A Review on Digital Energy Management Systems
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Abstract:
This paper examines the effectiveness of the electricity billing and payment system. In this paper, the proposed concept is to replace the traditional manual meter reading. In every aspect of life automation is required to reduce the work. So we have designed Automatic Energy Meter Reading system. This AMR will overcome the current old method of electricity billing process. It will eliminate the need for employing Electricity Board meter readers and this set of employees can be used elsewhere. The long queues in the billing counter can be avoided by implementing this model. Also the control of the system is fully automated by this technique. This system automatically collects the consumption and status of data from energy metering device and transfer the data to Electricity Board (EB) office. Automated Meter reading systems are an invaluable technological advancement that can lead to a better standard of living, owing to the fact that metering has become a part and parcel of our mundane lives. Moreover it is more economical and helps to save energy in a more efficient and effective way. This paper not only surveys the existing Automated Metering systems but also provides an abstract view of developing the automated meter reading system for improved metering and billing system.

Keywords: AMR, Electronic energy meter, Digital energy meter, GSM

I. INTRODUCTION
Electrical energy has become an indispensable part of life, and among others, it is the most limited resource in most developing countries. An electricity meter, electric meter, electrical meter, or energy meter is a device that measures the amount of electric energy consumed by a residence, a business, or an electrically powered device. Electric utilities use electric meters installed at customers' premises to measure electric energy delivered to their customers for billing purposes. Traditional metering method is not convenient for energy measuring and billing, also more difficult. The measurement of energy consumed by the particular user done manually and data sent to electricity board where the amount is calculated based on the usage of electrical unit. AMR is the technology of automatically collecting consumption, diagnostic, and status data from energy metering devices and transferring that data to a central database for billing, troubleshooting, and analysing. This technology mainly saves utility providers the expense of periodic trips to each physical location to read a meter. Another advantage is that billing can be based on near real time consumption rather than on estimates based on past or predicted consumption. This timely information coupled with analysis can help both utility providers and customers better control the use and production of electric energy consumption. Our paper deals with the implementation of wireless networks in the field of electricity billing. [4]

II. LITERATURE REVIEW
A. Energy Billing Systems
(i) Manual Energy Billing System
The early billing process used to be handled manually. In manual billing process meter readings are taken manually. Same would be entered in the individual ledger. Then the data entry of records and auditing takes place. Then Print the consumer-wise bills. Bills are sent to the respective consumers for making the payments. But there are so many problems with the Manual System. They are; Laborious and time consuming. Visiting the consumer premises to take reading. Data entry from ledger to pc. Printing of bills, Second visit again to deliver the generated bill. Every possibility for manual errors, Complaints on Non-receipt of bills / wrong entries in bills, Could not provide the expected results in so many aspects. Hence there is a desperate requirement for Automated Billing systems. [1]

(ii) Automatic meter reading Technologies
Automated Meter reading systems are an invaluable technological advancement that can lead to a better standard of living, owing to the fact that metering has become a part and parcel of our mundane lives. It solves many issues of the traditional meter reading system like need for human resources, efficiency, accuracy, delayed work, unavailability of customer during metering visit by employee, etc. Moreover it is more economical and helps to save energy in a more efficient and effective way. Furthermore it has a very notable advantage of having the ability to predict the energy demands of the future, starting from every household to the entire planet. Automated meter reading systems have been implemented using many different technologies like GSM, ZigBee, PLC, D-SCADA, WiMAX and Hybrid Technologies that comprises of a mixture of the above. This survey paper describes the working models, strengths and weaknesses of each technology by considering various factors like feasibility, cost, reliability, efficiency, and maintenance and user experience

B. Energy Meters:
Integrating type energy meter is an indicating and recording type instrument. It provides a cumulative value of electrical quantity. It contains a set of dials, pointer, scale or suitable indicator and a
recording mechanism. It indicates the value of the quantity under measurement sum up with previous readings. They were two types namely Watt-hour type energy meter and Ampere-hour type meter.

![Figure 1: Standard Energy Meters](image)

**C. Bluetooth Based Billing System**

Bluetooth technology is a short-range wireless communications technology. It has developed rapidly in attribution of recent years. It advantages in portability, reliability, function and application, and so on.. This method can eliminate the problems such as manpower requirement for billing and errors during calculation etc., and can provide necessary information such as tariff variation and due date for payment etc. to the consumer through the wireless medium. The wireless technology can be implemented by having a Bluetooth enabled transceiver interfaced with the electricity billing section server as well as in the consumer side. In this the energy meter which will automatically sense the energy used in the home and when it reaches to that value which is initially fed in the hardware it will disconnect the power line. A user interface is given in the hardware for user interface which will interact with the use with hardware, through abuser crossing point user can set a value or we can say a credit limit after which the user wants to be clued-up about that. The power burning up measuring circuit will side by side measure the power which is being used in the domicile. The measured values are then sent to the microcontroller for further process which includes comparison of the measured value with the entered one using the PC.[6]This system is designed with two modules which are Consumer module and Electricity Billing Office module.[3]

![Figure 2: Automatic meter reading system](image)

**D. GSM Based Billing System**

The Electricity Meter Reading using GSM system consists of GSM Digital Power Meters installed in every consumer unit and a back end database at the EB office which calculates the amount to be paid according to the number of units consumed. The GSM Digital Power Meter is a single phase digital kWh power meter with embedded GSM modem which utilizes the GSM network to send its power usage reading using Short LED, which indicates the consumption of energy, is replaced by an opto-coupler which produces pulses as energy is being used and transfers to the MSP430 microcontroller. The counter which counts the number of times the LED blinks and sends the data to the MSP430 microcontroller. This is received by the controller as an external interrupt. The controller is so programmed that it calculates the amount based on the number of units consumed. These details will be displayed on the LCD panel attached to the home module too. The Electricity Billing Office module consists of a database at the back end for storing values which are got from the home module via Bluetooth. The Electricity Billing Office Side Module is designed to work as follows; The receiver module is interfaced with a system which is monitored by the officials in the electricity board. The Bluetooth transceiver on the Electricity Billing Office module receives the data and displays it in the terminal C window of the system interfaced with it. The home module will be reset by the Electricity Billing Office officials as the bill is paid. The thing to be noted here is that only when the command is given, board will supply power to the particular customer. Else the supply will be disconnected until the payment of the bill. There by we contribute a small part to prevent the power crises as well[7]

![Figure 3: Consumer Module](image)

![Figure 4: Office side module](image)
Messaging Service (SMS) back to the energy provider wirelessly. The user interface also consists of LCD which displays the amount of power consumed. To achieve efficient meter reading, reduce billing error and operation costs, an Automatic Electric Meter reading system can be introduced with every energy meter in an area. It is an effective means of data collection that allow substantial saving through the reduction of meter re-read, greater data accuracy, frequent reading, improved billing and customs service, more energy profiles and consumption trends updates and better deployment of human resource.

![Figure 5: Electric Meter using GSM](image)

Electricity meter reading using GSM implements the emerging applications of the GSM technology. GSM is a Global system for mobile communication (GSM) and is a wide area wireless communications system that uses digital radio transmission to provide voice, data, and multimedia communication services. A GSM system coordinates the communication between mobile telephones (mobile stations), base stations (cell sites), and switching systems. Each GSM radio channel is 200 KHz wide channels that are further divide into frames that hold 8 time slots. The GSM system includes mobile telephones (mobile stations), radio towers (base stations), and interconnection switching systems.

**E. Power Line Communication Method**

Power Line Communication Systems use the existing power cables as a communication medium. This ultimately allows us to both control the devices remotely and also retrieve data from it in a half-duplex manner. PLC is like any other communication technology whereby a sender modulates the data to be sent, injects it onto medium, and the receiver de-modulates the data to read it. The main advantage of PLC is that the existing wiring can be re-used. Thus Power Line Communication can be used to transfer meter readings data to the central servers along with the use of GSM/GPRS. The data from every meter is collected using PLC. This data is then transferred to a central server using GPRS connectivity. The server in turn feeds the data to service provider’s billing servers thus creating a totally automated and reliable measurement and billing infrastructure. Value added services can be used to send alerts for prepaid users, SMS facility to switch off gas supply, alerts on gas leak detection and automatic switching off gas supply, credit card payment facility. [8]. Power line communication is an emerging home network technology that allows consumers to use their already existing wiring system to connect home appliances to each other and to the Internet. For communication purpose electrical power supply network is used in power line communication. Reduction in operational costs and expenditures for communication is the main thing in power line communication. For internal communication of electrical utilities, remote measuring and control task high, medium and low voltage supply have been used. PLC is also used in internal electrical installation within buildings and homes called in home PLC for various communication application.

![Figure 6. Power Line Communication System](image)

**F. Energy Billing using Wi-Fi**

Wi-Smart is a versatile platform which can be used by a variety of electrical home appliances in order to provide wireless TCP/IP communication using the 802.11 b/g protocol. Devices such as the Smart Thermostat permit a utility to lower a home’s power consumption to help manage power demand. The city of Corpus Christi became one of the first cities in the United States to implement city wide Wi-Fi, which had been free until May 31, 2007, mainly to facilitate AMR after a meter reader was attacked by a dog. Today many meters are designed to transmit using Wi-Fi, even if a Wi-Fi network is not available, and they are read using a drive-by local Wi-Fi hand held receiver. The meters installed in Corpus Christi are not directly Wi-Fi enabled, but rather transmit narrow-band burst telemetry on the 460 MHz band. This narrow-band signal has much greater range than Wi-Fi, so the number of receivers required for the project is far fewer. Special receiver stations then decode the narrow-band signals and resend the data via Wi-Fi. Most of the automated utility meters installed in the Corpus Christi area are battery powered. Wi-Fi technology is unsuitable for long-term battery-powered operation. [2]

**III. CONCLUSION**

Electricity becomes unavoidable agents of convenient living. The present traditional billing systems have many problems like problem of payment collection, energy thefts etc. due to which the traditional billing system is slow, costly and unreliable. So it is essential to develop a billing system which solves the problem of billing manually and also reduces the manpower. The remedy for all these problems is to keep track of the consumers load on a timely basis, which will help assure accurate billing, track
maximum demand, and detect online theft. These are all the features to be taken into account for designing an efficient energy billing system. This can control the usage of electricity on consumer side to avoid wastage of power. Installed energy meters by electricity companies do not have effective security or tamper-evident integrations and consequently breed free usage and illegal connections. This study is expected to aid electricity companies in their policies, and also trigger future studies into the technicalities of electricity billing and payment systems. We recommend temper-impossible energy meters for better billing.

IV. REFERENCES

[1]. “Handbook for Electricity Metering” by The Edison Electric Institute, The Bible of electric meters, continuously updated since electricity was discovered


