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Smart Energy Meter

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Abstract— *Now-a-days technology has developed to a large extend. At the same time the need for system with automation and high security are preferred. Energy fuels the growth and development of any country, and as such effective monitoring, measurement billing and access control is imperative. So, by using one of the best technologies available we designing a smart energy meter using Arduino and GSM for commercial and domestic purpose. Traditional meter reading for electricity consumption and billing is done by human operator from houses to houses and building to building. This requires huge number of labor operator and long working hour to achieve complete area reading and billing. Human operator billing are prone to reading errors as sometime in houses the electricity power meter is placed in location where it is not easily accessible. Labor billing job is sometime also restricted and is slowed down by bad weather conditions. By using system, we can avoid such problems. The energy measurement and billing system is automated*.

I. Introduction

In recent years many attempts have been made to design the energy meter with instant billing technique but till now the designed energy meters are not efficient and do not provide replacement. Now-a-days the number of Electricity consumers are increasing in great extent. It is hard to handle and maintain the power due to growing requirements. Maintenance of the power is an important task as the human operator goes to consumer's house and produces the bill as per the meter reading. The billing process takes much time if the consumers is not in the house while taking readings on energy consumption. It requires a lot of time and more labour to analyze energy consumption and generating the bill. If the consumer did not pay the bill, the Foreman needs to go to their houses to disconnect the power supply. These consumes time and difficult to handle. 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. Some of the energy meters which had been implemented are prepaid but it needs Smart card to recharge it. The major disadvantage of that method is that it needs internet and the computer interface. In this paper we propose a method which uses GSM Network which eliminates the need of internet. "An Integrated Prepaid Energy Meter using GSM system consists of Energy Meter and the GSM network. The system provides efficient power meter reading, usage notification and consumer's maximum demand using GSM network. GSM modem utilizes the GSM network to send equivalent unit for the recharged amount to the Microcontroller and send message to the consumer's end. The message consists of details like recharged amount and power consumption. In the energy provider side this system is used to update the consumer account and the database.

II. Literature Survey

[1] In the year of May 2012 the authors Abhinandan Jain, Dilip Kumar, Jyoti Kedia presented a paper titled "SMART & INTELLIGENT GSM BASED AMR SYSTEM". This paper represents the development of fully automated energy meter which is having capabilities like remote monitoring & controlling energy meter. Automatic meter reading (AMR) system continuously monitors the energy meter & sends data on request of service provider through SMS. It saves huge human labour.

[2] In the year of June 2012 the authors O. Homa Kesav, B. Abdul Rahim presented a paper titled "Automated Wireless Meter Reading System for Monitoring & Controlling Power Consumption. In this paper

the design presents new method for avoiding high construction & maintenance cost in the existing system. The system is designed in such a way that if the consumer is unable to pay the bill the power connection maybe disconnected automatically from remote server. The ARM 7 based hardware system consist of a processor core board & the peripheral board. The embedded C language is used as programming language in this system.

III. Block Diagram

This paper consists of following blocks Arduino UNO AVR controller is central for all controlling this smart energy meter. Energy meter is another important one in this system which is used for live reading of electricity consumption & which is interface with controller to communicate with server & which operates according server commands. Total blocks of the system are shown below:

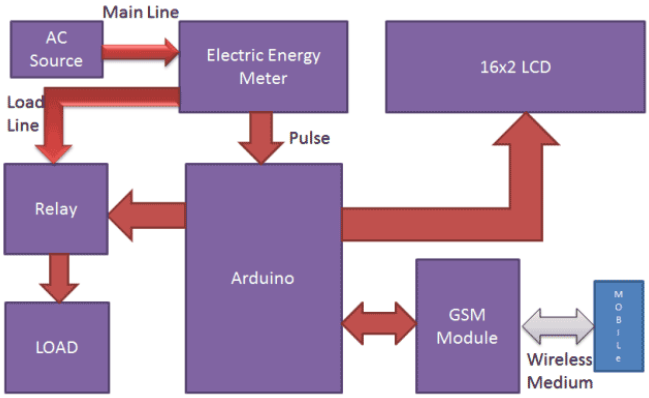

Fig. 1: Block diagram of Smart Energy Meter.

The above diagram represented the block diagram of our system. It consists of sensor for detecting current going to the load so that we can calculate the total power demanded by the load which are sensed & further processed by microcontroller kit. Microcontroller drives LCD display which displays the values. Further switching section & relay circuits are provided for driving loads if required. When the readings from the sensor deviate with respect to the input values from the controller. The microprocessor sends out a signal to the effecters to adjust the setting back to the input values.

IV. Functions OF COMPONENTS

4.1 ARDUINO: When we power up the system then it reads previous values of rupees stored in EEPROM and restores them into the variables then checks the available balance with the predefined value and take action according to them, like if available balance is greater than 15 rupees then Arduino turns On the electricity of home or office by using relay, and if balance is less than 15 rupees then GSM sends a SMS to user phone regarding low balance alert and requesting to recharge soon; and if balance is less than 5 rupees then Arduino turns Off the electricity connection of home and sends a SMS to user's phone for 'Light Cut' alert and requesting to recharge soon.

Fig. 2: Arduino

4.2 ENERGY METER: An energy meter is a device that measures the amount of electrical energy consumed by resistance, business or an electrically power device.

Electric meters are typically calibrated in billing units, the most common one being the KWh.

They are broadly classified in to electromechanical and electronic meters.

Fig. 3: Energy Meter

Power meters are sometimes referred to as energy meters and vice versa. Per definition, (active) power is a measure of what is required (or consumed) in order to perform useful work. For example, a light bulb with a 100W rating consumes 100 watts of active power in order to create light (and heat). Energy, per definition, is the measure of how much work has been required over a known period of time. In the light bulb example, leaving the bulb on for an hour it will consume 100W x 3600s = 360000Ws (watt-seconds) = 100Wh (watt-hours) = 0.1kWh (kilowatt-hours) of energy.

The meter described in this application note can be referred to as a power meter, an energy meter or a kilowatt-hour meter. The Energy Pulse output (EP) is a ready indication of active power, as registered by the meter; the frequency of the pulse is directly proportional to active power. Integrating pulses over time gives active energy. For storage purposes, the meter includes two pulse outputs (DPP and DPN) to directly drive various display counters. All pulse outputs are easy to configure for any reasonable rate. The default is 10.000 impulses per kilowatt-hour for the EP output and 100 impulses per kilowatt-hour for the DPP/DPN pulses.

4.3 GSM MODULE: GSM means Global system for mobile communication. GSM transfer the instruction to main circuit from operator and vice versa. The frequency range specified for GSM is 1850 to 1990MHZ. GSM is a wide area wireless communications system that uses digital radio transmission to provide voice, data, and multimedia communication services. A GSM system coordinates the communication between a mobile telephone (mobile stations), base stations (cell sites), and switching systems. Each GSM radio channel is 200 kHz wide channels that are further divided into frames that hold 8 time slots. GSM was originally named Group Special Mobile. The GSM system includes mobile telephones (mobile stations), radio towers (base stations), and interconnecting switching systems. This figure shows an overview of a GSM radio system. This diagram shows that the GSM system includes mobile communication devices that communicate through base stations (BS) and a mobile switching center (MSC) to connect to other mobile telephones, public telephones, or to the Internet. This diagram shows that the MSC connects to databases of customers. This example shows that the GSM system mobile devices can include mobile telephones or data communication devices such as laptop computers.

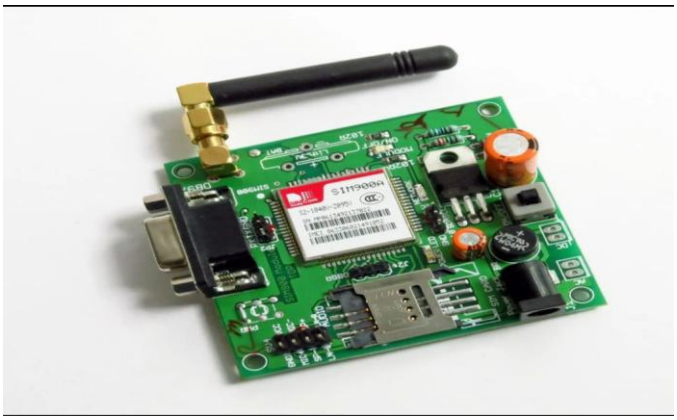

Fig. 4: GSM Module

4.4 LCD: LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications.
The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special characters.
A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. It displays date, time, units consumed and balance.

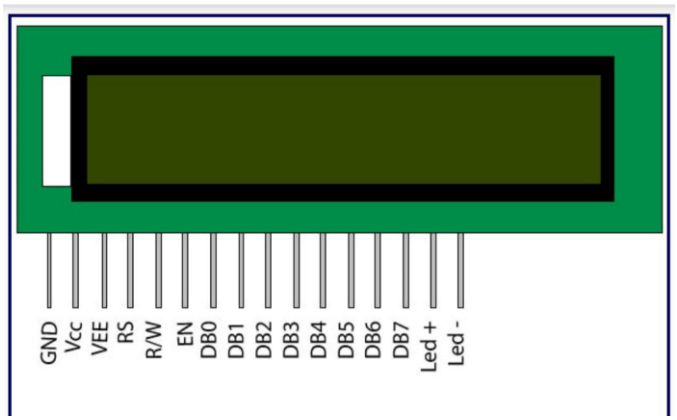

Fig. 5: LCD

4.5 RELAY: Relay is an electrical switch that opens and closes under the control of another electrical circuits. The phase of main supply is connected to relays. OFF condition relay contacts are in open, under ON condition contacts are in closed position. Means it connects the phase to the load in ON state only. A relay system has been used which shut down or disconnect the energy meter and load through supply mains when the recharge amount is depleted.

Fig. 6: Relay

V. Merits:

- Pay as you go.
- No need to stand in queue.
- No surprising bills.
- Allow customer to budget expenses.
- Help customers to contribute towards energy conservation.
- Up-front payment for electricity.
- Lower overloads.
- No load of billing distribution.
- No disconnection/reconnection.
- Tamper and fraud detection.
- Load/ demand control.

VI. Demerits

- Managing public reaction and customer acceptance of the new meters.
- Managing and storing vast quantities of metering data.

VII. Application:

- AC mains detection
- Reed relay driving
- Switch mode power supply feedback
- Telephone ring detection
- Logic ground isolation
- Logic coupling with high frequency noise rejection

VIII. Future SCOPE:

- A mini printer can be interfaced to get a printed bill or details of billing.
- Software can be modified to view the balance on request.
- Remote recharging can be implemented through telephone line or wireless network.

IX. Conclusion

- In the present situation all customers are using manual communication. To reduce the manual efforts and human errors, we need to have some kind of automated system monitoring all the parameters and functioning of the connections between the customer and electricity board.
- Also by implementing this system we can control the usage of electricity on consumer side to avoid wastage of power.
- Since there is need to utilize energy in better and efficient way this smart meter proves to be a boon in the power sector.
- In this system to save time of consumer and operator.
- By the implementation of this system overall efficiency in operations of the electric board will improve.

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