Smart Energy Meter

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Abstract: This paper presents a scheme to monitor and control energy meter readings remotely. It facilitates the reading of energy meters without having to visit every house/organization. This system comprises a microcontroller that takes the readings and processes them at regular intervals and records them in its memory. This feature of remote monitoring is made available with the help of a GSM module that communicates the information regarding the meter reading to a mobile phone via an SMS. The present meter reading system does not involve the GSM module. The scheme proposed and tested in this paper avails the GSM infrastructure, its nationwide coverage, and the Short Messaging System (SMS) cell broadcasting feature to wirelessly transmit the individual house/organization power consumption readings as well as manage the connection line if the user wants to disconnect the power connection with the help of a relay This system is greatly helpful to the Electricity Department as it enables them to take the meter readings regularly with less human resources and also helps the user to remotely switch off the power supply to his house/organization.

Keywords: Electricity meter, Smart Energy meter, Electricity billings, GSM module, relay.

1. INTRODUCTION

In this new era of Innovations, we continue to use the Traditional Energy metering system and its billing. In India, our energy metering system uses an electromechanical and semi-digital energy meter and manual measurement billing. which consumes time and labor. In the manual measuring of the power consumption and billing process, a person from the Electricity board has to visit each house to measure the power consumption and calculate the bill amount every month. So it requires a lot of manual work which is often slow, costly, and lacks flexibility and reliability; we aim to cut down this process and provide line controlling facilities. Today, accuracy in electrical billing is highly recommended. To overcome all these drawbacks, we have intended to construct a Smart GSM-based energy meter that gives real-time consumption values and accurate billing. Our metering system will measure the amount of Power consumed, which is sent to the Arduino, where we can easily monitor and analyze the data. The Real-time reading of the consumption can be sent to the user through SMS, daily or whenever requested and required by the end-user. Extension of the Smart energy meter with an embedded system can be designed for telemetering, tampering detection. In such a case, the supplier can disconnect service to the consumer. Smart Energy meters can make the relationship between the utility and the user more transparent and reliable. Power saving is another advantage that contributes towards the minimization of the problem of the ongoing energy crisis.

2. LITERATURE SURVEY

Smart Energy meter helps reduce human intervention and paves the way to a better structural and organized way of electricity consumption and billing without the need of any individual from the electricity department to visit the house and note down the meter reading [1]. The overload and theft detection also gives user security from undesirable power wastage. The frequent consumption alert and limit gives the user more awareness about their energy consumption and helps them to reduce overconsumption [2]. A new concept of the energy meter is discussed, where an SMS will indicate the maximum limit of energy a user can consume. After exceeding the maximum limit, the user can disconnect the line connection according to his requirement with the help of an embedded relay [3]. A new approach for implementing a smart energy meter is discussed, where a microcontroller input is interfaced with an energy meter. The microcontroller would take the reading from the energy meter and displays the values on the LCD. The energy meter reading can also be sent to the user's mobile phone by SMS via SMS loaded GSM modem [4].

3. REQUIREMENTS AND WORKING

1.   Hardware Requirements

The implementation of the project will require the following components with the mentioned specifications.
1.   AC Source

2. Single-phase Energy meter
3. Arduino Uno Microcontroller ATmega238 for counting & calculation
4. TTSL257 light to a voltage sensor
5. Real-Time (Clock RTC DS1307)
6. GSM module(SIM 300)
7. LCD Display
8. Voltage regulator (5V)
9. Mobile Device for sending SMS
10. Relay
11. Load

The hardware requirements mainly include Arduino UNO, the main controller, ATmega328P, as the interface between the energy meter and the GSM module (Global System for Mobile communication). It is also an interface for the energy meter and the LCD. GSM module connects the energy meter to the user's mobile phone. Real-Time Clock (RTC) DS1307 is used to get the real-time to count, and then the usage data is first displayed on the LCD then stored in the memory of the Arduino. Also, it is sent as an SMS to the user on his mobile phone.

BLOCK DIAGRAM
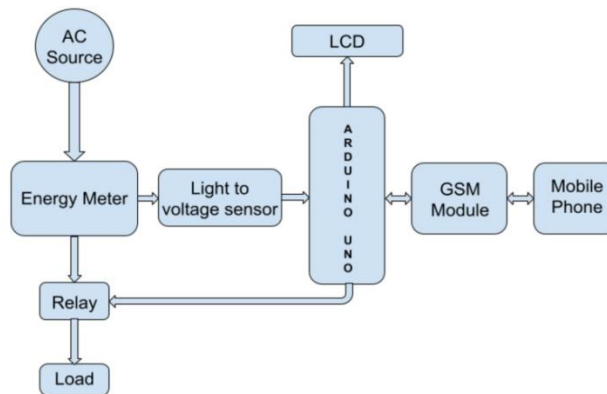
GIVEN INPUT AND EXPECTED OUTPUT

TSL257 light to voltage converter
Given Input: The sensor needs of 5V DC power supply
Expected output: ON\OFF pulse, which changes as per the LED Input is the of the sensor

Arduino UNO
Given Input: It receives the Input as the pulse from the light to voltage converter, counts it, and converts it into Units of Power consumed.
Expected Output: It sends the consumed units in a text message format to the GSM modem

GSM Modem
Given Input: The serial text format data from the Arduino is the Input
Expected Output: Transmission of wireless packets to the network is the output.

Mobile Phone
Given Input: Receives wireless packets from the network
Expected Output: Displays the units consumed on the mobile phone as an SMS, sends back an SMS to the GSM module for Power cut OFF if necessary.

LCD Display
Given Input: The energy consumption is given from the Arduino in text format for the LCD.
Expected Output: The received consumption as text is displayed on the LCD.

2. Software Requirements

The software requirements include a program developed in C language with the Arduino syntax in the Arduino IDE. AT Commands are used to send SMS to the Mobile Phone. The proposed system has demonstrated its capability to send regular consumption updates as SMS to the Mobile phone. Also, turn off the power supply in the line if the user asks.

3.   Working

An energy meter with a blinking LED signal is interfaced to the microcontroller with the help of light to voltage sensor (TSL257). An interrupt is sent each time the meter LED flashes to the programmed microcontroller (Arduino UNO) that counts the interrupt. The blinking LED flashes 3200 times for 1 unit. Therefore for every 3200 interrupts, 1 unit is calculated, and the number of units is updated. This updated number is displayed on the LCD duly interfaced to the microcontroller in real-time. Arduino keeps checking for the impulse from the energy meter, i.e., If an impulse occurs, it increases the consumption data and updates it on the LCD screen. The program in the Arduino decides what has to be done next. The use of the GSM module provides a feature of notification to a mobile phone through SMS where we can easily access the real-time energy consumption as an SMS on our Mobile Phone. The Arduino instructs the GSM module to send an SMS at a regular time interval or whenever requested. GSM modem also checks for new SMS. . If the SMS is "DATA", real-time energy consumption data is sent to the specific number given by the user. If the GSM module receives a message saying "STOP", This text is sent to the Arduino, and the program in the Arduino instructs the relay to turn off the power supply on the line. If a text message saying "START" is sent, the power supply in the line is restored. If there is any other SMS received in any other format, then the program in the Arduino will delete the SMS.

Flowchart
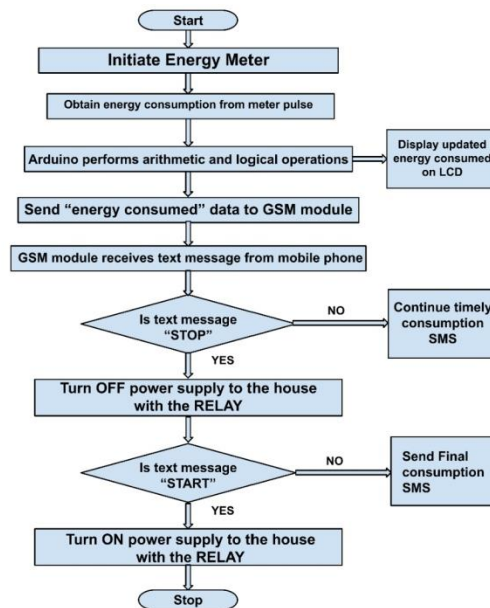
Schematic representation of the working of the smart energy meter.
Circuit Diagram
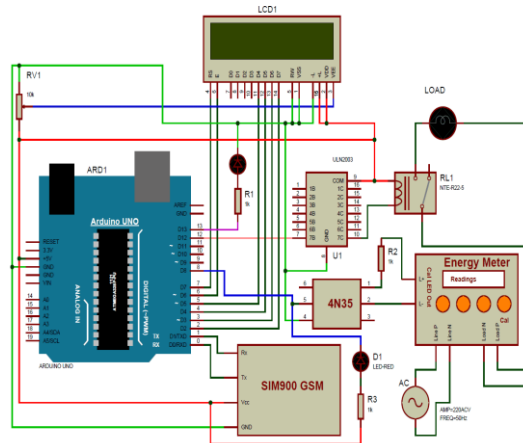
Circuit diagram of the Arduino board showing the connections for the smart energy meter.

4. FUTURE ENHANCEMENT

We can extend our current prototype into an advanced metering structure with a billing system. We can do the billing and payment interface of the power consumption instead of just monitoring and controlling. This enhancement will simplify the metering and billing system where the measurement is transparent and reliable, faster with less workforce requirement than our current method. We can use Wi-Fi instead of GSM, an Android App can be developed for the user interface instead of the SMS feature, and we can utilize a cloud storage facility for storage of the collected data. We can thus enable control of the device from any part of the world with an internet connection. A website and graph plot can be added as the backend interface, which will clearly show the user's consumption pattern and help in analyzing and reducing the power consumption wherever possible.

5.RESULT AND CONCLUSION

This paper aims to bring up energy consciousness in users by giving them timely feedback on the power consumption and helps in controlling the power connection in the line. It will help reduce technical errors in meter reading and bill calculation and simultaneously reduce human intervention.

In this paper, the architecture of a low cost and flexible Smart Energy Meter system using Arduino and GSM based Smart Energy Meter for advanced metering and monitoring system is built which can read and send data via wireless protocol using GSM technology, through GSM modem, capable of managing the meter as well as the line connection is proposed and implemented.

We use GSM Module and Arduino because this is straightforward, and its coding is extremely simple. By carrying out this kind of framework, we can guarantee energy conservation. With the assistance of this framework, we can increase the effectiveness of power consumption. However, this project needs more modification for a more reliable and higher degree of satisfaction and safety. For the GSM module, the network coverage of the SIM used might be a little complicated due to network strength issues.

6. ACKNOWLEDGEMENT

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