American Journal of Mining Engineering
1(1)_23-27,August 2019

Research **Paper**

Smart Energy Meter Monitoring System; a Review

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To cite this article: Dr.M.Sujaritha, Amritha Devadasan and U.Sushmitha. Smart energy meter monitoring system; a review. American Journal of Materials Engineering,1(1):23-27, May-June 2019.

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Received: 24th January 2019.|Revised: 16th February 2019.|Accepted: 18th March 2019.

Abstract: Lack of resources in the present world is initiating everyone towards energy-efficient technologies. Amongst all these resources, power is one which needs to be controlled and monitored as per the use since consumption of electricity is increasing day-by-day. We now in a situation where almost everything is running on electricity. Energy is the soul of the world which is related to the electricity and "electricity" is the term which now rules the entire world. So, proper utilization of these resources should be done. Even though many innovations are taking place in this world, the existing energy consumption billing process seems in India to be very old fashioned and it does not meet the latest technology now available. The assessment of meter reading is still carried out manually. This requires huge manpower. The incorrectness in this assessment leads to high revenue loss for the electricity board. This paper presents a newly designed digital meter based on very cheap distributed components like microcontroller architecture and current sensors. The already existing power lines and connect every household in a particular area as it does not even require a new installation. It uses WI - FI to communicate with the user's servers. By measuring current and voltage, energy consumption can be measured, makes the world smarter place and also makes better decisions using the Internet of Things. The presented system gives ubiquitous and continuous access to energy consumption to the consumer by using the advancement of IoT technology. This work can also be expanded to a large area from which load distributed in the area can be estimated.

Keywords: internet of things *(IoT*), electricity, digital meter, *Wi-Fi.*

1. Introduction

In recent years, due to the improvement in the field of Internet technology computerized electricity billing and online payment has become possible. But still, Meter reading is still carried out by a representative from the electricity board. This requires huge manpower. Even if there is any incorrectness in assessment it may lead to high revenue loss. *AMR* (Automated Meter Reading) is a technology that combines automatic assessment of consumption of energy, analysis on the assessed data for billing and payment. To achieve this *AMR*, assignment of IP address to each energy meter is essential. This technology of bringing any device online and connecting it to the internet is termed as the Internet of Things **[1].**

A ton of frameworks has been planned and created to decrease the vitality utilization in the mechanical condition and in the private family units. These customary vitality administration frameworks can be isolated into two kinds. These are alluded to as nosy and non-meddlesome frameworks. For nosy frameworks, sensors are introduced at each machine, furthermore, a correspondence arrange is required to control, screen, what's more, speak with the sensors. Nosy vitality observing frameworks are exorbitant to send since a different number of sensor gadgets are required to be appended to each apparatus. Something else, just costly apparatuses. Redesigning each no compatible gadget with an extra system interface in a private family unit can be excessively costly curiously, this system prompts another complex test of deteriorating/disaggregating the information to perceive the power and vitality utilized by every person apparatuses. Strategies for disaggregation are conceivable due to the one of a kind examples/fingerprints of vitality utilization for a machine type **[3].**

Nowadays, many solutions are available in the market for this monitoring of energy purposes. OpenEnergyMonitor.com introduces a system that has the capability to monitor various kinds of parameters of an electrical system such as alternating current (*AC*) power, temperature, and humidity with hopes of extending the value measurements to include other air measurements like moisture. Internet of things has helped many organizational systems to improve efficiency, increase the speed of processes, minimize error and prevent theft by coding and tracking the objects. Both the Computing and communications have its future in the transformation brought by

the technology *IOT*. The consumption of power can be reduced to a great extent if we can monitor our daily power usage and switch off appliances which are unnecessary consuming electricity. Thereby this system focuses on developing monitoring the energy system more effectively and hence it can be utilized effectively by using the technological advancement in *IoT* technology **[4].**

2. Various methodologies

2.1. Using *ARM* microcontroller

The general procedure of the system appeared in the accompanying figure. The equipment and the product interface are associated with one another to screen the power utilization of the client and further, this will be observed by the server and will be transferred to cloud from where the client can sign on to the page in PC and App introduced in the versatile. The savvy meter will show the voltage, current, and power on $16X2$ *LCD* show. Usage comprises of programming and equipment execution. Keeping in mind the end goal to actualize the site, we utilized *MICRO KEIL VERSION 4, XAMPP, HTML, EMBEDDED C*, JavaScript, and *PHP*. Whereas to execute the equipment, we utilize a voltage sensor, current sensor, *LCD, ARM7* Microcontroller *LPC2148, WI-FI* Module, Web gateway, Computer or Mobile. Current Sensing anyway presents significantly more troublesome issues because of the rich symphonious substance in the present waveform. Current transducer sensor not just requires a significantly more extensive estimation dynamic range, yet additionally important to the treatment of a substantially more extensive recurrence extend **[5].**

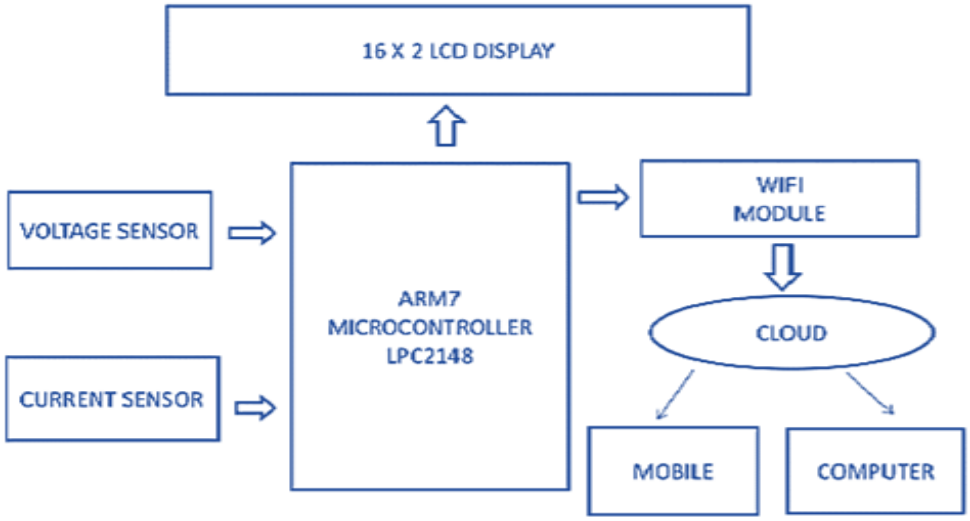

Figure – 1: Architectural Design of Meter.

2.2. Using *ATMEGA328* microcontroller

The fundamental objective was to outline and execute a framework and a model able to procure vitality related information after a couple seconds so vitality utilization examples could be considered. The model gadget, consequently named as *ELIVE* gadget, was named after the objective to record live vitality estimations. Keeping in mind the end goal to accomplish this, we utilized *ATMEGA328* microcontroller to interface with an *ESP8266 Wi-Fi* framework on chip (*SoC*) module, an AC transformer, and additionally present transducers. The *ESP8266* enables the microchip to associate with the Internet effectively through a setup *Wi-Fi* association, in view of serial interfacing prerequisites. Arduino coordinated improvement condition *(IDE)* was utilized to program the microcontroller to acquire vitality estimations utilizing simple to a computerized converter (*ADC*) to interface with the sensors. Figure 3 demonstrates the square graph of the segments of the vitality observing model. Five noteworthy segments are utilized which are control source module.

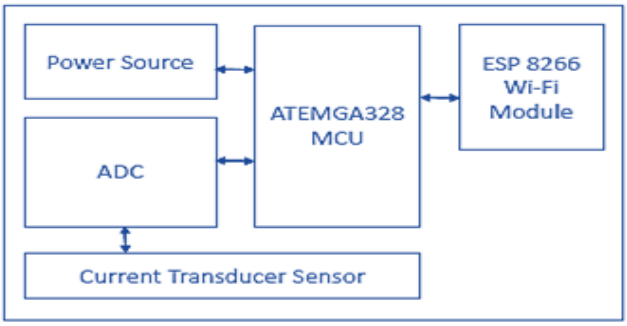

Figure – 2: Interfacing block diagram

We contrasted our model and a financially accessible vitality observing framework from Billion. This framework contains an entryway (*SG6200NXL*) which speaks with sensor gadgets (*SG3015*) utilizing ZigBee based correspondence. The Billion passage can go about as a remote customer and in addition a *Wi-Fi* passage. The Billion passage gives an improvement stage to framework combination and programming to coordinate further in its own cloud

benefit and applications. Vitality estimations as recorded by the Billion framework were utilized as a benchmark **[6].**

2.3. Using Radio Frequency (*RF*) Module

Automatic meter reading is designed based on the actual digital electricity meter available in each resident of the consumer. Figure 3 shows the basic block diagram of the whole automatic meter reading system. Basically, the system uses the existing one phase digital electricity meter in consumer residence. The digital electric meter will then display the amount of energy consumed by the consumer based on the daily usage of current. At the digital electric meter, the build in liquid crystals display (*LCD*) will then display the energy consumed according to the number of pulses generated by the blinking of an *LED*. Therefore, the total numbers of pulses generated by the *LED* are then a directly proportional amount of energy used by the consumer.

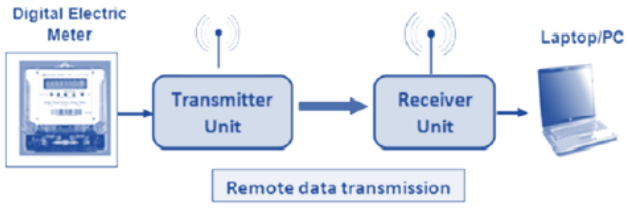

Figure – 3: Block diagram of the whole system

The transmitter section consists of transmitter module, microcontroller *PIC16F877A, LCD* display, Real Time Clock (*RTC*), digital electricity meter and load. The pulses from the meter are given to the microcontroller via an optocoupler. The transmitter sends the amount of energy consumed in a unit to the receiving end through the RF module. The *LCD* display is used to display the unit value, time and date. At the recipient end, the information is gotten by a collector module and the microcontroller will show the information over the *LCD* show. The *LCD* at collector side additionally shows time, date and unit esteem. The *PIC* transmits this information to workstation/PC by associating *MAX232* as an interface between the controller and *PC/PC [7].*

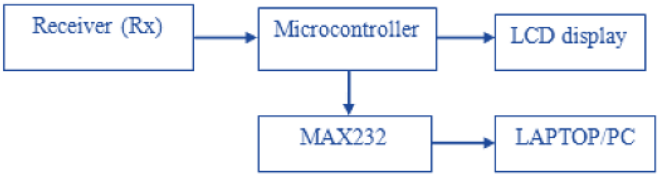

Figure – 4: Receiver block diagram

2.4. *ARM*-Based Power Meter using *Wi-Fi* module

Wi-Fi has a place with the short-extend remote innovation which is utilized in workplaces and structures. This innovation depends on the *IEEE 802.11* of remote interchanges innovation. It can work in the transfer speed close to the *2.4 GHz* which needn't bother with any consent for utilizing. It's as of now interchanges gauges is *IEEE 802.11a, IEEE 802.11b, IEEE 802.11g*, and *IEEE 802.11n*, and so on and the world fiercely utilized in them is *IEEE 802.11b*.

The equipment arrangement of *PMWCM* is comprised of Power Information Collection Module, Wireless Communication Module, the Hand-off Control Unit, *LCD* Module, et cetera. Thinking about the office of troubleshooting and expansion, the *ARM* equipment framework is normally comprised of the Core-Board and the Fringe Board. The Core-Board of the *PMWCM* is made out of one *32*bit *ARM9 CPU*（*S3C2440A*）, one *64M* Streak *(K9F1208),* two *32M SDRAM* (*Hynix561620*). The Fringe Board is made out of the 3.5V and 3.3V power module, the power estimation module (CS5460A), the Voltage/Current Transformer（*SCT254FK*、*SPT204E*）, the *LCD*（*LCM1602* ）, the Relay (*HHC67*) and the remote correspondence module(*VIA VT6656*)**[8].**

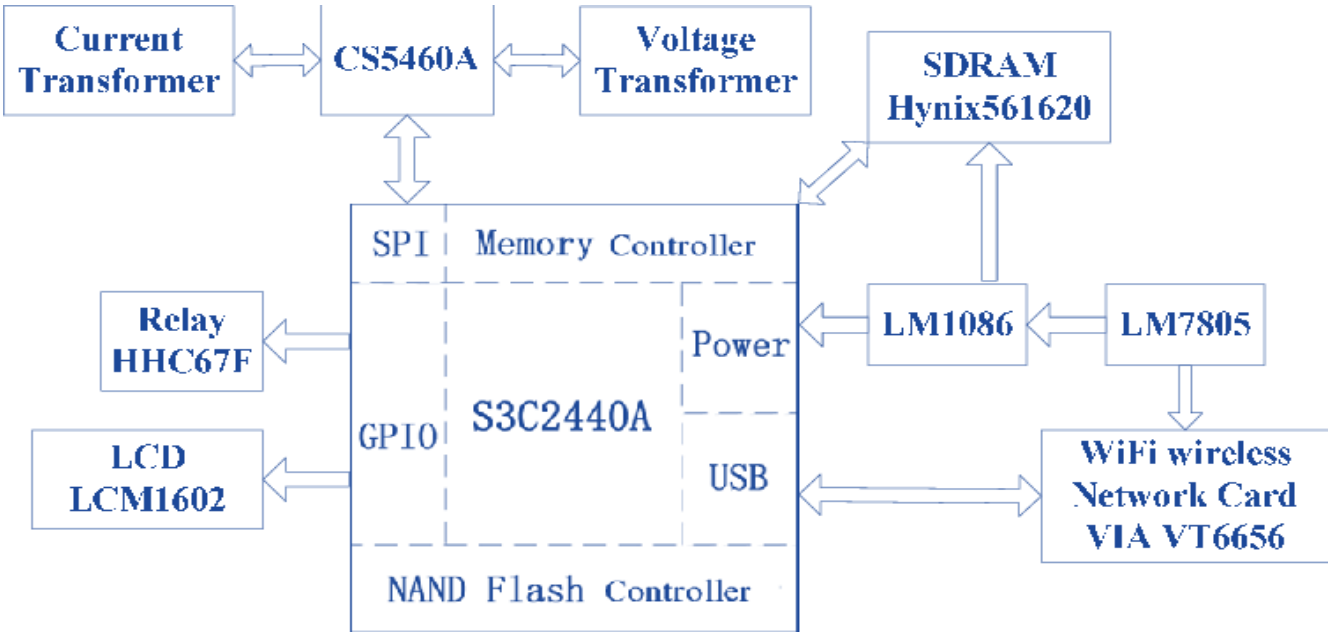

Figure – 5: The Hardware System of PMWCM

2.5. Using *GSM* Technology

When building up an innovation that may supplant one which has been being used for over thirty years, not just the key issue should be tended to, however, included usefulness and solutions for different snags showed by the past innovation should be tended to. Notwithstanding existing meter per users also, different bosses need to acknowledge the quality and adequacy of the proposed system. The building challenge is to build up an item that can fill in as remote framework swap for the metering and charging framework at present being used. This accentuation that the meter being worked on needs to work under the old conditions, what's more, play out all the past capacities, yet in addition have the capacity to hand-off the data recently and play out extra capacities, without the need of supplanting all meters on the electrical framework all the while.

The created *AMR* framework comprises of three principal parts: an advanced *GSM* control meter introduced in each person shopper unit, transmission office (*SMS* passage), and charging server at the vitality supplier side. The proposed framework for vitality charging is programmed, don't require human exertion to peruse the meter, the shopper can straightforwardly know the sum he needs to pay at the season of bill readiness itself and can even pay the sum on the web.

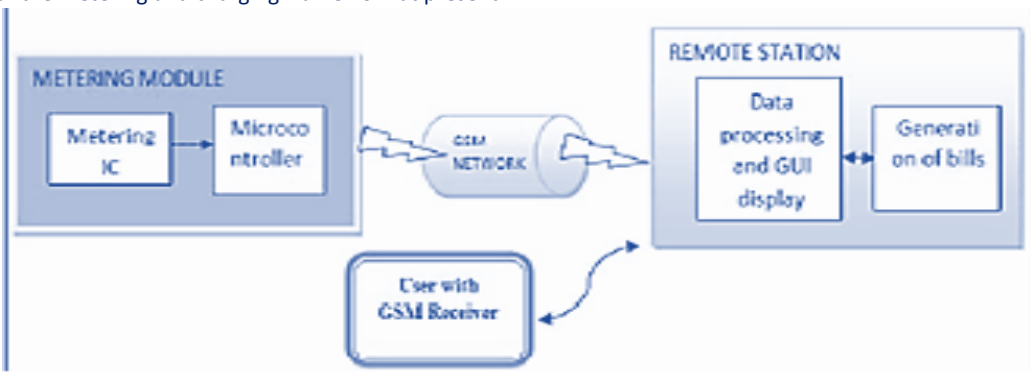

Figure – 6: Overview of Proposed System.

This *GSM* vitality meter is developed utilizing the microchip single stage committed vitality metering *IC MCP3905A*, a show, *8*-bit *PIC* Microcontroller *PIC16F877A* and *GSM* modem. *A 10A* class *I* single stage meter is composed with installed *GSM* modem which uses the current *GSM* system same information is likewise put away in the related non-unpredictable memory (*EEPROM). RTC* module is likewise incorporated in the meter to have time-stamped recording of utilization points of interest **[9].**

3. Performance Analysis

Table -1: Comparison of different works

Reference used	Tittle of paper	Technique Used	Drawback
[5]	Towards the implementation of IoT for energy meter monitoring in homes	Using ARM microcontroller	Hardware cost
[7]	Implementation of Automatic Meter Reading (AMR) using radio frequency (RF) module	Using Radio Frequency (RF) Module	Separate module for transmitter and receiver
[9]	GSM based automatic energy meter reading system with instant billing	Using GSM Technology	Short range

4. Challenges

Every technology has its own advantages and drawbacks; while smart meters have their benefits, they also present challenges to electric utilities and customers. The majority of these drawbacks are however short term. The smart meters can be very useful to both electricity providers and consumers once the system has been set up and training is complete. Smart meters reduce these challenges and costs to the electricity board. The transition from one technology to new technology and processes is difficult. Creating awareness among public r and customer acceptance of the new meter. Making a long-term financial bond to the new metering technology and related software.

5. Conclusion

There are different electronic meters have been developed and are still being developed. The use of *GSM* in this kind of system provides numerous advantages over the other methods that have been used previously. The transmission of data is charged at standard *SMS* rates, therefore the charges are not based on the duration of data transmission. The cost-effective transmission of readings. Guarantees that power utilization esteems can be transmitted all the more much of the time to a remote station. Thus it is possible to transmit

readings at particular time intervals based on the energy utilization will be able to generate timely bills, better understanding energy demand patterns, managing meter failures more efficiently and managing fraud better. The system developed is highly effective in the sense it can able to eliminate the problems of serial communication. ***I.e.*** even though it lacks on the acknowledgment of the *SMS* sent it is not affecting the performance of the system. Even If a message is missing then also the system is accepting the calculated value and the next time which includes lost content. And then while preparing the bill of the system it is accepting the maximum consumption of the electricity value. These implementations make the system now designed very much unique and more effective compared with the previous proposals. This developed system uses the emerging technology *IoT* for the real-time residential energy metering purpose. This gives ubiquitous and constant observing of current utilization. The centrality of the examination is to decrease labor prerequisites in evaluating the electricity readings and furthermore lessen mistakes caused by them. A low-cost single module system is developed to sense, compute and transfer real-time data. A low-cost single module system is developed to sense, compute and transfer real-time data. It also provides a user-friendly platform to offer an interactive experience to the customers. Further, the developed work can be done using the latest technologies and it can be expanded to a large area.

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