Smart Electric Meter Reading and Monitoring

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ABSTRACT: Without Electricity nothing is possible, so it is very important to save Electricity and use it properly. So we can help our next generation for their life. In each and every equipment Electricity is important like to rotate Fan it is required to charge cell phone it is required. That's why it is very important to reduce misuse of Electricity and try to use natural energy. But each and every situation natural energy is not suitable so that there is need of Electricity. Solar energy is one of the best option but in rainy season it faces some problems. So monitoring of Electricity is very important task in our day todays life. So for that some advanced technology is required to measure Electricity accurately and monitor it properly.As compared to electromechanical meters automated meter reading systems (AMR) are more accurate and real time system that are utilized in developed countries. The advantages these electric metering system offers make it a more accurate measuring device than the conventional electro-mechanical meter reading system being used in developing countries like India. AMRs capacity to automatically transmit data real time increases the reliability of this metering system, unlike electromechanical meters which occasionally make use of previous readings as a basis of the consumer's current billing. It also puts consumers at a disadvantage as the accuracy of power consumption readings is being compromised. The integration of ZigBee protocol in single board computer Raspberry Pi, through the programming language Python, has successfully facilitated the reading and wireless transmission of the voltage or power consumption of the user. Through Python, the raw data transmitted to the coordinator ZigBee is then converted to a CSV file, the data type required by the MySQL database for the received data to be uploaded on PC.

KEYWORDS: Receiver, Transmitter, Transceiver, Automated Meter, Wireless Transmission, Monitoring System

I.INTRODUCTION

A. BACKGROUND OF THE STUDY

As nowadays electricity requirement increased than few years back from now. Electric meters is the device that used for creating the billing charges, that billing charges are on a month basis & that is computed in terms of kilowatt-hours (kWh).Automatic meter reading (AMR) it is the creation or new invention of automatic collect information of energy meter. After that the collected information is send to base station for other analysis. The main aim is not to reduce manpower its main aim is to collect data from different and difficult places which is not possible or difficult to collect from the premises or from any other places. AMR system is not used only for electric power measurement it is also used for many application like water uses that is consumption of water in developed countries. AMR system is mainly designed for reduce problems of accuracy of meter reading data. To get these requirement, ZigBee model is integrated in a Raspberry Pi single-board computer (SBC).

B. PROBLEM STATEMENT

As seen in Developing country, electro mechanical meter reading systems is present in premises of consumers and information is collected by using man power in each month. So, that meter has some disadvantages like:

Meter reader person must be required to read that meter of each consumer for reading power consumption. By using of electromechanical meters meter reading changes and errors are more. Calculated bill is used at time when extreme weather conditions occur and meters to be read are not easily accessible to the reading - so it is problematic for consumer and supplier. Nowadays wireless technology is invented and this wireless technology is widely used for AMR systems and for many other applications in the developed countries but now also used in the developing countries.

C. SIGNIFICANCE OF THE STUDY

A smart meter is an electronic device that records consumption of electric energy in intervals of an hour or less and communicates that information at least daily back to the utility for monitoring and billing.Smart meters enable two-way communication between the meter and the central system. Unlike home energy monitors, smart meters can gather data for remote reporting. Such an advanced metering infrastructure (AMI) differs from traditional automatic meter reading (AMR) in that it enables two-way communications with the meter. The term Smart Meter often refers to an electricity meter, but it also may mean a device measuring natural gas or water consumption.

Similar meters, usually referred to as interval or time-of-use meters, have existed for years, but "Smart Meters" usually involve real-time or near real-time sensors, power outage notification, and power quality monitoring. These additional features are more than simple automated meter reading (AMR). They are similar in many respects to Advanced Metering Infrastructure (AMI) meters. Interval and time-of-use meters historically have been installed to measure commercial and industrial customers, but may not have automatic reading.

Research by which the UK consumer group, showed that as many as one in three confuse smart meters with energy monitors, also known as in-home display monitors. The roll-out of smart meters is one strategy for energy savings. While energy suppliers in the UK could save around £300 million a year from their introduction, consumer benefits will depend on people actively changing their energy use. For example, time of use tariffs offering lower rates at off-peak times, and selling electricity back to the grid with net metering, may also benefit consumers.

II.METHODOLOGY

A. Overview

To remove human fault in the conformist metering system, this AMR scheme contributing ZigBee as a wireless protocol is premeditated and established in this. Two common parts will be the significance of this reading. The block diagram of the premeditated design is shown in Fig. I. It includes of 2 imp parts, the transceiver which can performing as Transmitter (premises unit) and a router (for extensive distance dedications) and the receiver (server database at the billing office of the supplier electric company).The key goal of the scheme is transmitreal timemeter readings of meter by using wireless communication to the base station of the electricity company.

Fig.l. General BlockDiagram

At the positions unit where metering data are met and handled, records are formerly diffused by ZigBee, after which, the expected data is sent to the PC. The said premise unit is also a unit casing the geographical zone which receives information from the source and passes that files to receiver since each sites division capacity have partial range of wireless coverage to transmit info straight to the checker. The member of staff serving at table of server in the billing office will be extremely- safe databank structure which allows official team members of the electrical energy provider firm to reading and printing that electrical energy bills.

B. LEVELS OF THE STUDY

The stages of this reading, shown in Fig. 2, it will starts since the strategy and construction of the two main parts: the transmitter and the controller or the reception end. The databank server and observing scheme is the subsequent stage. Finally, it will over and done with the estimate of the recommended reading.

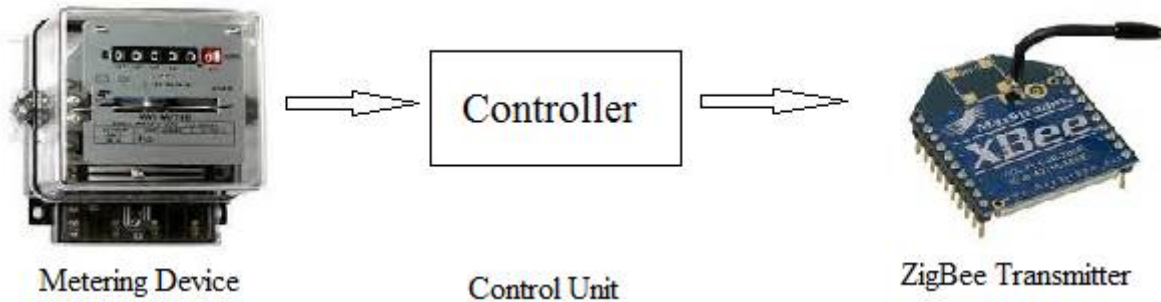**Phase 1: Design and Creation of the Transmitter/Router**

Fig 2. Transmitter Block Diagram

A block diagram of the transmitter is shown in Fig. 2. Its required function is to send the files that actuality measured to the receiver end. Mostly, it also includes Metering Device, Controller Unit that controls the communication from Tx end to Rx and ZigBee section that helps as the transferring chip&. When data transmitted through wireless communication over lengthy distances, it is essential to consume some apparatus at determined distances from the source for the moment reception& retransmission of information to the selected receiver. In that method, the said transmitter can also doing as a router, so at the time of execution of the scheme, each locations division can be designed to act both as a sender (when transmitting its data) and a router (for temporarily reception/retransmission of documents upcoming from other adjacent locations divisions) at dissimilar times.
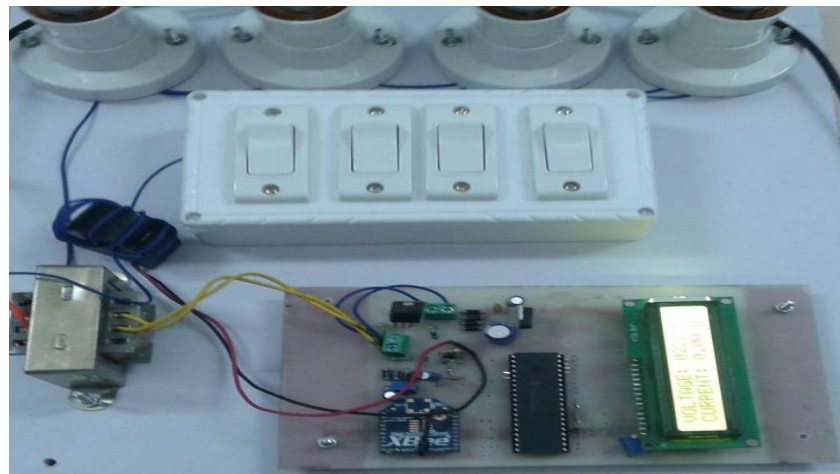
a) **Metering device/sensor**

Fig.3. Connection Interface between Metering Device

Smart meters go a step further than simple AMR (automatic meter reading). They offer additional functionality including a real-time or near real-time reads, power outage notification, and power quality monitoring. They allow price setting agencies to introduce different prices for consumption based on the time of day and the season.

Another type of smart meter uses nonintrusive load monitoring to automatically determine the number and type of appliances in a residence, how much energy each uses and when. This meter is used by electric utilities to do surveys of energy use. It eliminates the need to put timers on all of the appliances in a house to determine how much energy each uses.In this study, sub meters will be used. The first sub meter will be located at a place which is less than the maximum range. The second sub-meter will be located somewhere at the middle of the maximum range that could test the part where the said transmitter can act as a router. The third sub-meter will be located at exactly the maximum range of Zig8ee module transmission.

b) *ZIGBEE MODULE*

ZigBee Module is a low-cost, low-power, wireless mesh networking standard. The low cost allows the technology to be widely deployed in wireless control and monitoring applications, the low power-usage allows longer life with smaller batteries, and the mesh networking provides high reliability and larger range. Temco has developed a embedded antenna of wireless data communication module, which adopts standard ZigBee wireless technology. This module is in line with the Industry Standard applications of wireless data communication module.

This module can achieve transparent data transmission between many devices, and it can form a MESH network. This device has the characteristics of small volume, ultra-low power consumption and low-cost. It can be either as an independent data transmission termination or be easily embedded into a variety of products to form a short-range wireless data transmission solution.

Phase 2: Design and Creation of Receiver
a) Receiver ZigBee

For the receiving end, a ZigBee module identical with the ones on the transmitting unit is used to ensure compatibility of the two modules. This allows the periodically-transmitted meter reading to be received and send a command from the receiving end to the transmitting end whenever the user prompted it to send a reading at any given time.

b) Raspberry Pi

The Raspberry Pi 2 delivers 6 times the processing capacity of previous models. This second generation Raspberry Pi has an upgraded Broadcom BCM2836 processor, which is a powerful ARM Cortex-A7 based quad-core processor that runs at 900MHz. The board also features an increase in memory capacity to 1Gbyte.

The Raspberry Pi is a credit-card sized computer that can be connected to electronic devices. [8]. its main function is to control the communication between the transmitter and the receiver. Also, it controls communication between the transmitter and the other router whenever the ZigBee module cannot transmit wirelessly over the distance. The program on the Raspberry Pi reads the energy consumption, transmitting time and the processed output in digital form are sent to the personal computer through ZigBee transmission. Another feature of Raspberry Pi is that it has its own Random Access Memory (RAM) where data could be stored. It uses Python as its programming language which emphasizes code readability, and its syntax allows programmers to express concepts in fewer lines of code than would be possible in languages such as C.

III. CONCEPTUAL FRAMEWORK

An automated meter reading system was used to measure the voltage outputted by an electric outlet for accurate recording of real-time consumption of electricity. The AMR utilizes RS232, which uses few wires by means of serial transmission method, to transfer the data collected to the Raspberry Pi, that is why a crossover must be executed to make the data format collected from the AMR transferrable to and readable by the Raspberry Pi and also to facilitate bidirectional communication between the two. The transmitter (L), receiver (Rx), and ground wires of RS232 were connected to DB9 to establish communication between the two devices. Since the RS232 to DB9 connection makes use of the serial transmission method, a serial to USB converter was used to make the connection fit to the USB hub of the Raspberry Pi. To make the data wirelessly transferrable, a ZigBee was attached to the Raspberry Pi. Raspberry Pi alone does not have the capability to transmit and receive data, so a Raspberry Pi used to interface the Raspberry Pi and ZigBee, since the ZigBee module has bot transmitter and receiver capabilities. The collected data will then be transmitted to another Raspberry Pi for the uploading of the collected data to the online database where consumers can access and monitor their voltage usage based on real-time consumption. The meter will start reading the voltage consumption of the user. The data read will be directed to the Raspberry Pi's SO memory card. The coordinator will send then send a query. If the end devices receive the query, it will respond and will be prompted to send information the ZigBee module. Otherwise, the reading of the metric data will repeat. Once the end device has responded to the coordinator query, data willbe forwarded to the ZigBee module then to the coordinator.

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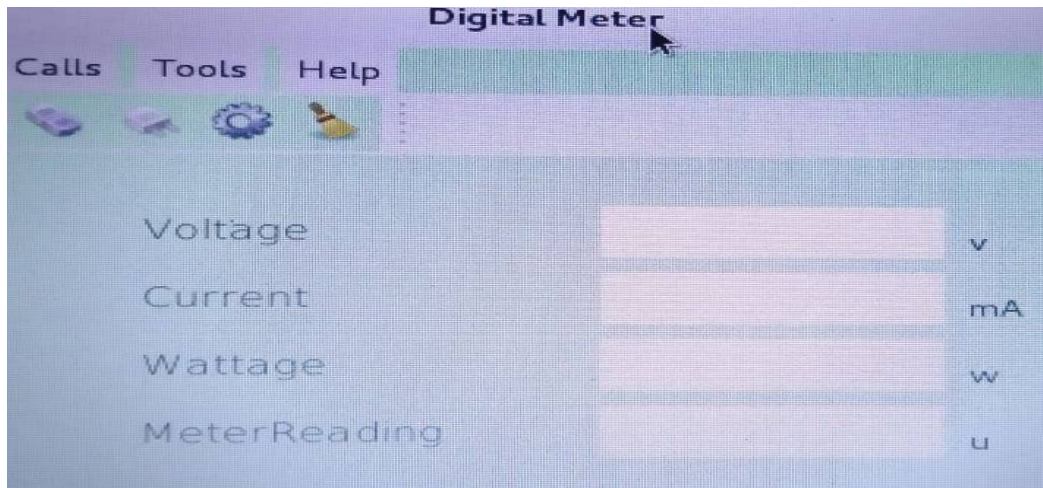
Fig.4 Personal Computer Screen of Digital Meter

IV. RESULTS

Three loads-a charging laptop rated at 76Wh, a charging cellular phone rated at 4Wh, and a lamp rated at 9Wh-were connected to the meter. Twelve (12) trials, each lasting for five(5) Minutes, were carried out to complete an hour of consumption. Theoretical readings were obtained by adding the previous reading to the product of 89Wh and the fraction of hour the trial lasted.
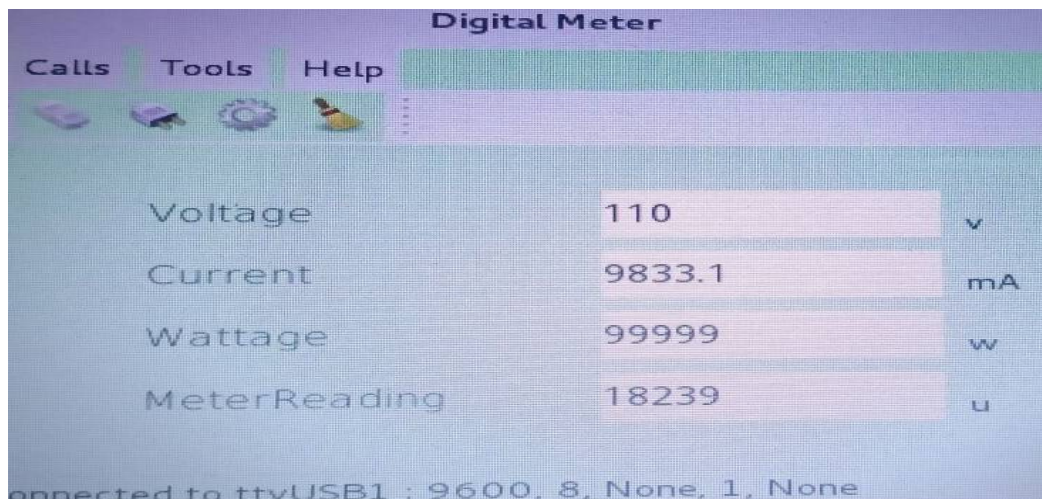

Fig.5Personal Computer Screen output

V. CONCLUSION AND RECOMMENDATIONS

The AMR system, which consist ZigBee module in a Raspberry Pi,been cleary implemented. The Raspberry Pi-to-Arduino Shields connection bridge interfaced the ZigBee module to the Raspberry Pi. The use of the ZigBee module used to the wireless transmission of the meter data possible. The transmitted data were received by the coordinator Zig8ee and were converted into CSV file through Python. The CSV file was utilized so data, specifically the voltage consumption, can be accessed by consumers.

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