International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 08 Issue: 04 | April - 2024 SJIF Rating: 8.448 ISSN: 2582-3930

"Cloud Based Smart Energy Meter"

Priyanka Rathod[1], Prof. Ajinkya D.Salpe[2]

[1] *CSMSS Chh.Shahu college of engineering kanchanwadi, Aurangabad*
.[2] *CSMSS Chh.Shahu college of engineering kanchanwadi, Aurangabad*

Abstract - The electricity is an very much important in our day to day time, without it life on Earth is impossible now a day. So there is a need for measuring the consumed electricity by the respective user. It is done by the wattmeter in old days, but a person from MSEB office has to visit each house for measuring the power consumption and also calculating the bill amount. So it required so much of manual work and consumes time. In order to avoid all these drawbacks we have proposed to construct an IoT based energy meter system. So the proposed energy meter system measures the amount of power consumed by user and uploads it to cloud, from which the concerned person can view the reading and paid the bill. The power reading from the meter is sent to cloud server using ESP8266, a Wi-Fi module. The power reading from Analog wattmeter is read using the opt coupler and transmitted digitally with the ESP8266 module. So it automates the process of measuring the power consumption at homes using IoT and thereby enabling remote access and digitalization.
Also we develop theft alarm system, which can provide the alarm through the buzzer.

***Key Words*:** IOT, Energy Meter Billing, ESP8266, Relay,

1.INTRODUCTION

The energy utilization can be observed by utilizing an electric gadget called energy meter. The expense and the ordinary use of Power utilization are educated to the client to conquer high bill use. The Energy meter shows how much units consumed and moves the information to both the client and to the electrical board so this assists in decreasing with monitoring power. The client can actually look at their Power use from anyplace and whenever stretch. The IoT is utilized to Turn on/off the home devices utilizing hand-off and Arduino interacting. The target of this framework is to screen how much power consumed. The distributer and the customer both will be benefitted by ultimately lessening the all out Power utilization
The Internet of things idea empowers us to associate the typical everyday gadgets with one another over the web. The gadgets associated through IOT idea can be controlled and dissected from a distance. The IOT idea gives the essential framework and chances to shape an association between the actual world and PC based frameworks. The idea has been acquiring significance with an ever increasing number of remote gadgets that are expanding quickly on the lookout. It interfaces the equipment gadgets with one another over the web. The ESP 8266 Wi-Fi module utilized in the framework gives the availability the web in the framework. Presently a-days the interest for power is expanding at a steady rate all through the populace and is being used for different purposes wiz, horticulture, businesses, family purposes, clinics and so on. Thus, it is turning out to be increasingly more confounded to deal with the power upkeep and necessities. In this manner there is a quick imperative to save however much power as could be expected. As the interest from the more up to date ages of populace for power is expanding so as per it the innovation improvement is required.

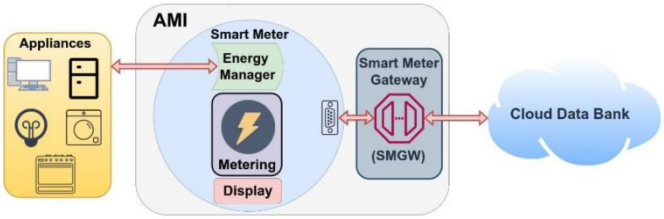

Fig1.1 Smart Billing and monitoring System

The interest for power is being expanded in the World. Large numbers of the purchasers are involving customary power meters in their homes. These days the vast majority of the homes are associated with Internet through WiFi. The utilization of Internet of Things (IoT) innovation empowers an Internet-based observing framework to as needs be measurably gather data and show them. In this, the Information connected with estimation of electrical energy boundaries, for example, constant estimation of voltage, flow and power can be acquired. The data is then intended to a web based constant observing framework for electrical energy utilization inside the house. The power utilization consistently can be seen by the client through an easy to understand versatile application and a site page. These website pages can be associated with the power specialist co-op to create power charges naturally. The continuous qualities are changed over completely to units (kW/h) and shipped off the data set through Internet. Since the outcomes should be visible through the site page and a portable application, the client might have some thought of decreasing utilization of power than prior. This gadget can be carried out to lessen the human reliance in gathering the month to month perusing and limit the specialized issues experienced during charging process. The proposed brilliant energy

meter controls and computes the energy utilization utilizing ESP 8266 12E, a Wi-Fi module and transfers it to the cloud from where the customer or maker can see the perusing. Consequently, energy examination by the customer turns out to be a lot more straightforward and controllable. This framework additionally assists in recognizing with fueling robbery. Along these lines, this shrewd meter helps in home.

2. LITERATURE SURVEY

In early years, electricity is available only to a specific section of affluent society. The advancement in technology over time encouraged meeting the demands of common people in all parts of the world. The history of electricity meter is well connected involving researchers from past.

[1] The author explains people‘s behavior towards the Smart Metering system and states the services such as viewing electric consumption in real time, viewing the effect of turning electrical appliances on and off, making estimation of the next bill, or receiving messages directly from the grid operator. The consumption patterns during night and weekends are projected in the paper.

[2] A survey is conducted in different countries over different households and user‘s feedback is obtained so that people become motivated to be energy-conscious. A socio-technical review to promote sustainable energy consumption using Smart Meters is done. Answers are proposed for a set of research questions such as 1) Is feedback useful for energy saving and behavioral change? 2) What presentation of feedback is good and effective? Scientific advice on energy saving instruments for household energy consumption is provided.

[3] A Smart Metering privacy model is implemented to measure the privacy that a Smart Meter will provide with and without involvement of third parties.

[4] Vehicle plate number recognition system has broad applications and is not limited to traffic control. The secured scenario can be maintained by connecting the meter to the data centre. When Smart Meters are connected with mobile phones, the actual power consumption of a device when it is switched ON/OFF or plugged in/out is observed.

[5]An overview of Smart Metering installations, implementations, and functionality which is installed in the Netherlands is given.

[6] Smart Metering involves installation of one or several Smart Meters by continuously monitoring and sending feedback of data to the customer. Consumers, by making use of Smart Meters, will get safe, secure and affordable energy, and a reduction of carbon emissions is possible.

[7] Smart Metering involves installation of one or several Smart Meters by continuously monitoring and sending feedback of data to the customer. Consumers, by making use of Smart Meters, will get safe, secure and affordable energy, and a reduction of carbon emissions is possible.

[8] The architecture of Smart Energy Management System was developed to control the transmission capacity and rate generation for the aggregated load conditions of the Smart Appliances. Energy prices, consumption and cost of consumption under different demand conditions i.e. on-peak, mid-peak and off-peak values are tabulated. The energy cost of each appliance is shown in pictorial form.

[9] The importance of Smart Meter in the market with respect to the customer and business organization has been reviewed. Functionalities and benefits of Smart Meters compared to mechanical meters are explained. The authors are curious to find out the hypothesis to the proposed questions in this particular research paper. To make energy efficient society, the customer must be aware of the energy consumed. So, different feedbacks are proposed in this paper to save energy and improve energy efficiency.

[10] The monitoring of Smart Meters in Hungary is discussed. The meter has two-way communication capability for tariff based operation and remote control. The communication tools of the meter such as Zigbee, WIMAX and Home Area Network supporting the energy meter is addressed. Energy Management System with high level application possibility has been proposed.

3. Body of Paper

In our proposed method, the consumer or user can manage their energy consumption by knowing their energy usage time to time through the system. This method not only provides two way communications between utility and consumer but also provides other functions that are if the consumer fails to pay the electricity bill the energy supply would be cut down from the utility side and once the bill is paidthe energy supply is reconnected through the system. Another advantage of this system is that it notifies the consumer & utility at the event of the meter tampering. By this information the consumer & utility can control the electricity theft is reduce energy crises within a time?

3.1 EXISTING METHOD

The present system able to provides bills and unites to the customer at the end of the month. Also the meter readings are taken manually door to door. User can know the units consumed by receiving their electricity bill only at the end of the month. Also large number of manpower is required to take the meter readings. There

is no protection for energy meter theft. The consumers cannot monitor the everyday energy consumption or usage using our system. The major drawback of this system is the management of power consumption is difficult. The conventional mechanical energy meter is based on the phenomenon of "Magnetic Induction". It has a rotating Aluminum Wheel called Freewheel and many toothed wheels. Based on the flow of current, the Freewheel rotates which makes rotation of other wheels. This will be converted into corresponding measurements in the display section. Since many mechanical parts are involved, mechanical defects and breakdown are common. The Electricity Board has got used to the manual process and they go along with it even though there are many concerns coupled with it. Because of the human errors after getting faulty bill, it is problem of user to get it corrected from the energy supply board. In that case customer has to stopover the office, stand in a queue and get it corrected. The problem is just because of human intervention.

3.2 PROPOSED METHOD

In the proposed method, the consumer can manage their energy consumption by knowing their energy usage time to time. This method not only provides two way communications between utility and consumer but also provides other functions that are if the consumer fails to pay the electricity bill the energy supply would be cut down from the utility side and once the bill is paid the energy supply is reconnected. Another huge advantage of this system is that it notifies the consumer & utility at the event of the meter tampering. By this information the consumer & utility can control the tampering are reduce energy crises. Since IoT is cost effective compared to SMS, monitoring of energy meters at lower cost is made possible. Daily consumption reports are generated which can be monitored through web portal. The current system of electrical energy billing is erroneous and also time consuming. Errors introduced at every stage are due to electro -mechanical meters, human errors while noting down the meter reading. This Project reduces the deployment of manpower for taking meter readings. It has many advantages from both suppliers as well as consumer's point. Smart Meter Reading. A device which remotely obtain meter readings and transmits this data to the system's computer via communication media such as IOT(Internet communication module) This devices can detect outages, remotely connect and disconnect services, detects tampering as well as other uses. Economic benefits include increased cash flow, lower Labor and equipment cost, increased accuracy and lower costs. Some customer satisfaction benefits include improved service quality, more customer choices and faster response time.

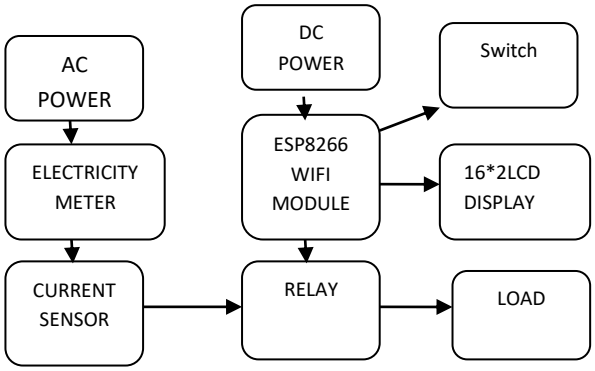

Fig -3.1: Block Dig of Hardware

4 PROBLEM STATEMENTS

The present system only provides feedback to the customer at the end of the month that how much power is consumed in the form of bill. The consumer has no way to track their energy usage on a more immediate basis. The consumers are growing exponentially fast and load on power providing divisions is rapidly rising. In the existing system meter tampering can be done easily and it's one of the major drawbacks for an energy crisis.

5. RESULTS

In the first stage of the research we have to perform a literature review related to Smart Meters. The data which is measured using Smart Meters is obtained from an energy provider. The results which are obtained from data are plotted in the form of graphs and observations are done regarding the consumption, price-cost, cumulative cost of the household and further statistical analysis. Particularly, in this stage the results are statistically summarized from the arrived data.

In the second stage of the research, a prediction model is selected. Model matching should be done after model selection, which is followed by validation. Different household energy consumption and cost patterns can be modeled using ARIMA. Various data sets are processed to obtain price-consumption correlations for observing behavior of households using superposition.

In the third stage of research, a method of flattening consumption patterns is identified and developed, aiming at flattening daily patterns and attempting to change the attitude of consumers. Finally, conclusions are drawn from the analysis.

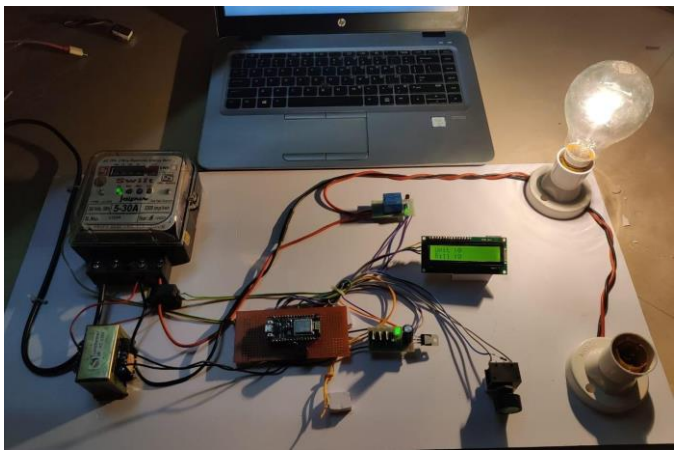

Fig 4.1 Hardware Of The Smart Energy Meter

Here we have interfaced electricity energy meter with ESP8266 using the pulse LED (Calibration or Cal) of electricity Energy meter. The pulse LED can connect to ESP8266 throughan Opt coupler IC.

When we power up the system microcontroller reads the how many times pulse LED will blinkin a minute using following equation.

Pulse= (Pulse rate*watt*time)/ (1000*3600)

Then we need to calculate Power factor of a single pulse, means how much electricity will be consumed in one pulse:

Power Factor=watt/(hour*pulse)

Using this power factor, we can calculate the no of units consumed by devices and then generate bill. Generated bill can be send to the customer server account and to the electricity board through wifi module. These data can also send to the LCD display connected to the ESP8266.

When the various appliances of the household consume energy the energy meter reads the reading continuously and this consumed load can be seen on meter.

1. We can see that the LED on meter continuously blinks which counts the meter reading. Based on the blinking, the units are counted. Normally, 3200 blinks is one unit.

2. In our project we are trying to develop, a system in which ESP8266 act as main controller, which continuously monitor energy meter.

3. As per the blinking of LED on energy meter the ESP8266 will measure the unit consumption.

4. The measured reading with the calculation of the cost will be continuously displayed on web page that we have designed.

5. Threshold value can be set on webpage with the help of Wi-Fi, as per the consumer's requirement. When the consumers reading will be near about to the set threshold value it will send a notification value to the consumer.

6. This threshold value notification will increase the awareness amongst the consumer aboutthe energy.

7. When the consumer gets the notification he can visit the webpage and change thethreshold value.

8. If the consumer is not aware with the threshold notification, then the meter will automatically get off. Then the consumer has to visit the webpage again and increment the threshold value. By the incrimination, the meter will automatically get ON.

9. Finally the overall monthly bill with cost will be sent to customer as well as service provider in the form of text at first day of every month.

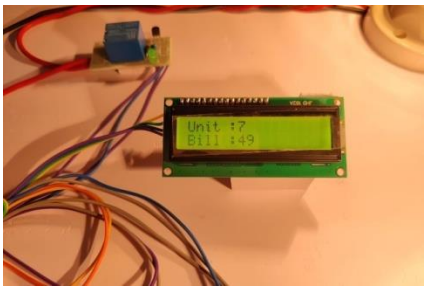

Fig4.2 Outputs Of The System On 16*2 LCD DISPLAY

Fig4.3 Outputs Of The System On Server

3. CONCLUSIONS

Subsequently the article makes sense of the essential construction and framework plan for CLOUD based energy meter charging and checking framework. The article likewise makes sense of the essential blocks and parts utilized in this system. It's a finished contextual investigation for the proposed project plan. The project is particularly useful for decrease in energy wastage and counteraction in electric deficiency. In this system shopper can do drive the executives by knowing energy utilization time to time. Utilizing this system we can give constant bill observing system and time decreased charging framework.

ACKNOWLEDGEMENT

I express my sincere thanks to my guide **Prof. Ajinkya Salpe** for guiding me at every step in making of this project. He motivated me and boosted my confidence and I must admit that the work would not have been accomplished without his guidance and encouragement.

Lastly I would like to thank all the staff member of Electronics & Telecommunication Engineering department and my friends without whom the Dissertation report would not have been completed.

REFERENCES

[1] F. Benzi, N. Anglani, E. Bassi, and L. Frosini, ―Electricity Smart Meters Interfacing the Households,‖ IEEE Transactions on Industrial Electronics, vol. 58, no. 10, Oct. 2011, pp. 4487–4494.

[2] E. F. Livgard, "Electricity customers' attitudes towards Smart Metering," in IEEE International Symposium on Industrial Electronics (ISIE), July. 2010, pp. 2519-2523.

[3] Z. Qiu, G. Deconinck , "Smart Meter's feedback and the potential for energy savings in household sector: A survey," in IEEE International Conference on Networking, Sensing and Control (ICNSC), April 2011, pp.281-286.

[4] J. M. Bohli, C. Sorge, and O. Ugus, ―A Privacy Model for Smart Metering,‖ in IEEE International Conference on Communications Workshops (ICC), 2010, pp. 1–5.

[5] M. Weiss, F. Mattern, T. Graml, T. Staake, and E. Fleisch, ―Handy feedback: Connecting Smart Meters with mobile phones,‖ in 8th International Conference on Mobile and Ubiquitous Multimedia, Cambridge, United Kingdom, Nov. 2009.

[6] L. O. AlAbdulkarim and Z. Lukszo, ―Smart Metering for the future energy systems in the Netherlands,‖ in Fourth International Conference on Critical Infrastructures, 2009, pp. 1–7.

[7] M. Popa, H. Ciocarlie, A. S. Popa, and M. B. Racz, ―Smart Metering for monitoring domestic utilities,‖ in 14th International Conference on Intelligent Engineering Systems (INES), 2010, pp. 55–60.

[8] S. Ahmad, ―Smart Metering and home automation solutions for the next decade,‖ in International Conference on Emerging Trends in Networks and Computer Communications (ETNCC), 2011, pp. 200–204.

[9] J. Stragier, L. Hauttekeete, L. De Marez, "Introducing Smart grids in residential contexts: Consumers' perception of Smart household appliances," in IEEE Conference on Innovative Technologies for an Efficient and Reliable Electricity Supply (CITRES), Sept. 2010, pp.135-142.

[10] S. David, S. Peter, ―Characterisation of Energy Consumption in Domestic Households,‖ in IET Conference on Renewable Power Generation., Strood., Kent, Sept. 2011, pp. 1-8.

[11] N. Lu, P. Du, X. Guo and L. G. Frank, ―Smart Meter Data Analysis,‖ in Transmission and Distribution Conference and Exposition (T&D), May. 2012, pp. 1-6.

[12] D. Ren, H. Li and Y. Ji, "Home energy management system for the residential load control based on the price prediction," in Online Conference on Green Communications, Sept. 2011, pp. 1-6.

[13] D. Y. R. Nagesh, J. V. V. Krishna and S. S. Tulasiram, ―A Real-Time Architecture for Smart Energy Management,‖ in Innovative Smart Grid Technologies (ISGT), Jan. 2010, pp. 1-4. 53

[14] G. Deconinck, B. Delvaux, K. De Craemer, Z. Qiu and R. Belmans, ―Smart Meters from the angles of consumer protection and public service obligations,‖ in Intelligent System Application to Power Systems (ISAP), 2011, pp.1-6.

[15] T. Choi, K. Ko, S. Park, Y. Jang, Y. Yoon and S. Im, ―Analysis of Energy Savings using Smart Metering System and IHD (In-Home Display),‖ in Transmission and Distribution Conference and Exposition, 2009, pp.1-4.

[16]http://www.investopedia.com/terms/s/standarddeviation.asp#axzz28GofaIjT [Accessed: 2012-10-07]

[17]http://www.investopedia.com/terms/a/autocorrelation.asp#axzz28GofaIjT [Accessed: 2012-10-07]

[18]http://tonyhodgson.blogspot.se/2010/12/energy-electricity-pictures.html [Accessed: 2012-10-08]

[19]http://www.Smartgrid.gov/the_Smart_grid#Smart_home [Accessed: 2012-10-09]

[20]http://compassrosebooks.blogspot.se/2010/11/pee-genie-how-were-all-at- risk.html [Accessed: 2012-10-15]

[21] S. Gottwalt, W. Ketter, C. Block, J. Collins and C. Weinhardt, "Demand side management—A simulation of household behaviour under variable prices," vol.39, no.12, pp. 8163-8174, Dec 2011.

[22] M. Zhou, Z. Yan, Y. Ni and G. Li, "An ARIMA Approach to Forecasting Electricity Price with Accuracy Improvement by Predicted Errors," in IEEE Power Engineering Society General Meeting., Denver., USA, 2004, pp. 233- 238.

[23]http://people.duke.edu/~rnau/411arim.htm [Accessed: 2012-10-22]

[24]http://www.mathworks.se/help/ident/ug/akaikes-criteria-for-model- validation.html [Accessed: 2012-11-06]

[25]http://www.mathworks.se/help/stats/linearmodelclass.html [Accessed: 2012-11-06]

[26] T. Jakasa, I. Androcec and P. Sprcic, "Electricity price forecasting - ARIMA model approach," in 8th International Conference on the European Energy Market (EEM), 2011, pp. 222-225.

[27] J. Contreras, R. Espinola, F. J. Nogales and A. J. Conejo, "ARIMA Models to predict Next-Day Electricity Prices," in IEEE Transactions on Power Systems, vol. 18, no.3, pp.1014-1020, Aug. 2003. [28] http://matrix.dte.us.es/grupotais/images/articulos/berhanu_itrevolutions.pdf [Accessed: 2012-11-12]

[29] http://www.investopedia.com/terms/n [Accessed: 2012-11-14]

[30] http://people.duke.edu/~rnau/seasarim.htm [Accessed: 2012-11-15]