PREPAID HOUSEHOLD ENERGY METER WITH THEFT DETECTION AND POWER FACTOR MONITORING

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ABSTRACT – *An energy meter is a device which is used to measure the consumption of energy of any residence or other industrial establishment. In Conventional metering system, to measure electricity consumption the energy provider company hire persons who visit each house and record the meter reading manually. These meter readings are used for electricity bill calculation and this bill sent to consumer house by post. In this people try to manipulate meter reading by adopting various corrupt practices such as current reversal, partial earth fault condition, bypass meter, magnetic interference etc . There is a stark amount of revenue loss being incurred by a country. Hence we brought the concept of Prepaid Energy meter where the consumer themselves can monitor their consumption and can accordingly save the loss. The Prepaid Energy Meter is established in most of the countries and its work is successfully followed by other countries too.*

KEY WORDS: **Prepaid Energy Meter, AT328p, GSM modem, Current sensor.**

1. INTRODUCTION

Nowadays the most flooding issue of any country is the increased revenue for the electricity supply hence to monitor and control the wastage of electricity is the main concern of government of a country. The Prepaid Energy Meter is a measure through which we can keep a check on our country's electricity consumption. In this system we have a GSM modem encrypted on both consumer and service provider side that time to time keep us updated about the consumption. The prepaid system lets the consumer decide about his budget and accordingly decide about his consumption. It is noticed that with the introduction of. AMR is an effective mean of data collection that allow substantial saving through the reduction of meter re-read, good data accuracy, allow frequent reading, improved billing and customer service, more timely energy profiles and usage trends updates, and better deployment of human resource. AMR system is very useful for remote area or small villages which are not connected by any means of transport such as an island or remote precinct. GSM based data collection system can be very swift, accurate and efficient. Prepaid energy meters based on GSM network has been proposed .These meters incorporate the facility of prepaid metering system and remote load control. Also, can be further matured to address the problem of electricity theft.

2. HARDWARE DESIGN

The Hardware of prepaid energy meter include AT328p, current sensor, liquid crystal display (LCD), GSM module, keypad, load.

2.1 Energy Meter

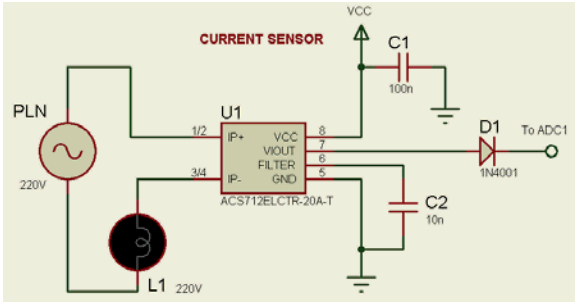
Prepaid household energy meter gives the information of meter reading, power cut, total load used, power disconnect and tempering on request or regularly in particular interval through SMS. This is our aim to measure and monitor the electricity consumed by consumers in a locality and transmitting the consumed power to the station as well as issuing the bill of consumed power automatically and online payment is also possible. It also aims to find the malpractices in the meter. Provider Company with the help of Global system for mobile communication (GSM) network access prepaid energy metering system to control electricity theft. Server station is also served by a GSM module for transmission and reception of data as energy auditing. Constraints are accurate metering, energy theft and implementation of proper tariff as well as billing system and maintaining a constant power factor.

Electric utilities use electric meters installed at customers' premises for billing purposes. They are typically calibrated in billing units, the most common one being the kilowatt hour (kWh). They are usually read once each billing period. When energy savings during certain periods are desired, some meters may measure demand, the maximum use of power in some interval. "Time of day" metering allows electric rates to be changed during a day, to record usage during peak high-cost periods and off-peak, lower-cost, periods. Also, in some areas meters have relays for demand response load shedding during peak load periods.

2.2 Current Sensor

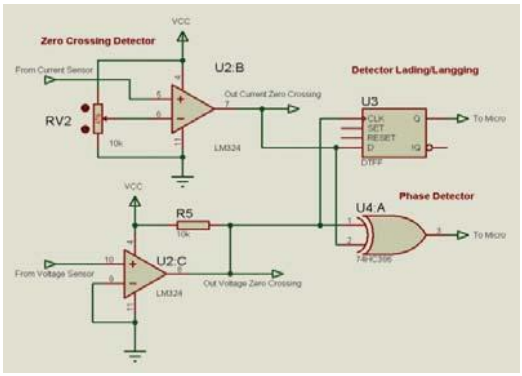
Current sensor was used to measure how much electric

Current flows on the grid in the household. This study uses Current sensor that widely available in the market namely the type ACS712. This sensor directly integrated with a prepaid energy meter. The design of current sensor is as shown.



2.3 Zero Crossing Detector

Zero Crossing Detector is a technique to detect the power Factor. Power factor was obtained from the phase angle difference between current and voltage. Therefore, the model needs a circuit to detect each corner of the current and voltage waveform flowing.

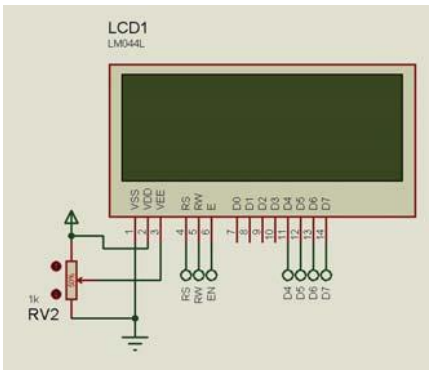


2.4 AT328P

The Atmel ATmega328P is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the ATmega328P achieves throughputs close to 1MIPS per MHz. This empowers system designer to optimize the device for power consumption versus processing speed. 32 x 8 General Purpose Working Registers, 32KBytes of In-System Self-Programmable Flash program,1KBytes EEPROM,2KBytes Internal SRAM, Two 8-bit Timer/Counters, One 16-bit Timer/Counter, Real Time Counter with Separate Oscillator, Six PWM Channels, 8-channel 10-bit ADC, Two Master/Slave SPI Serial Interface, One Programmable Serial USART, One On-chip Analog Comparator, Interrupt and Wake-up on Pin Change

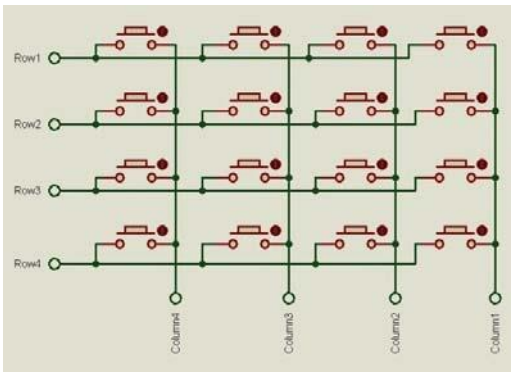
2.5 Liquid Crystal Display (LCD) module

The important information such as voltage and current need to be displayed, it will appear on the display screen. LCD (Liquid Crystal Display) size 16x4 is used to display the information.



2.6 Keypad

Pulse input and various settings on the digital prepaid meter are performed by emphasizing the buttons on the keypad module.the design of keypad module is as shown



3.Energy Calculation

Energy is the measure of how much work has been required over a known period of time. We are using a light bulb as a load with a 100W rating which consumes 100 watts of active power in order to create light (and heat) [2]. First of all a wattmeter is used to measure the power consumed by the load by using the equation. The frequency across 100 W load obtained during an experiment is F= 0.5 Hz And P = 100*X/0.5 P = 200*X Where X is the frequency of pulses that is produced by the energy meter. 1 watt sec = 1 kW sec/1000 1 watt sec = 1 kWh/ (1000*3600)

Therefore Energy = P * Sec/ (1000*3600)

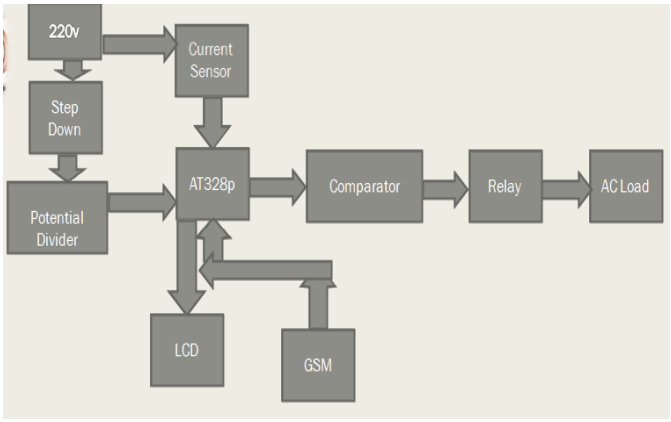
4. Working

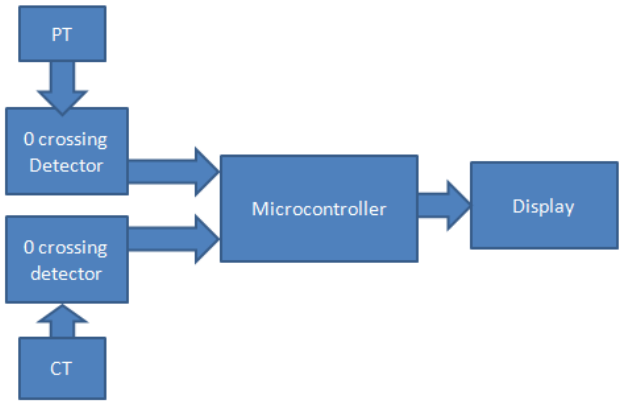
A 230 V A.C – 12 V D.C step down transformer is used as power supply. The rectifier circuit is used to convert A.C into D.C. at the output of rectifier circuit +12V power supply is generated.Connect the circuit as shown. An opamp IC 741 is connected as a comparator which

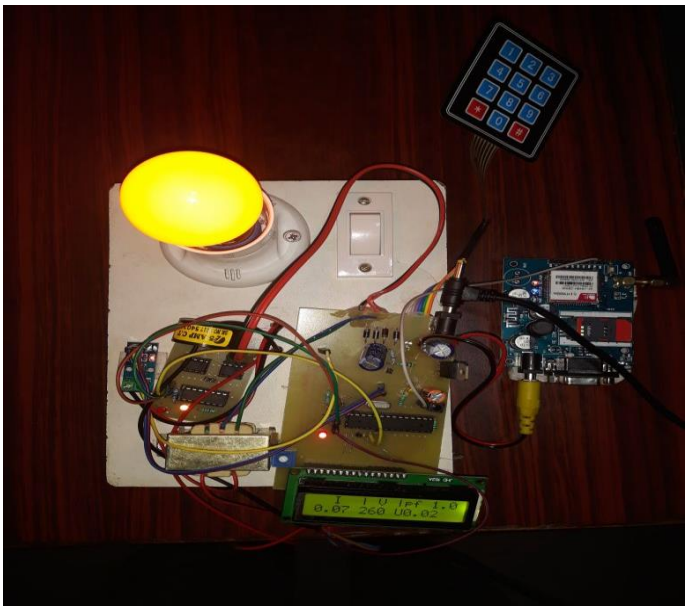
compares the units consumed with the threshold value set by the user .Connect the bulb as load. Connect the GSM. When the microcontroller AT328p which gets signals first of all we insert the recharge number and number of units is stored by entering using the keypad. The recharge unit is stored in IC and this recharge unit is display in Liquid Crystal display (LCD).As the power is consumed the reading of the single phase energy meter is increased and the units in LCD is decreased by 1.When the balance reaches to 75% of the amount of units as entered by the user then than the GSM sends an alert message to the user about 75% consumption and after full consumption of units another alert message is sent regarding the complete consumption of units entered and if balance is nil then the relay is switched off and no electricity flows. If any excessive power is being consumed and that consumption is not by user, then theft can be detected.

Two Op-amp ICs are used for 0 crossing detectors and are connected and input from the 0 crossing detectors and taken as voltage and current and the phase difference is calculated between them. Measure time difference between zero crossing of voltage and current waveforms. Calculate phase angle using time difference

Time difference = avg. value of timer/1000
θ = time difference* 2π
power factor= cos(θ)







5. Advantages of Prepaid Energy Meter

-Reducing reading expenses

-Bad debt collection

-Greater awareness on consumers consumption habits

-Reducing reading expenses

6. CONCLUSIONS

Smart metering system is useful to both utility Provider and consumers. An intelligent circuit which detects theft and generate a switching pulse on detection of theft can be designed and integrated with the system. A power factor monitoring system aptly maintains the power factor constant and thus saving the appliances from damage. An apt tariff system and theft detection circuitry can be integrated with the proposed smart meter design. This provides reliable, effective and efficient automatic meter reading, online billing, and notification through the use of GSM network and thus reduce human effort in meter reading and this method is very economical and time saving. This paper is aimed at reducing the heavy losses and revenue losses that occur due to power theft by the customers. By this design it can be concluded that power theft can be effectively curbed by detecting whether the power theft has occurred and informing the authorities. Also an automatic circuit breaker may be integrated to the unit so as to remotely cut-off the power supply to the house. The ability of the proposed system to inform or send data digitally to a remote station using a wireless radio link adds a large amount of possibilities to the way the power supply is controlled by the user. The system design mainly concentrates on single phase electric distribution system.

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[5] Vol-2 Issue-3 2016 IJARIIE-ISSN(O)-2395-4396 2608 www.ijariie.com 3434 PREPAID ENERGY METER WITH AUTO POWER THEFT DETECTION