



## RESEARCH ARTICLE

### A SMART METER SYSTEM USING GSM AND WI-FI MODULE WITH INSTANT BILLING

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#### ABSTRACT

The technology of Electronic Metering has gone through rapid technological advancements and there is increased demand for a reliable and efficient Automatic Meter Reading system. This system presents the design of a simple low cost wireless GSM energy meter. The proposed system replaces traditional meter reading methods and enables remote access of existing energy meter by the energy provider and also it offers additional functionality including real-time reading, power usage notification etc. Also they can observe the meter readings frequently without the person visiting each house. The accurate functioning of electric meter is controlled by a specially designed IC called ASIC. Usually Person will come from the MSCB office and take the readings from meter and then analyses the reading, generate the bill. This process will take more time as compare to smart meter system. To reduce the time smart meter system is used. In this proposed system the time required to generate the bill is reduced. The measurement system is an ARM7 based wireless technology that incorporates with disconnecting meter via esp8266 web page application & alert via SMS network. This system is time saving and work reducing.

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## INTRODUCTION

Electricity is become crucial part of our life. Apart from efforts taken to fulfil the increasing demands, automation is requisite in the energy distribution to upgrade our life standards. Conventional meter reading for utilization and billing is done by human operator from home to home and building to building. This requires very large number of workforce and additional time to achieve entire data reading and billing. Human operators are incapable to encounter the future suburban development requirement. To fulfil the requirement Automatic Meter Reading (AMR) system was introduced, which has huge demand as compare to the conventional meter reading. AMR system collects the meter reading electrically without human operator.

#### Objective of this system is as follows

- Real time data handling and security.
- To create real time communication.
- To implement and install smart grid based on new system in industry or buildings to insure better productivity.

#### Smart Meter –Architecture

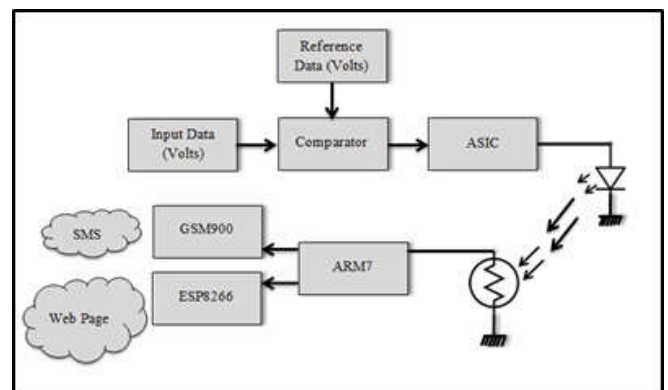


Fig.1. Overview of Proposed System

The block diagram of the Smart Meter Device is illustrated in fig1. The Input data (Volts) is compared with programmed Reference data (Volts) and the Voltage Rate will be given to the output. This output is then converted into Digital Data by the Analog to Digital Converters (ADC) present in the ASIC. This digital data is converted into a Mean value. Mean Value are the measuring unit of power. The output of ASIC is available as "Pulses" indicated by the LED (Light Emitting Diode) placed on the front panel of Digital Energy Meter. These pulses are equal to Average Kilowatt Hour (kWh/unit). Output of ASIC is taken by a LDR (Light Dependent Resistor) photoresistor which is available in the form of blinking of

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LED. Instead of LDR we can directly send Pulses to an input port of ARM7 just by connecting output port of ASIC to the input port of ARM7. LCD display is used to display the energy consumption, date and time. The GSM900 is used to send appropriate bill to user with SMS (Short Message Service). Esp8266 is used to send bill on the web server where the generated bill is display in the form of graph to know the provider how much bill is generated. With the SMS the last date of bill payment is also given to the user. If bill is not paid on time, then provider can turn-off meter with another esp8266 module with its controlling web page where the switches buttons are given to close the particular meter. After paying bill the meter will be turn-on by same web page.

**1. Calculation of Conventional metering**

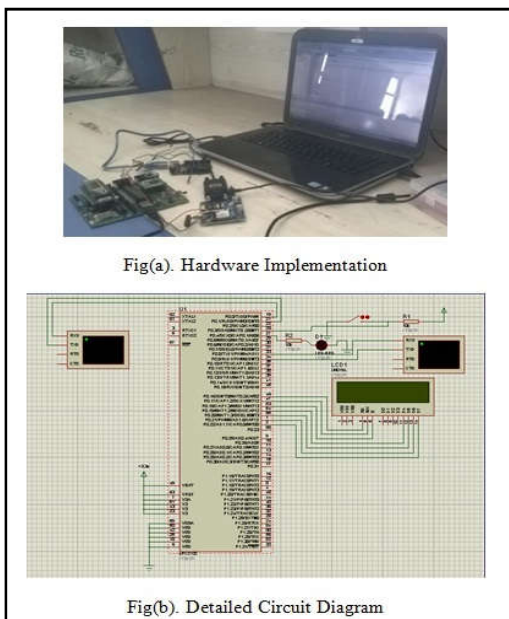
Used watt x 24 hours = watt-hours per day  
 Watt-hours per day/1000 = kWh per day  
 kWh per day x 30 days = kWh per month  
 kWh per month x Rs. KWh=Rs. Per month

**2. Calculation of Smart metering**

Blinking of LED = 1000 = 1 Units  
 1 Units = 1 kWh  
 1 kWh = 1,000 Watt hours  
 Units x Rs. Units = Rs. Per month

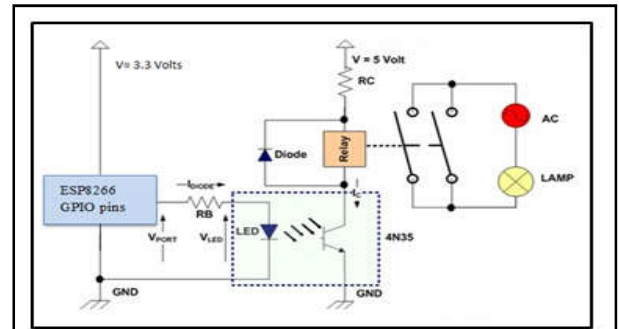
**Hardware Implementation**

Fig.2. (b) shows the detailed implementation circuit. This system is connected with an electricity (energy) meter. A LDR (Light Dependent Resistor) is coupled with the LED (Light Emitting Diode) which is on the front panel of energy meter. The combine circuit of LED and LDR acts as an Optocoupler and sends a signal to ARM7 module whenever the LED blinks. Blinking of LED will be counted and Depend on count units will be calculated. After this unit are used to generate bill. This generated bill is sent to user by SMS (Short Message Service) with last date of bill payment. Also this generated bill is sent on the web page. Operator can see generated bill on web page. If user doesn't pay bill on or before last date, then meter will be get close with the help of another web page i.e. controlling page of meter by operator.



**Fig.2. Hardware Implementation**

**Meter Closing Circuit**



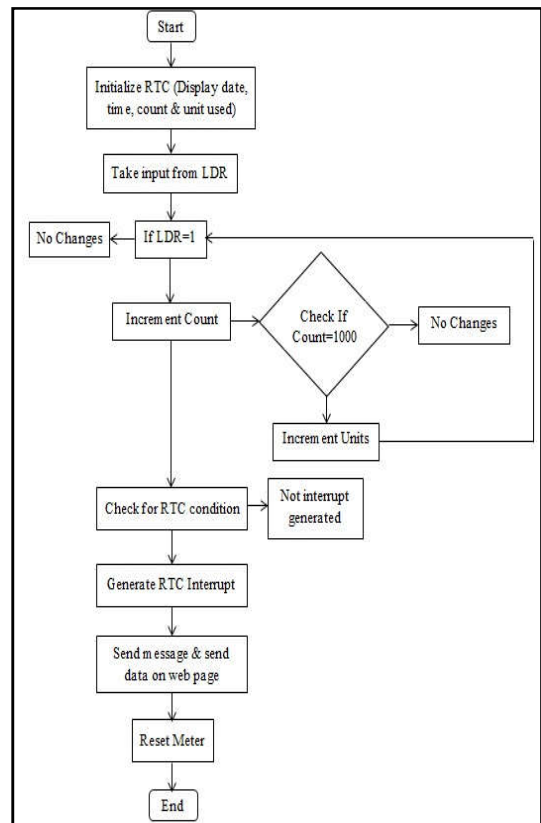
Fig(a). Meter closing relay circuit



**Fig.3. Meter Closing Circuit**

Fig.3. (a) shows the connection diagram of meter closing circuit. As shown in Fig.3. (b) when operator press the OFF switch then the meter will get close also when user pay bill then operator will start meter again by pressing ON switch.

**METHODOLOGY**



**Fig.4. Methodology for Smart Meter Device**

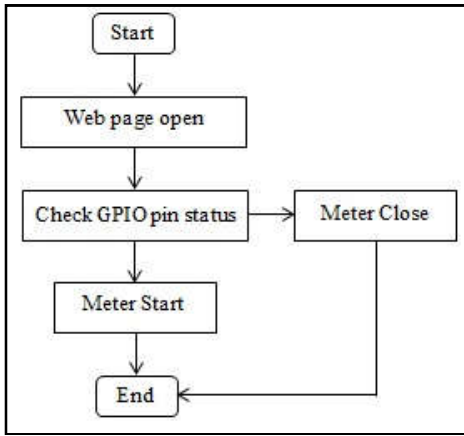
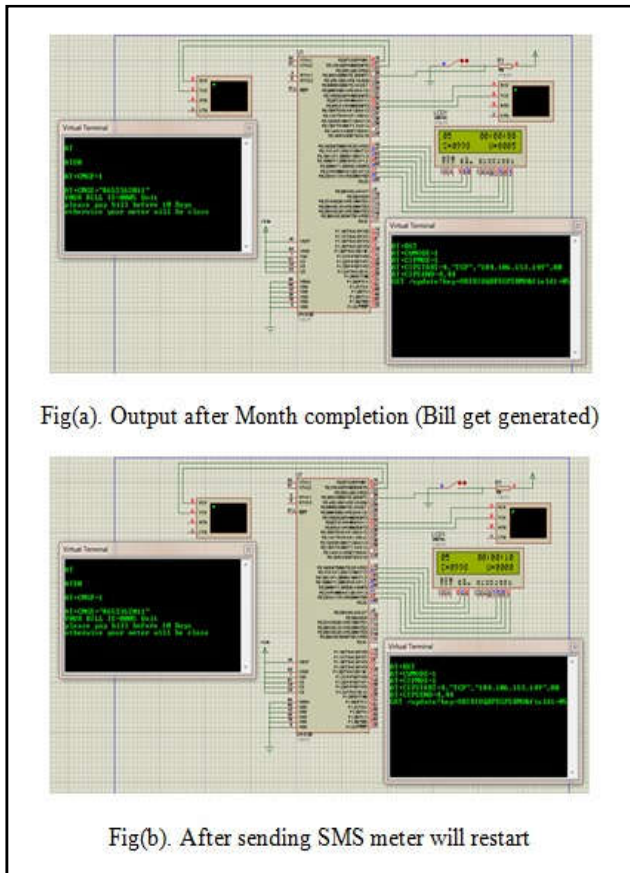


Fig.5. Methodology for Meter closing

**Software Simulation**

A complete circuit diagram to demonstrate the performance of smart meter device has been simulated in the proteus simulating software as shown in Fig.6. (a) and Fig.6. (b). Proteus software is generally used for microprocessors and microcontroller simulation, electronic design automation and electronic technicians to create electronic schematics and electronic prints for manufacturing printed circuit boards (PCB). According to the requirement the code is written in Keil  $\mu$ Vision4 which is startup file in C and assembly. This file is then converted in Hex file by making some settings in compiler which is loaded into the ARM7 to generate appropriate output.



Fig(a). Output after Month completion (Bill get generated)

Fig(b). After sending SMS meter will restart

Fig.6. Overview of Proposed System

**Case Study**

By comparing accuracy graph of traditional metering and smart metering we say that increase in number of traditional

meter accuracy of result is reduced as compared to the smart meter in Fig.7.

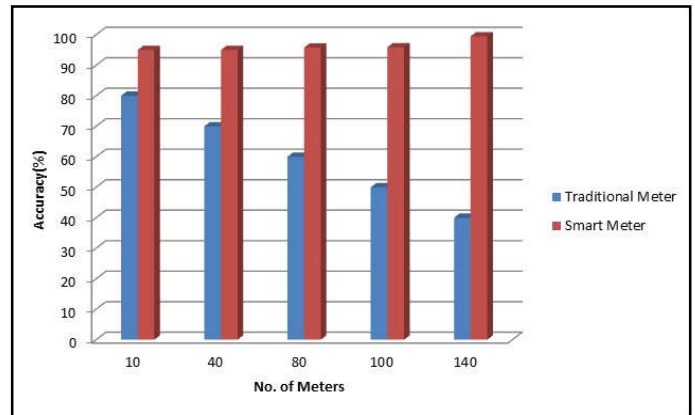


Fig.7. Accuracy of results

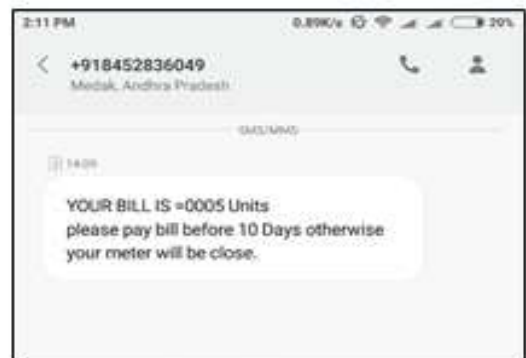
**RESULTS**



Fig(a). Web Page



Fig(b). Updated Web Page



Fig(c). SMS reception

Fig.8. Result

### Future Scope

- After increasing online users, the bill can be send on Email instead of SMS.
- This system can be used for any type of meter system e.g. Gas, Water like vise.
- We can make all the process online e.g. bill generation, notification of bill payment.

### Conclusion

Various smart metering systems are developed and also in future number of systems are being developed, However the use of GSM and Wi-Fi module in this system yield great asset. Accurate data transmission and bill generation is possible using this system. This system achieves all the objective which is defined earlier.

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