

# Review of Smart Energy Meter

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**Abstract:** Electricity is inevitable in our day to day life. The main objective of this project is to produce the user analysis of the energy consumption. This leads to automatic bill generation. By doing so we can reduce the labour requirements in taking meter reading. This is also helpful because the reading can be taken even if no one is present in their houses, After generating the bill, the bill message will be sent to the users along with the last date up to which the payment is accept. If the bill is not paid warning message will be sent to the user, if the user still doesn't pay the bill, it will result in automatic disconnection. We also propose a way to give alert during load shedding by giving the users the time of the load shedding at their location.

**Keywords:** Arduino, Energy Consumption, Alert Message, GSM, IoT, LCD display, Bill Payment

## I. INTRODUCTION

India is third largest producer of electricity in world and fourth largest in electricity consumption. Power generation capacity in India is surplus and infrastructure for supplying electricity to all need people is lacking. To develop the infrastructure, government of India launched a scheme called "Power for all". Electricity sector in India is dominated by coal, fossil fuels. Government increases only renewable energy. For leading a comfortable life, electricity is the vital requirement and is to be properly used and managed. At present, a human operator from electricity board visit the resident and take reading from energy meter and produce bill for corresponding energy consumption for each month manually. To reduce the human interference and problems of generating bill generation, a new idea is introduced from electricity board. Information about power consumption, bill and pre-determined shutdown details are communicated to customer. If the consumer doesn't pay the bill within the time limit, a message is send to consumer using IOT and if consumer doesn't pay the bill, power connection is disconnected from the remote server.

The system will provide energy consumption and pre-shutdown details on daily basis and also provide an alert message if energy consumption exceeds the certain limit and automatically terminate the power supply through message when consumer is out of station. Losses in electricity in two ways. Technical and managerial. Technical loss of energy is due to functional tendency of equipment. Managerial loss of energy is due to lack of human interference periodically. These losses are higher in developing countries.

## II. LITERATURE SURVEY

[1] Streetlight being the major source of light against the darkness of the night .The street light ensures the safety in urban and rural area increases the visibility of the roadways. As a result of rapid and modern infrastructure development a new innovative technology is need in energy sector. A GSM based smart light improve the efficiency by using timed controlled switching of street lights, which automatically turn On/Off according to the needs. The major advantage of these systems is that they are less costly to implement, also they are highly scalable. We have put forth a solution for the smart lighting system. Through a single touch energy can be controlled it more eco-friendly.

[2] The system will replace traditional meter reading method with GSM based smart energy metering system using IOT. The sensed units automatically send on cloud generating using IOT. It is very efficient and low cost system because this model reduces the miscommunication between the user and the controller. An efficient systematic approach is used for the design to acquire accurate measurements for the energy meter. The prevention of malpractice, it gives an accurate accounting of units.

[3] Proposed design and implementation of an Innovative Internet of Things based on smart energy meter. This model describes its design along with its working. I t will make the leading to be handy and measure the energy consumption accurately. Here the energy wastage is reduced also brings awareness among all.

An innovative method by which an IoT-based smart exam application can be used to obtain information. The metrics values can be determined by using a Biometric Smart Pen (BISP), through which handwritten characters, words and

gesture movements can be recognized and can be used for further analysis. Smart exam applications are helpful in analysing how much is spent on a question through which improvements can be brought into action.

In [4] Involves development of smart energy meter. It is used to monitor the energy usage of different applications and provide other features like advanced billing system and high accuracy. Meter can control energy supply and usage of energy based on load requirement and measure cost power consumed. Consumer gets a clear idea about his usage & cost.

As mentioned in [5] system takes reading from energy meter automatically and sends to server side. At server side receives readings and processes it and generates bill for corresponding reading and generates pdf for bill payment. This pdf is stored at remote location. The necessary information's are sent to customer via SMS. The system consists of a power LED. Each time LED is blinked. Arduino module monitors the blinking of LED and the count is stored in EEPROM. If Arduino module is off count will be stored in EEPROM and Arduino module checks the current day of month. At 1 day of month, the blink count and id will be sending to server side. Arduino modules have a unique id. This id is sent along with blink count to server side. This is done by configuring with network and parameters are sent via GSM module in server URL and that URL will be hit. Before hitting URL, at server side will have a database and it contains all details about user. MySQL is used for performing each of operations in database like insertion, deletion, updating etc. When URL is hit, server checks the parameter list in URL and compares it with the database, these details are fetched using SELECT query. After fetching details, generate bill for corresponding blink count. The cost for one count is already set in database. After calculating bill for corresponding blink count, create a pdf for bill and store it at remote location. Customer name, link to pdf generated and number of user which is separated by using (:) and are sent to GSM module. GSM module extracts message part and sends it to user via SMS.

In this paper [6] A smart meter is an electronic device to measure and manage the power consumption. The proposed system replaces regular electricity meter with hall sensor and ESP8266 interfaced with Arduino UNO to transmit data. Data collected from various households and sent directly to Arduino UNO module. From Arduino UNO module, data transfer to Arduino YUN module through ESP 8266 Ethernet shield. From Arduino YUN module data stored at Temboo cloud. User can access the data from Temboo cloud. Therefore server uses the details of user and can retrieve it using their Id. Regular updates from server is sent to user through SMS or email. Electricity bill generated at every month and sent to user. If the user doesn't pay the bill, electricity connection is automatically interrupted using relay switch. Here hall sensor sense amount of current is consumed using current sensing theory. The phase wire is passed through hole of hall sensor. When current passed through phase wire, it is measured from magnetic field generated. Therefore potential differences referred to as a hall voltage. The advantage of hall sensor is measured the current without breaking the system. Per capita power consumption is rapidly increasing with increasing population. When user concerned about electricity bill and power consumption, there are high chances for reducing per capita power consumption. This system increases privacy and will reduce health hazards compared to previous systems.

In this paper [7] ZigBee is low cost, low powered wireless networking standard based on mesh topology. This system is based on ZigBee technology. Consumer side consists of energy meter, microcontroller, LCD display, voltage sensor, ZigBee module and power supply unit. Micro controller continuously monitors energy meter. When user temper the meter, theft is detected then meter tempering signal send to microcontroller via optocoupler. Theft signal display at LCD display at consumer side. The microcontroller directly interfaces with ZigBee module. The theft signal send to server side through ZigBee module LCD display energy consumption in unit, power status, theft status, monthly bill. Electricity side consists of ZigBee module and personal computer system. Monthly bill status will send with help of "send bill" button. If theft is detected, power switched to off with help of "cut-off" button. Power supply can be restored using "Restore" button. This communication takes place wireless via ZigBee module.

In [8] IOT Based electricity bill generation is a technology. It is used to gather information from energy meter and it transfer to the database. Database analyses this information for billing purpose. Energy is stored in the chemical form. Using kernel programming, reading will be taken from energy meter. Kernel programming will give battery status and is sent to the server through Gateway. At server side calculated bill will be sent to customer through browser and GPRS Gateway. This system avoids human intervention in electric bill generation. If the user gets wrong information he has to visit electricity board for correction. These errors are avoided by taking reference of meter reading and send details to server and maintain the database at real-time. This system avoids use of paper and provides fast meter reading. Here we take laptop battery for reference. In future it may be possible to take readings directly from meter and send data to server at real-time.

In this paper [9] The system gives a wireless GSM based energy meter. It associates with web interface. Here the electric energy meter is integrated with GSM based wireless module. Also each entity has the remote access to the usage of electricity. In the other end, there will be a PC with a GSM receiver. It contains the database which acts as the billing point. The GSM based energy meter reads the live meter reading and sends to the billing point periodically and it will be updated on the central database. At the end of each month due amount and complete monthly usage is sent back to the

each customer. The energy meter consist of dedicated IC MCP3905A,LCD display,8 bit PIC Microcontroller PIC16F877 and GSM Modem. A RTC module is used that will record the usage detail it counts consumption in seconds, minutes, hours, date of month, day of the week and year with leap year compensation valid upto 2100.

According to [10] here GPMC (GSM based power meter and control system) is developed which consist of the integration of single phase IEC61036, standard compliance digital KWh power meter. This system keeps track of energy meter reading of each day. Unique id is given for each energy meter and it is interlinked with the customers unique id mobile number. So the reading with the user id number is sent it to the electricity board department as well as user. Also the electricity e-billing system is connected with electricity department and it will keep the track of SMS, meter reading and bill generated. At end of each month calculated bill is sent to the appropriate user from the server. The GPMC also feature distribution control system which controls the power of the appliance. The system gives meter reading at any time the customer request. The system provide powerful and efficient tool for evaluation and forecasting. It will reduce unwanted power consumption and it is very cost effective method.

In[11] microcontroller ATmega328P and GSM based energy metering system detect and control the energy meter from power theft and solve it by remotely reconnecting and disconnect the line of a perticular consumer. In majority energy theft is important problem because the population increases it will lead to energy consumption high. Therefore utilities in electricity system are destroying the total amount of revenue due to the energy theft. Here single phase digital energy meter use current sensor and voltage sensor to estimate the Kwhr consumed by the applied load. During any unauthorised tapping or access in the service then any of these sensors will give zero and also the product of current and voltage will also zero resulting in no energy measured in the energy meter. Here solid state relay(SSR) is used to disconnect and reconnect the supply line. Arduino continuously monitors the value in the voltage and current sensor respectively then it will displayed on the LCD Display. This system gives the advantages of both hardware and utility and the customer.

In [12] the system uses the GSM technology to automate the energy meter. GSM is efficient technology available since it give the good range for efficient data transmission and large number users can be added. In here the meter readings are automatically sensed and sensed unit sent to the billing point through GSM. Then the corresponding bills are calculated in the units of measure and it will send to the corresponding user at correct time. The digital GSM power meter is installed on every consumer unit. it will work digitally and show the current, power ,voltage on the LCD Display. When the load is applied the electrically powered devices are consume some amount of current. It will automatically sensed by the sensor and sensed units of current can be sent to the billing point also displayed on the LCD.

Utility [13] power metering application is described using the design of high fi electronic current sensor. A low-permeability core material with a current transformer makes up the sensor which yields a tolerance which also ensures immunity to powerful dc magnetic fields. Flux-change sense winding and the secondary winding of the feed-forward of the voltage is used to configure the transformer. The error due to magnetizing current that will be high with a low permeable core will be minimized. Neither core-gapping nor the Hall Effect sensor will be required here. This is a low cost solution since we are combining it with simple analog electronic circuitry. A load management which is intelligent and a power metering utility with a suitable current sensor design. Winding of the flux change sense and the secondary winding which control the voltage of magnetizing branch and magnetizing current error.

In [14] The no of non-renewable energy resources that are available on the earth is limited. Because of that we are in need of ways for the efficient use of energy is SMART ENERGY concept has been introduced for this purpose. For future energy use the need of concepts like SMART ENERGY is critical. This paper presents survey on smart electricity meters. It gives importance to the major aspects like metering process, different stakeholder interest and this purpose. The paper also gives insight on the importance of cloud environments. Even though these concepts have some bad effects in future these concepts will be a way of life for all with the help of the survey conducted and discussed in this paper it helps to identify the current limitations in smart metering.

The design [15] of Automative meter reading based on Zigbee. The implementation of a Wireless Sensor Network (WSN) and on Automatic Meter Reading (AMR) in indoor environments based on Zigbee is described in this paper. Utility data is remotely collected using Automatic Meter Reading. These utilities include water, gas, electricity etc. The main focus is on the electricity power monitoring. Using this we can remotely control power service, monitor power quality which will help the consumes for prepaid billing.

In [16] System adopts a new concept for automatic billing and metering system. The consumer would receive messages about the consumption of power and if it reaches the maximum amount it will alert the consumer to recharge automatically using GSM technology. An overview of prepaid energy meter is discussed. It will minimize the electricity theft with cost efficient manner.

In [17] the method proposed in this paper is a totally automatic identification of consumer load profiles. We can identify load profiles by the data we get from smart meters and develop an interface between consumer and the utilities. The paper helps to TCP/IP sockets through which we can receive data through a client server software interface. The client and server software represents the consumer and utility respectively. To store data of consumers, a database was created. The consumer's load profiles can be read by the utility software from the database. Each month's electricity bill will also be sent through email to the consumer. The introduction of smart meters in the distributed power system made the way to show some benefits of the load profile identification.

In this paper [18] DSM (Demand side management) programs play the significant role in home energy management. For scheduling the appliances of residential user the DSM model uses Evolutionary Algorithms (EAs). Binary practice swarm optimization (BPSO), Genetic algorithm (GAs) and cuckoo search. This also helps to reduce the electricity bill and high peaks. The system will monitor the current and voltage through a sensor for each device. These sensors are measuring the voltage and current state of the EB meter. If any customer consumes more energy an indication will be sent and power will cut-off at certain time.

In this paper [19] use three phase four wire energy meters. The meter reading is sensed in the form of digital domain and these readings are transmitted to the mobile user by wireless GSM technology. Every time the user gets an update of electric energy utilization on this mobile. The controller is used for controlling all functions of meter. The system is divided into four units like measurement unit, controller unit, display and Communication unit. Current and voltage is measured using Hall Effect sensor.

In [20] the main focus of this paper is to make intelligence of regular energy meter. The system gives high mobility, low cost, efficient monitoring and easy maintenance of the total system. The system is controlled by a Bluetooth technology and smart phone. This system gives the line voltage and current by using voltage and a current sensor. These sensors will measure current with respect to the applied load. The sensor is connecting to the microcontroller unit. Every time the measured data is displayed on the LCD display and this will be transmitted to an android device via Bluetooth.

In [21] The smart meter using GSM would give an exact knowledge to people aware of the amount of energy they are using and help to conserve the conventional resources. It will introduce to avoid the disadvantages of a mechanical meter. So it is highly accurate, reliable and tamper proof. The meter has a feature of detecting variations of voltage and current in the distribution system. It is achieved by checking the supply status at the distribution transformer and that at the consumer. The sensed values at power are used to calculate total power consumed by the applied load and calculate the power quality. Automated billing is made by connecting the GSM modem to the residential energy meter.

### III. CONCLUSION

The smart energy meter proposed reduces the human labour load and also makes a more structural and organized method of electricity consumption and billing. The overload and theft detection also gives user security from unwanted treatments. The daily limit gives the user more awareness about their energy consumption and helps them to reduce their over consumption. The automatic disconnection method proposed also helps the electricity board to disconnect those consumers that don't pay the bill in time.

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### REFERENCES

- [1]. Omkar Natu, Prof.S.A.Chavan (2013), "GSM Based Smart Street Light Monitoring and Control System"(IJCSE),187-18
- [2]. NIKHIL.N.PATIL,SUMIT.N.KHAMKAR,DILEEP M.BIND, VIVEK R.KURADE, GANESH L.SONAWANE (2018), "Smart Wireless Electronic Energy Meter" (IRJET),2662-2665
- [3]. Dr.Adithya Tiwary, Manish Mahato, Mohit Tripathi,Mayank Shrivastava,Matnak Kumar Chandrol,Abhitesh Chidar (2018),"Design and Implementation of an Innovative Internet of Things(IOT) Based Smart Energy Meter"(IJFRCSE),244-247
- [4]. M.Faisal ,Thahia Fahrin Karim, Abu Ridwan Pavel, M.S.Hossain Lipu (2019) "Development of Smart Energy Meter For Energy Cost Analysis of Conventional Grid and Solar Energy", (IEEE),91-95
- [5]. Syed Asra Shah (2019)," Automatic Electric Bill Generation System "( IOSR-JECE),75-79
- [6]. Jayant.P.Pawar, Amirthaganes.S, ArunKumar.S, Satiesh Kumar.B(2016)," Real time energy measurement using smart meter"(IC-GET),
- [7]. Pandurang G.Kate, Jitendra R.Rana (2015)," ZigBee Based Monitoring Theft Detection & Automatic Electricity Meter Reading" (ICESA), 258-262
- [8]. Shubham Paturkar1, Subhash Diwakar2, Harshal Nerkar3, Sunita Patil4 (2017) IOT Based Electric Bill Generation (IJARCCE),4

- [9]. Ashna K, Sudhesh N George (2013), "GSM Based Automatic Energy Meter Reading With Instant Billing "(IEEE), 65-71
- [10]. Mr.Rahul Ganesh Sarangle, Prof.Dr.Uday Pandi Khot , Prof. Jayen Modi (2012), "GSM Based Power Meter Reading And Control System" (IJERA), 664-671n
- [11]. Visalatchi S , Kamal Sandeep k (2017), "Smart Energy Meter power theft control using Arduino & GSM" (12ICT),858-861
- [12]. S.P.Karthi, T.Monisha, S.Prathana and T.Radha (2017),"Smart Energy Meter Using GSM" (AJAST),90-94
- [13]. Neville McNeill, Harry Dymond , Philip H. Mellor ,(2011),"High Fidelity Low-Cost Electronic Current Sensor For Uility Power Metreing" (IEEE)2309-2317
- [14]. Damminda Alahakoon, Xinghuo Yu (2016),"Smart Electricity Meter Data Intelligence for Future Energy Systems: A Survey", (IEEE)425-436
- [15]. P.Corrall,B.Coronado,A.C.D Lima, O.Ludwig ,(2012),"Design of Automatic Meter Reading Based On ZigBee", (IEEE)1150-1155
- [16]. Yederi Kavya, Jhansi Pansdiri , "Raspberry Pi & GSM Based Smart Energy Meter For Advanced Metering & Billing System"(IJECEC),84-89
- [17]. Ricardo A.S Fernandes, Ivan Nunes da Ailva , Mario Oleskovicz (2013) "Load profile Identification Interface For Consumer Online Monitoring Purposes In Smart Grids", (IEEE)1-10
- [18]. R.Asha, R.Aruna, J.Divya, K.Balasaranya(2018),"Smart Energy Meter for Advanced Metering & Billing Alert Framework" (IJESC),16541-16544
- [19]. Tejaswini S.Powale, Vrushali B.Shende, Yogesh P.Bawangade, Prof.M.D.Ghatole (2018),"Hall Effect Sensor Based Digital Smart Three Phase Energy Meter" (IRJET), 1948-1949
- [20]. A.A.Noman, M.F.Rahaman,H.Ullah,R.K.Das (2017),"ANDROID BASED SMART ENERGY METER"(ICT-06-NCNST'17)
- [21]. Mrs.Anusha M N, Mrs.Kokila K S, Niveditha G J, Poornima K S, Ranjana B R, Rashmi A J (2018),"Syncretic Use Of Smart Meter For Power Quality Monitoring And Energy Management In Emerging Networks", (IRJET), 4380-4382

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