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# **An Intelligent System for Energy Monitoring and Metering through Android and GSM Technology**

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**ABSTRACT:** In this modern world everything is automated and the technology has merged itself with the daily life of humans, so in this paper we intend to fuse our present technology into the existing functionalities of Tamil Nadu Electricity Board to enhance their operations effectively. The operations like waiting in a long queue for payment, forgetting to remit the bill on time, absence of family member during the time of meter reading and so on can be resolved permanently. We here with propose an Intelligent System for Energy Monitoring and Metering in which the Energy consumption can be automatically read from the energy meter fixed in their houses and the bill can be generated and dispatched to the customers through wireless technology. This methodology is highly beneficial to the customer in that he can visualize the energy consumption and the cost well in advance in his Android Mobile regularly with the help of BlueTerm application in order to alert him to minimize the energy consumption according to his budget . The existing manual system in Tamil Nadu has major drawbacks. This system is prone to errors and can also be easily manipulated. The prevailing manual system also requires lot of human workforce. The major disadvantage in this system is that the meter cannot be accessed by the meter reader if the customer is not present at home.

**KEYWORDS:** Intelligent System, Wireless Technology, Android, Blueterm application.

## **I. INTRODUCTION**

The main aim of this paper is to make use of the new modern technologies and implement them into more practical fields which is completely user friendly and cost effective. Our project deals an Intelligent System for Energy Monitoring and Metering in which electricity billing becomes fully automated and data transmission is made possible via Global System for Mobile Communication (GSM) and Android Technology where the user can also have an update of his meter reading then and there including the cost of consumption per unit. We can make use of this technology to such an extent such that even complex problems can be handled in an easier way, Intelligent Meter Reading (IMR) in very simple terms emphasizes the meter reading aspects of a particular utility function with the absence of any human intervention. IMR is the remote collection of consumption data from customers' utility meters with GSM. Meter reading is all about communication, that is, the accurate conveying of information from thousands of separate locations (the meters) to one location (supplier's office). IMR systems are best classified by which technology links that are used to communicate. In this system the EB officer need not come and visit every house for collecting Meter reading and which reduces lot of human workforce and there by increasing the efficiency by eradicating all the drawback in the existing system.

## **II. RELATED WORKS**

The currently prevailing system involves the user to go up to the EB office to manually pay his bill. The readings are taken using the analogue meter present in the customer's house. The readings are taken using an employee working at the EB office. This system has a set of disadvantages which are given below:

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*Erroneous Readings* – This involves errors present in the meter reading which are committed due to human mistakes.

*Easy Manipulation* – Since all data here are taken manually, the dates can be easily manipulated by third party, which affects the EB office and the customer.

*Manual Labor* – The amount of workforce involved in this prevailing EB system is too large as the EB people have to visit many areas at roughly the same date.

*Time Consuming* – This system takes a lot of time to go personally to the customer's house and take.

## 2.1 Ad-hoc Wireless Routing

Using Ad-hoc wireless routing [13] the system is partially automated and the communication is made possible entirely through the power line [8]. This communication is bi-directional at a faster data rate through long distances. By digitizing, the currently used analog energy meter has been completely transformed to a digital one.

Since this system uses AD-HOC WIRELESS ROUTING large amount of data's cannot be transferred at the same time which causes overhead and leads to collision there by missing the data's that eventually leads to missing of the EB meter reading.

## 2.2 Renewable Energy Applications

This paper is trying to introduce the application area of smart meters to the Renewable Energy [6] applications in which the wireless GPRS communication link was introduced for the remote connection to collect the data [12].

**Communications:** RS232/485 or Ethernet with protocol for data uploaded. The types of protocol can be IEC or DNP, MOSBUS depends on the applications. One additional point is to access the data from INVERTER via open protocol. Therefore, optional integrator may be needed in this case.

**Remote control:** smart meter can be used as control unit for lighting, heating system and air conditioning units. Remote setting and control schedule can be setup via the communication.

**Import/Export:** it has the ability to measure electricity flowing to decide whether it is import/export energy from the customers' premises and to support utility tariffs calculation when renewable energy source such as PV or wind energy are available.

**Remote connect/disconnect:** it is the ability for the electricity supply to be cut off and restored remotely when tenants move in and out.

**Outage detection:** to allow utilities to monitor the status of each meter to know whether the circuit is outage or in normal operation.

**Power Quality recording:** the ability to detect the sag/swell, outage and transient, etc and to capture the event. If it cause the problem to the tenant/business and utilities may provide solution to the customer in future We need a Data traffic and routing management server and In case that the communication has problem or outage/ tripping problem happen, it may need the on-site repair of the circuit. These record may be useful for the traceability of the event happened and the load profile to indicate the loading usage or the issue of from the renewable source

## 2.3 ARM Controller

This paper uses an ARM [3] [1] processor based board is used. It uses a 32-bit processor with on-chip ADC [4], timer/counter module, PWM and UART module to interface a GSM modem and energy meter in which the service provider can now inform the customer regarding the current bill or status using the customer's registered phone number by either a message or a phone call.

Since this system uses lot of processors its not cost effective.

## 2.4 Voltage Distribution Network - PLC

This paper tells there are many different forms of communication links that can be utilized as the communication medium in an AMR system. One such link is the power line carrier or PLC [11]. The advantages of

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using the PLC as the communication medium is readily apparent since the power line network is the property of the utility company and its infrastructure is already there.

Power lines are never meant for communication and which creates much noise. Therefore, various modifications have to be made to make the PLC suitable to be the AMR communication channel.

## 2.5 Zigbee and Bluetooth

Using Zigbee and Bluetooth[2][5][7] they retrieve the meter reading with little human intervention, are proposed and implemented in the targeted applications PC, will poll each and every individual Bluetooth Energy Meter[9][10] automatically regularly in order to get the meter reading of the corresponding households.

In order to facilitate the work of retrieving the meter reading with little human intervention, two useful techniques are developed. They are AMR (Automatic Meter Reading) and the APM (Automatic Polling Mechanism). Few commercial applications are suggested to apply for the Bluetooth-Enabled Energy Meter.

## III. PROPOSED WORK

To implement this system, a pic board is used. It uses a 32-bit processor with on-chip ADC, timer/counter module, MAX232 and RS-232 module to interface the GSM modem and the energy meter. In the energy meter the IR sensors are used to calculate the power consumed and these pulses are fed to PIC microcontroller which is programmed to count these pulses. The system reads these pulses and after counting specific number of pulses it converts it in to number of units consumed and the PIC microcontroller program. the cost is also calculated in

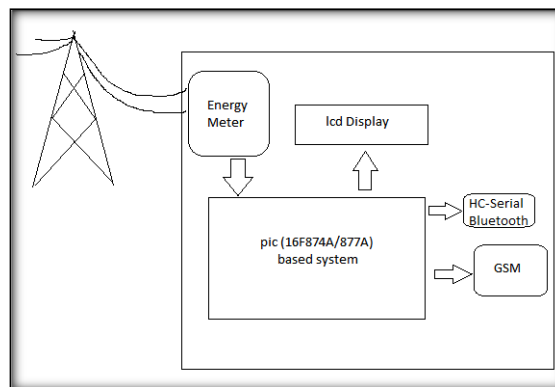


Fig.1 Block Diagram

The MAX232 acts as an interface between GSM modem and the PIC microcontroller, Now the PIC microcontroller reads the number of units calculated and sends the data to the MAX232 further MAX232 sends the data to the GSM modem which sends the energy meter reading of the consumer to the service provider and the service provider maintains a database of all the customers power consumption and the readings are fed automatically with the help of wireless transmission. Fig.1 shows the Block Diagram of the Intelligent Energy meter system. An LCD is connected to the PIC Microcontroller which shows the meter reading of the consumed electricity on the Energy meter System.

We use a Bluetooth HC-Serial port in the PIC Board which integrates the consumers Android mobile with the help of Bluetooth to connect this we use a RFCOMM/SPP protocol which helps in serial communication over Bluetooth and we use a BlueTerm application which displays the energy meter reading and cost calculated per unit on the mobile screen this helps the user to know his power consumption and the cost per unit in his Android mobile using the BlueTerm application.

The Working Module of Intelligent Energy Meter is shown as a flow chart in the Fig.2 where the IR sensor is used to calculates the meter reading and the values are stored in the PIC microcontroller and the received value is fed to

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the GSM modem and displayed on the LCD as well as these values are send to the users Android mobile via the Bluetooth Modem and the user can know the up to date power consumed and the cost per unit in his mobile with the help of BlueTerm application.

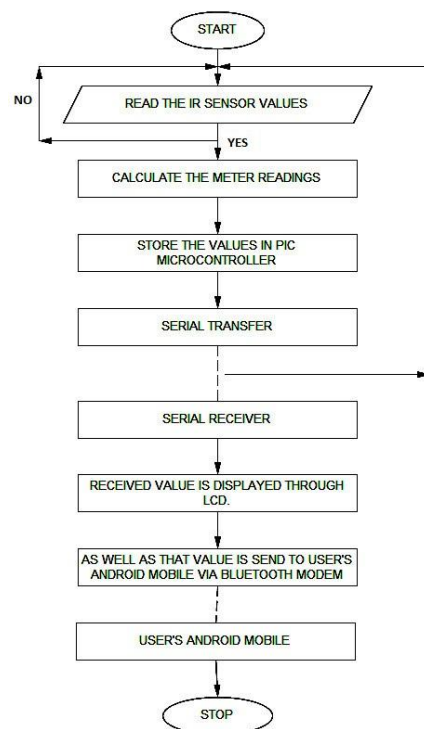


Fig.2 Flow Chart

## IV. FUNCTIONAL MODULES

The following Fig.3 and Fig.4 shows the Overall Functions between the Intelligent Metering System with the Office Server and EB Meter to the User Interface Module.

### 4.1 Overall Functions on Intelligent Metering System

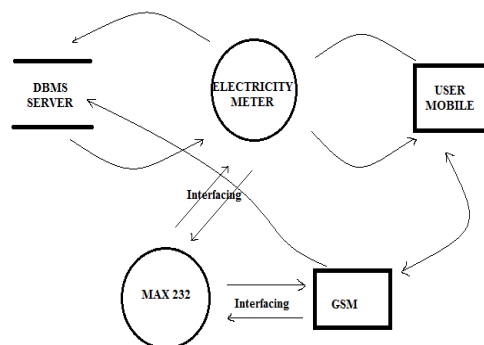


Fig.3 Overall Functions on Intelligent Metering System

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### 4.2 EB Meter and User Interface Module

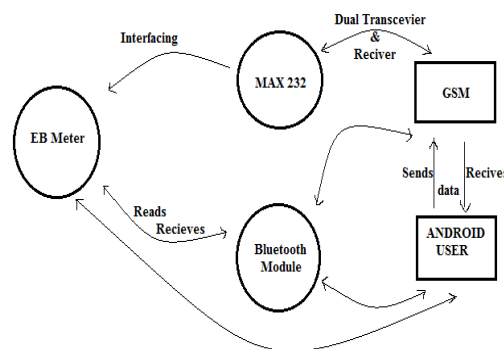


Fig.4 DFD for EB Meter and User Interface Module

## V. THE DESIGN OF HARDWARE

The Consumers energy meter reading consists of three modules, intelligent data acquisition, data storage and data transfer through GSM.

GSM module uses WAVCOM GSM/GPRS (900/1800 range) modem for wireless transmission of the meter readings which has Dimensions B x H x T 115mm x 54mm x 33mm, Weight 130g, Power Supply: 10,8...31,2 V/DC (worst case, including application board on basis DS 87C520/PLCC44) 325 mA transmit mode 10,8V 47 mA idle mode 10,8V. This modem helps in transmitting the meter readings to the service provider automatically and the service provider receives it and updates it at regular interval of time.

The energy meter reading is calculated with help of IR sensors which has an IR emitter and IR phototransistor, An infrared emitter is an LED made from gallium arsenide, which emits near-infrared energy at about 880nm. The infrared phototransistor acts as a transistor with the base voltage determined by the amount of light hitting the transistor. Hence it acts as a variable current source. Greater amount of IR light cause greater currents to flow through the collector-emitter leads. So in between the IR emitter and IR phototransistor we mate a disc to rotate by cutting one edge of the disc at the cutting edge the IR emitter and IR phototransistor meets and the count is stored and ten count is taken as one unit and stored in Pic microcontroller there by calculating the power consumption and the cost. As shown in the Fig.5 below, the phototransistor is wired in a similar configuration to the voltage divider. The variable current travelling through the resistor causes a voltage drop in the pull-up resistor.

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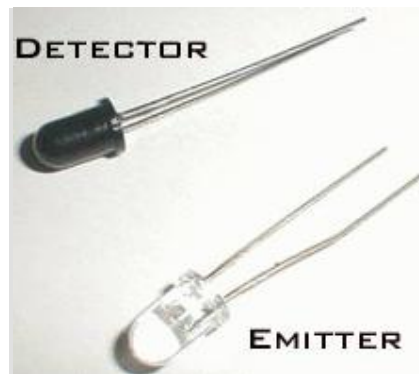


Fig.5 IR Sensors

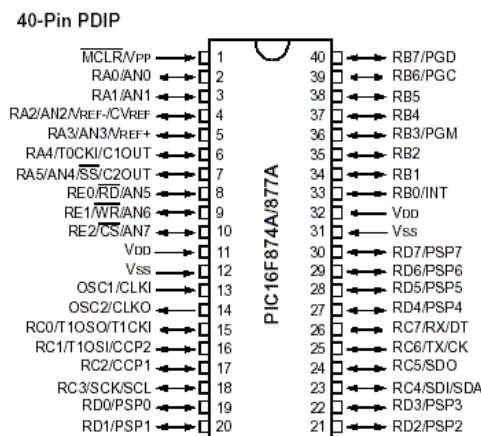


Fig.6 Pin diagram of PIC16F874A/877A

The Data that is collected needs to store the received data and send to the service provider so in order to store and calculate the cost of power consumption we use PIC16F874A/877A which is shown in Fig.6.

In order to send the energy consumption from the PIC microcontroller to the GSM modem MAX232 interface circuit which has dual transceiver and receiver that helps in transmitting and receiving the data from and to the supplier side, Fig.7 shows the pin diagram of MAX232 interface circuit.

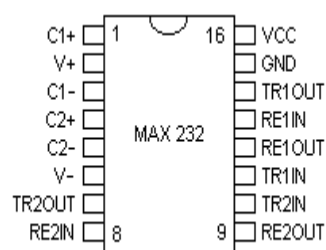


Fig.7 MAX232 Pin diagram

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The transmitters take input from controller’s serial transmission pin and send the output to RS232’s receiver and to the GSM modem. The receivers, on the other hand, take input from transmission pin of RS232 serial port and give serial output to microcontroller’s receiver pin. MAX232 needs four external capacitors whose value ranges from 1μF to .22μF, Fig.8 shows the Pin diagram of RS232 serial port.

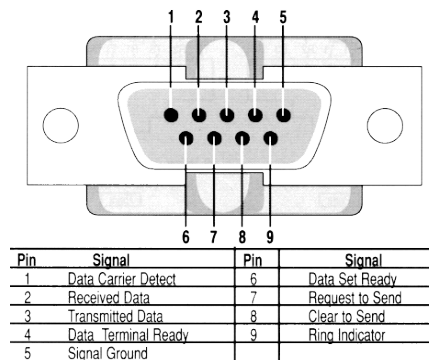


Fig.8 RS232 Pin Diagram

We use GSM modem for wireless transmission of the data to the supplier side with the help of WAVCOM GSM/GPRS modem (900/1800 range) with Dimensions: B x H x T 115mm x 54mm x 33mm, Weight: 130g, Power Supply: 10,8...31,2 V/DC (worst case, including application board on basis DS 87C520/PLCC44) 325 mA transmit mode 10,8V 47 mA idle mode 10,8V. The GSM modem is connected to the PIC board with RS232 Serial port.

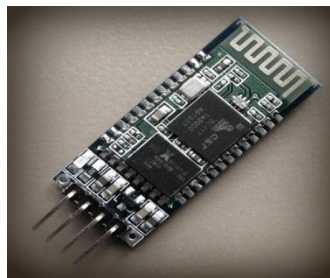


Fig.9 HC-04 Bluetooth interface

The above Fig.9 shows the HC-04 Bluetooth interface module used in order to pair the consumers Android mobile which displays the energy meter reading and cost calculated per unit on the mobile screen this helps the user to know his power consumption and the cost per unit in his Android mobile using the BlueTerm application, the Fig.10 shows screen shot of the BlueTerm application example.

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Fig.10 BlueTerm application example.

## VI. CONCLUSION AND FUTURE WORK

Thus the Intelligent System that uses Android and GSM Technology performs energy monitoring, profiling and control system with the help of Android and GSM technology. This System will help to avoid EB officer visiting every house or industry for calculating the Power consumption which gives,

Precise consumption information

Clear and accurate billing

Automatic outage information and faster recovery

Better and faster customer service

Up to date power consumption and cost in users Android Mobile.

For the future generation we can interface the BSNL land line or Wi-Fi modem with the EB meter since the BSNL Tele services are establishing its communication network all over India which will avail cheaper and faster data rates.

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