

Embedded Power and Energy Management System Using Low Power Arduino

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ABSTRACT

Electronic metering technology greatly reduces the man power and time and also made easy for remote area people for paying the bill. It also reduces the non-payment of the bill and avoids the mistake due to manual calculation. Power theft is one of the greatest problems that our country is facing and with the help of this AEM power theft can be greatly reduced. This energy meter always have predefined value of amount of electricity that the user is going to use .If there is any huge difference between the amount of power transmitted (including technical losses) and amount of power being billed then it comes to the conclusion that there exist an power theft .This power theft can be greatly reduced with the help of AME. This paper deals with automatic meter reading and theft control system. In the proposed work, the total power consumption at the load end will be calculated by using arduino microcontroller and it is used to detect any theft between energy meter and service line.

Keywords: Wireless, Automatic Energy Meter (AEM), Theft detection & tampering system, relay driver, SMS

I. INTRODUCTION

The electricity plays an important role in our life. Now-a-days as the consumers are increasing rapidly it becomes increasing so in accordance with it the technology improvement is needed. So we developed the system with faster very hard to handle the electricity requirements. As the generation increases the consumer's requirements also increases, so in accordance with it the technology improvement is needed.so we developed the system with faster and improved technology the electricity also contains some issues like power theft. Power theft is a measure crime and it also directly affects the economy of our country. Illegal usage of electricity can be solved electronically without any human control. Now a days the traditional manual Meter Reading was not suitable for longer operating purposes as it spends much human and material resource. It brings additional problems in calculation of readings and billing manually. The number of Electricity consumers is increasing in great extent. It became a hard task in handling and maintaining the power as per the growing requirements. Presently maintenance of the power is also an important task as the human operator goes to the consumer's house and produces the bill as per the meter reading. If the

consumer is not available, the billing process will be pending and human operator again needs to revisit. Going to each and every consumer's house and generating the bill is a laborious task and requires lot of time. It becomes very difficult especially in rainy season. If any consumer did not pay the bill, the operator needs to go to their houses to disconnect the power supply.

In this system current transformer are used, here one current sensor is placed in input side of the post line. Other current sensor are placed at the distribution points of the house lines. The output of current sensor values is given as input to arduino microcontroller convert analog inputs to digital. Then controller compares the input current and the same of output current. If compared result has any negative values then this particular post is detected as theft point. This compared value is transmitted to utility company, this value display in LCD display. The information will then be processed by the microcontroller.

These processes are time consuming and difficult to handle. Moreover, the manual operator cannot find the Un-authorized connections or malpractices carried out by the consumer to reduce or stop the meter

reading/power supply. The human error can open an opportunity for corruption done by the human meter reader. So the problem which arises in the billing system can become inaccurate and inefficient. But this proposal greatly reduces the manpower, save time and operates efficiently without any human interference, and the person who is checking the amount of electricity consumed by the user automatically using the arduino microcontroller chip. Technical losses in T&D are computed with the information about total load and the total energy bill. Transmission, generation and distribution of electricity include the loss of electricity. To avoid the losses we need to monitor the power consumption and losses, so that we can efficiently utilize the generated power.

It is a state-of-the-art technology for obtaining electrical energy meter readings from anywhere automatically without human intervention. It is a system for remotely monitoring and controlling domestic energy meter. Information is sent and received by the energy providing company such as PHC (Power Holding Company). This system not only reduces the Labor cost but also increase meter reading accuracy and save huge amount of time. User's interface consist of LCD (Liquid Crystal Display) which displays the energy consumed, the (unit recharged) amount of bill paid and the amount left to be used.

The software section contains the embedded 'C' Language program consisting of a string of set and other instruction set to make the whole system workable. The 'C' source code was transferred to arduino IDE software for conversion to 'Hex file', and then to the microcontroller. This section also contains the simulation of the whole system which was done with Proteus ISIS professional version 7.6 sp4.

II. METHODS AND MATERIAL

A. Existing Method

Energy consumption is measured using various methods. Bill for usage is generated and provided to the customer using certain methods. Payment is collected in electricity board from the customer. Recently, research into the field of Automatic Meter Reading System has continued to receive much attention in academia.

(i) Traditional Electro-mechanical meters were used to measure the energy consumption. It is an analog meter where readings are noted in person and were taken to Electricity board station where the bill is generated for the consumption. Consumer has to pay the bill for the usage in Electricity board station. Human error is the main disadvantage of this method.

(ii) The Software developed here is with GUI which makes easier to work on it. It is created using .NET. It has database management system which helps to maintain the data. Customer can directly pay the amount in Electricity Board station where this software helps to complete the payment

(iii) Developed a Bluetooth based system, were a method was introduced to retrieve data by means of wireless communication known as Automatic meter reading (AMR). AMR is a mechanism whereby the Energy meter sends the recorded power consumption of a household in certain interval of time to a 'wirelessly' connected reader, which could be a personal computer. The reading were noted in a database and the bill will be generated.

B. Proposed Method

The system consists of Automatic meter reading facility with the help of current sensor. The values are fed to controller to calculate the usage of power. A software is created using .Net in the server which will generate the bill for our usage according to the tariff. A database is maintained in the server which contains customer details and their consumption. Thus we can avoid human errors in measuring the readings

- AMR for measuring energy consumption.
- Microcontroller to calculate Energy consumption.
- Current sensors to detect a power theft in a transmission line.
- LCD Display for readings and information of consumer side.

This paper deals with automatic meter reading and theft control system. In the proposed work, the total power consumption at the load end will be calculated by using micro controller and is used to detect any theft between energy meter and service line.

(1) Automatic Meter Reading (AMR)

AMR is a system where power and telecommunication infrastructure work together



Figure 1

Automatic energy meter reading system is also provided with payment facility and it provides high security in serial communication. In this system the energy is measured in units and the data is fed to a remote computer server where a software solution is provided to generate bill for energy consumption.

A meter reader carries a handheld computer or data collection device with a wand or probe. The device automatically collects the readings from a meter by touching or placing the read probe in close proximity to a reading coil enclosed in the touchpad. When a button is pressed, the probe sends an interrogate signal to the touch module to collect the meter reading. The software in the device matches the serial number to one in the route database, and saves the meter reading for later download to a billing or data collection computer.

(2) Power Theft Identification

Digital energy meter will measure the consumed power by load (LM1 & LM2) over a period. It will send a data in proportion with consumed power to receiver with the help of wireless digital data transmitter. Receiver on the pole system will receive a data sent by transmitter in a load side meter. Receiver will send it to microcontroller. Also energy meter on pole will measure power sent over line 1 and provide appropriate data to microcontroller. Now microcontroller has two readings one is power calculated on pole itself and another is power consumed by load (LMI & LM2) respectively.

Suppose there is tapping done by any unauthorized person on the line to connect his appliance as over a certain period there will be difference between meter reading and pole based reading (PM1). Microcontroller will compare these two values and if the measured value on pole is more than value sent by meter (M1) by some tolerance then power theft is happening on that line. Illegal tapping of the exact location is displayed in the virtual terminal mode.

Benefits of Smart Metering for the Utility Company

- Accurate meter reading, no more estimates improved billing.
- Accurate profile classes and measurement classes, true costs applied
- Improved security and tamper detection for equipment
- Energy management through profile data graphs
- Less financial burden correcting mistakes
- Less accrued expenditure
- Transparency of “cost to read” metering
- Improved procurement power through more accurate data - “de-risking” price
- In cases of shortages, utility will be able to manage/allocate supply.

The benefits of smart metering for the customer.

- Improved billing and tracking of usage.

Benefit of Proposed System

1. Smart automated process instead of manual work.
2. Accurate information from the network load to optimize maintenance and investments.
3. Customized rates and billing dates
4. Streamlined high bill investigations.
5. Automatic outage information and faster recovery. Better and faster customer service.

Advantages

- Automation has been evaluated. So, the chance of human error and corruption will be reduced.
- In the extremely bad weather conditions like heavy snow, rain, storm, etc the system will not hamper on collecting.

- Illegal Social activities avoided (Power Theft, tampering...)

Arduino Uno . The inputs of the Relay were connected on the digital pin of 7. After this; the sketch was uploaded to the set-up from a computer.

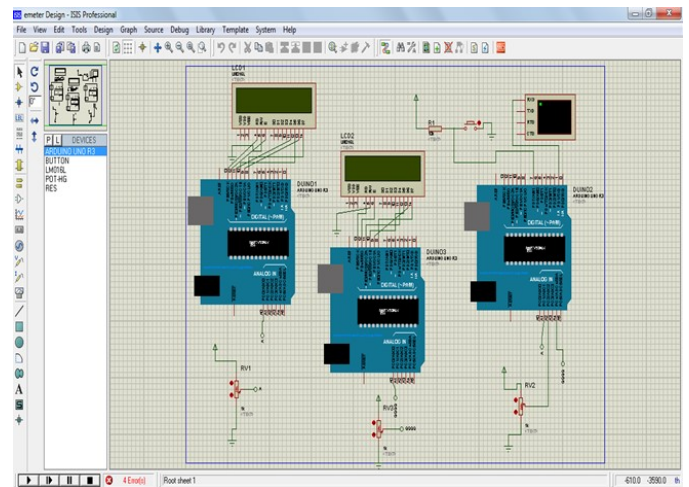


Figure 3. Simulation Layout

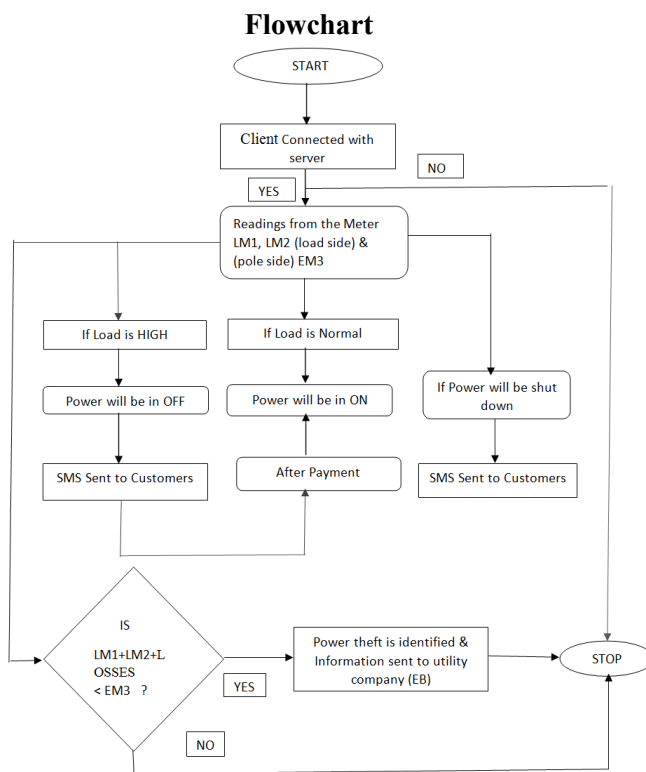


Figure 2

III. RESULTS AND DISCUSSION

Simulation Results

- The simulation of the proposed method is done using proteus 7.6 sp4 and the fig 1.2 shows the simulation of automatic energy measuring with power theft detection.
- The entire units were connected together to form a functional system. Normally, Arduino Uno are often mounted on top of the Arduino board. This means that the Arduino Uno was mounted on top of the Arduino Mega 328 board .The output of the current sensor was connected to A2 input of the

User’s interface consist of LCD (Liquid Crystal Display) which displays energy consumed, the (unit recharged) amount of bill paid and the amount left to be used.

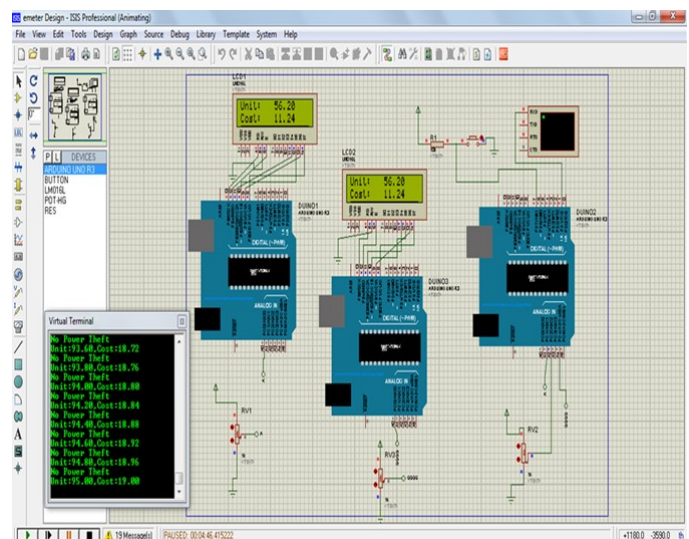


Figure 4. Output 1(Normal load)

Using proteus 7.6 sp4 software and arduino IDE the detection and notification of Power theft, in which displays energy consumed, the (unit recharged) amount of bill paid, message sent notification. If any load difference from the consumer unit, power theft is identified & illegal tapping of the exact location is display in the virtual terminal mode.

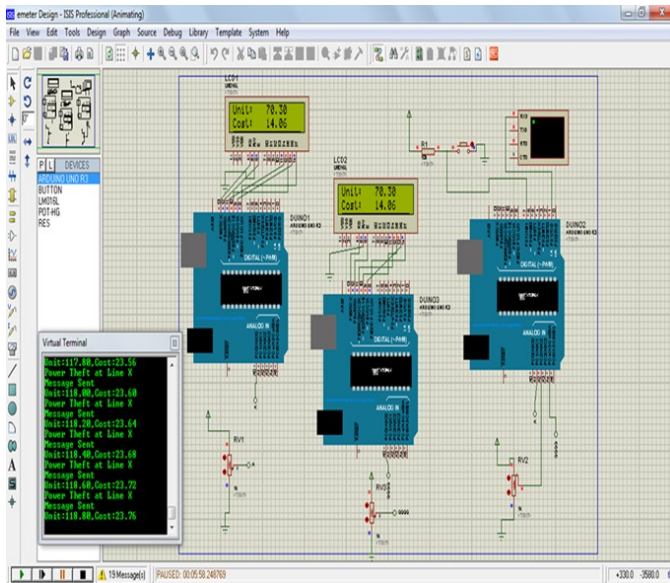


Figure 5. Output 2 (In case of any power theft)

III. CONCLUSION

Electric Power consumption is an essential need in the day to day life. In order to make the power saving EEPMS is playing an effective role to bring the power wastage factor in control. In this system, display section is kept in the device in a visible manner. At the same time the controlling person also can see the energy consumed and amount value through the home server. This method possible to solve the problem of manual process of energy measurement and billing system and our technology gives towards solution. This implementation detects accurately the location and the amount of power theft can be displayed in the virtual terminal.

IV. FUTURE SCOPE ANALYSIS

In future this work will be extended for multiple units with more precise identification & control of illegal power tapping (considering the distribution line losses).

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