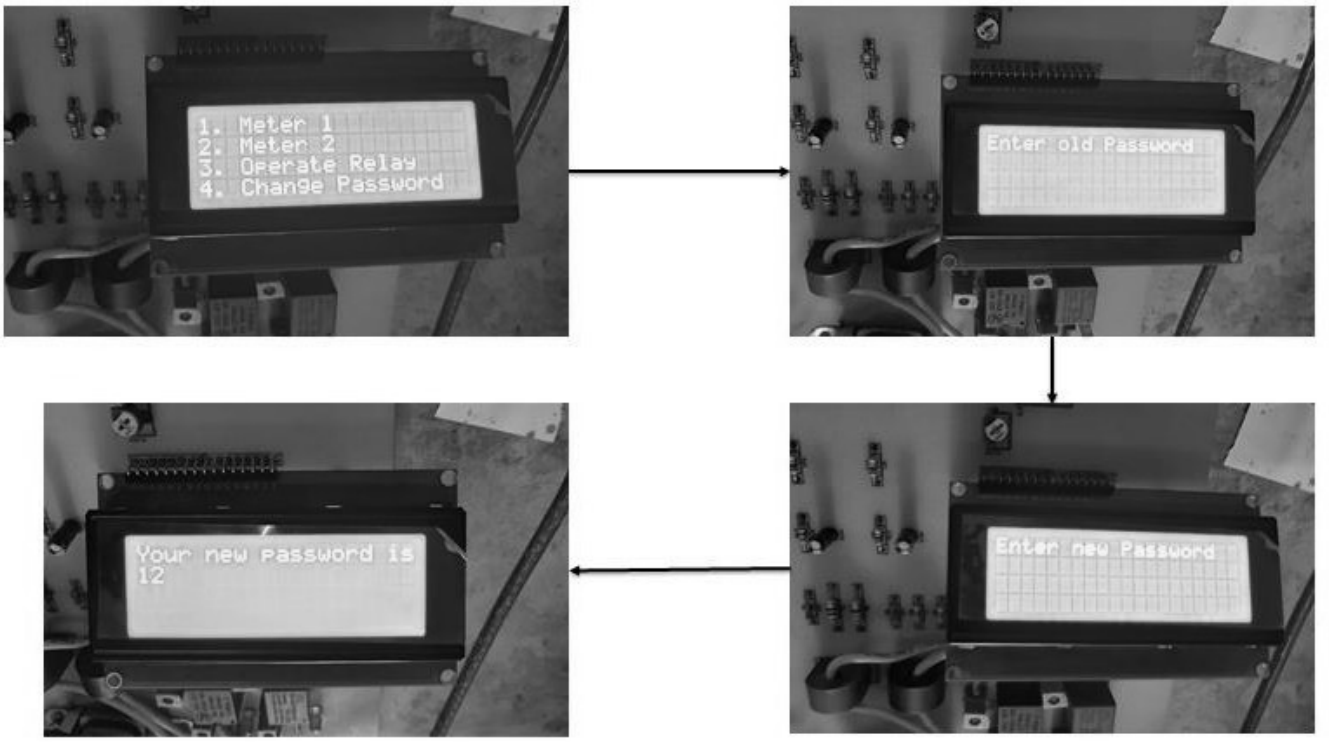


*Fig13. Display selection options through key pad menu – Password changing option*

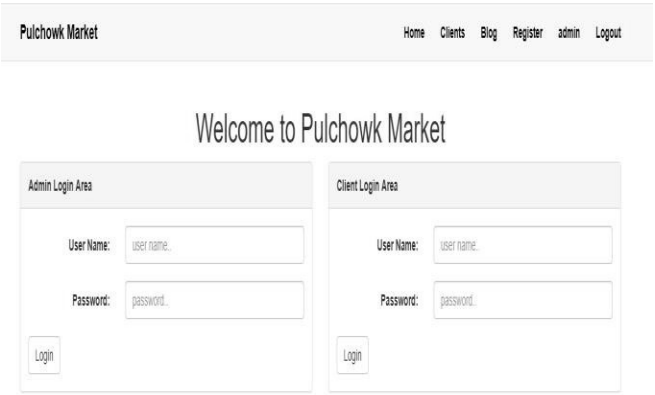


*Fig.14. Login page*

In admin login area, admin operator can view the information of all the customers and in client login area, admin can view details of clients like payment, energy charges etc. To add new customers,the client have to fill in their details in client registration page shown in Fig.15.

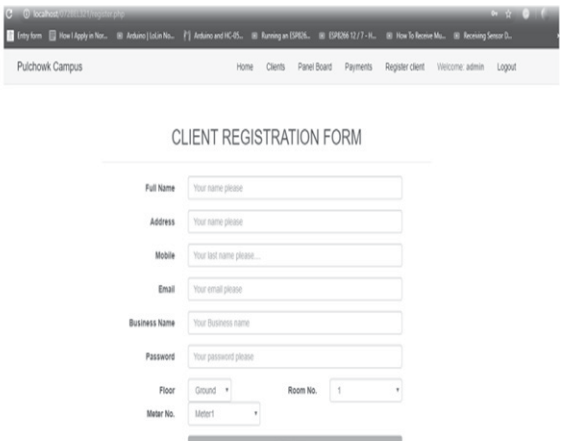


*Fig15. Client registration page*

Fig.16 shows the admin section view. Here the details of meter connected are shown. Fig.17 shows the client section page.

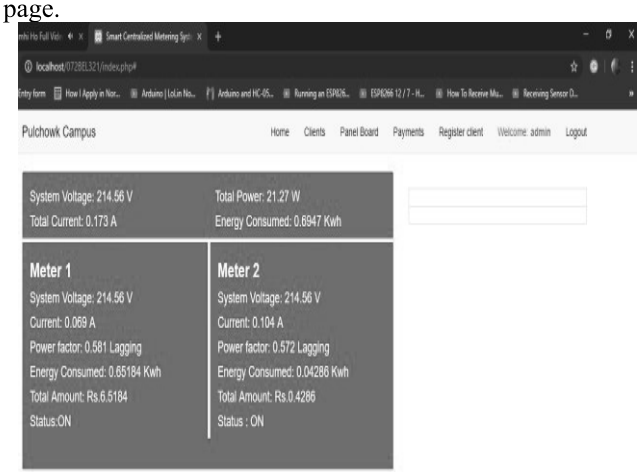


*Fig. 16. Admin section*

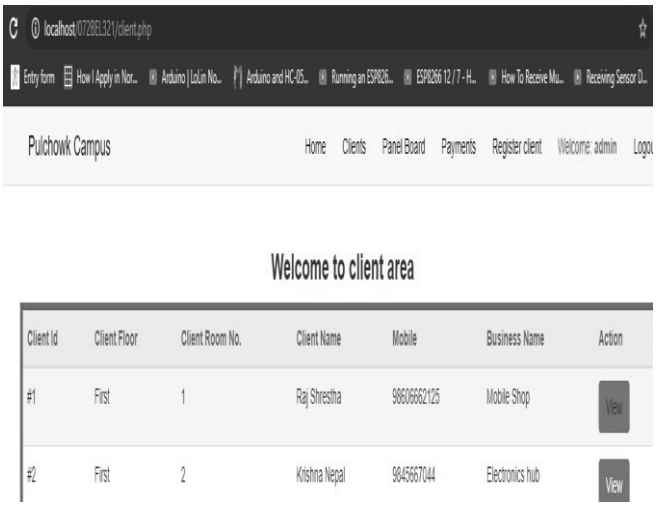


*Fig. 17. Client section page*

*Fig. 17. Client section page*

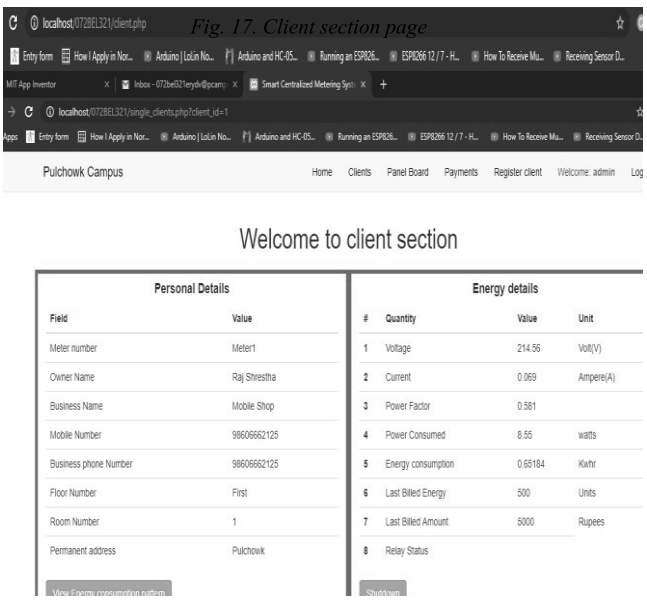


*Fig.18. Client details*

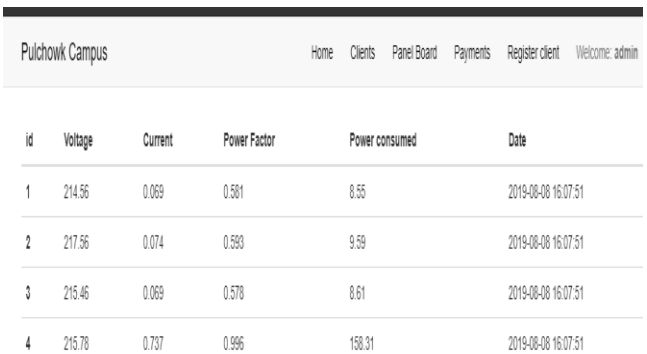


*Fig.19. Consumption details of client*

*For payment* of bills there is separate payment section in server. Here the amount paid is entered and the amount is shown in the Fig.20.

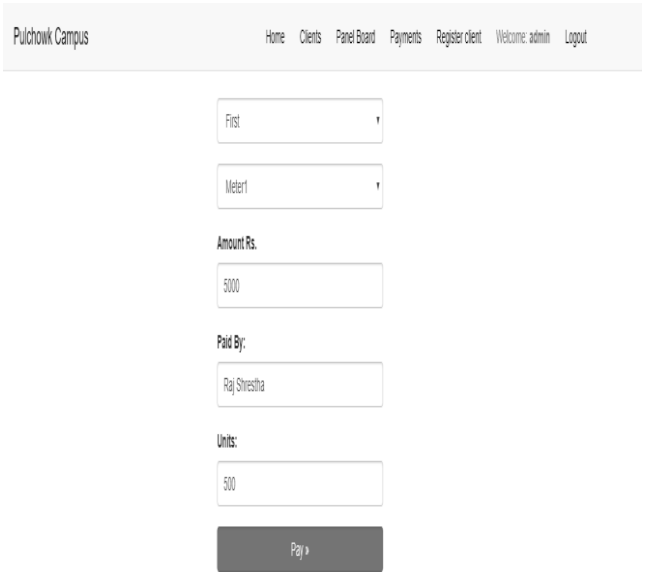


*Fig. 20 Payment section*

## V. CONCLUSION

The main objective of the proposed system is to make readings of many shops at different floors in one place. Distributors will be able to have more control over the distribution system. Moreover, the convenient way of billing will help to pay timely bills. The proto type hardware is cessfully fabricated and tested.

## VI. REFERENCES

[1] http://dspace.bracu.ac.bd/ xmlui/bitstream/handle/ 10361/8

[2] L. Kaicheng, L. Jianfeng, Y. Congyuan and Z. Ming, "Remote power management and meter-reading," in Precision Electromagnetic Measurements Digest, 2008.

[3] S. S. Karmakar, S. V. Gedam, H. W. Nagpure, A. Yadav and G. S. Thote, "LITERATURE REVIEW & ANALYSIS OF WIRELESS ENERGY,"