Energy Monitoring Using Wireless Technique

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Abstract:- The single phase static meter getting more & more advanced due to advance electronic. So the automatic metering needs to be implemented to single phase metering level. Same is implemented in this paper simple energy monitoring using wireless GSM technology. Single phase energy meter data can communicate to computer for billing purpose. The main thing behind this paper is to replace old method of taking reading of energy meter. This is possible by GSM technology & modem system. Energy Monitoring with single phase energy meter, GSM & wireless modem is very reliable for data communication (SMS). A GSM receiver at the other with PC end which contains all the data of previous billing. Real time meter reading by the GSM technology can be carried out periodically so as to get definite billing cycle. Hyper terminal software is used to read the data. This data can be converted to PDF format; this is very useful for determining consumption pattern of energy consumption. These records can be maintained throughout in the PDF formats.

Keywords—The Global System for Mobile Communications *(GSM);* Peripheral Interface Controller *(PIC); Short Messaging System (SMS); Automatic meter reading system (AMR)*

I. INTRODUCTION

Electrical Energy is becoming very important in human life day by day. Energy monitoring of house hold consumer is becoming critical in now a day's. Along with the growing rising energy demand, automated energy monitoring in local level distribution is also important. The old meter reading by human is taking too much time to cover residential distributed area. Hence to achieve meter reading in minimum time Automatic Meter Reading (AMR) systems is introduced. The AMR collects meter readings through SMS technology. Its application is expanding over wide consumption range i.e. single phase, three phase & CT operated meters. Wireless metering offers potential benefits to householders. This paper helps to manage consumer monitoring their energy use. Energy meter with a display outside their homes could provide up-to-date information on electricity consumption and in doing so help people to manage their energy use and reduce their energy bills.

Meter readings collection is very time taking activity & also very inefficient because of meter reader has to physically be onsite to take the readings. This method of collection of meter readings becomes more costly when readings have to be collected from vast, and often scattered rural areas. Meter readers is very resistive to go to consumes premises & take all the reading & submit inaccurate estimated readings of electricity consumed. Here in this paper Wireless Energy Monitoring is introduced which will integrate the energy used at energy consumption end & record the reading continuously. Then data will be send to the remote server (PC) through the existing GSM network. Once the data is collected the records regarding that consumer is created by hyper terminal software.

II) EXISTING SYSTEM FOR ENERGY MONITORING

The existing meter reading techniques in MSEDCL (MSEB) are analyzed. There are two types of meter in existing system existing system either an electronic energy meter or an electro-mechanical fixed outside consumer premise for measuring the usage. The meters currently in use are only capable of recording kWh units & Voltage. The monthly reading (KWh units) have to take manually by going consumer premises. The physical recorded data to be processed by MSEDCL. For billing the consumer the old recorded units must be altered from current reading this is manually done. After that applying specific tariff bill is generated.

The above process is carried out only in case of single phase consumer. For three phase & CT operated consumer the process is quite different. The hand held instrument called Meter Reading Instrument (MRI) is used to take out the reading from meter. The MRI has DOS based operating system & by entering key words one can take all the data. For taking the reading of above consumer reading, reader has to walk to consumers premises & put the MRI on meter port & take the reading. Then this MRI has to carry to office located at far end from meter. This MRI then connected through wire to PC located at office. This whole process

requires too much time. Some time data got corrupted & reader has to follow the above process again.

III) DESCRIPTION OF PROTOTYPE SYSTEM

The energy meter is constructed using the energy metering IC ADE7753, a display, 8-bit PIC Microcontroller PIC16F877A and GSM modem. A 100 watt single phase meter is designed with GSM modem. The GSM uses network to send its energy monitored value as SMS to the PC wirelessly. While sending the message each time, the same data is also stored in the in memory location of Microcontroller. The detailed block diagram of Prototype System (Fig.1) & Measuring Unit Block Diagram (Fig.3) are shown. The GSM modem consists of SIM900 mode. Also the measured data displayed locally by 16X2 segment display unit. Both GSM modem & Display derived by PIC microcontroller.

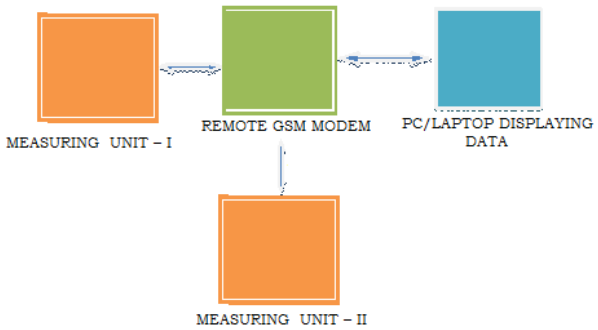

Fig.1 Block Diagram of Prototype System

Fig.2 Photocopy Of Prototype Syetem

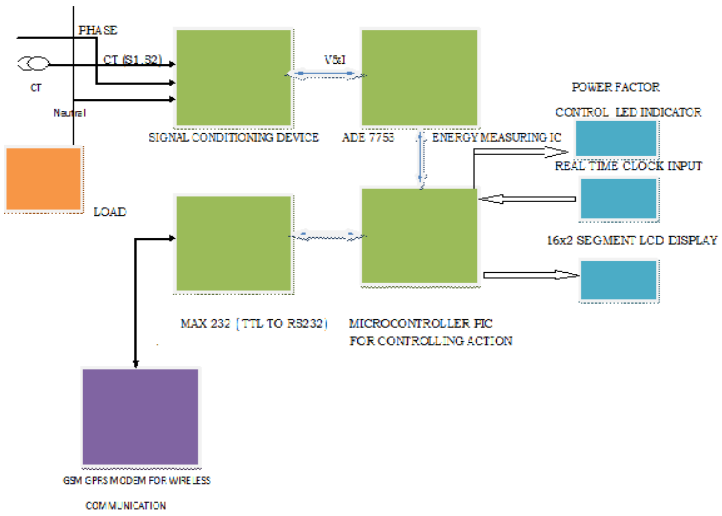

Fig.3 Block Diagram of Measuring Unit of developed prototype system

IV) HARDWARE DETAILED DESIGN-

A. Power Supply

Power supply fed to the microcontroller and other devices by converting AC to DC by rectifier & regulator circuit. The rectifier output voltage will be 12V DC non-regulated. The IC7805 used as voltage regulators & convert 12 V to 5V DC. Circuit details are shown in Fig.4 The cost of DC power is very low. Supply circuit which also included Zener diode-limits AC signal feeding.

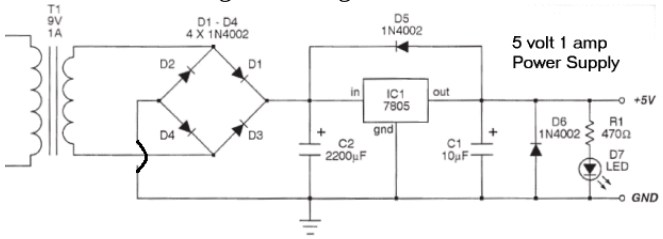

Fig.4 Power Supply to Microcontroller

B) Energy Measuring IC ADE7753

The ADE7753 has feature of ADCs and DSP. It has high accuracy at different atmospheric conditions and time. ADE7753 has two second-order 16-bit ADCs, (on CH1), reference circuitry, temperature sensor, and reactive, and apparent energy measurements, line-voltage period measurement, and rms calculation on the voltage and current. The on-chip digital integrator has selectable direct interface provides di/dt current (i.e. rate of change of current) sensors just similar to Rogowski coils, hence no need of external analog integrator. The ADE7753 has facility of read data by serial interface, and it also has pulse output frequency (CF), which is proportional to the active power. The system calibration has channel offset correction, phase calibration, and power calibration, tends high accuracy. The

low or high voltage variations can be measured in short duration. The energy measured in positive accumulation mode gives the option to accumulate energy only when positive power is detected. In general the energy meter has error known as creeping. Creeping means measure the energy when there is no load or current. ADE7753 has internal threshold. It provides no creeping on no-load. The zero-crossing output (ZX) pin gives pulse output at zero-crossing point of the line voltage. This is very useful for measurement of active, reactive & apparent power & energy accumulation modes. The interrupt status register (INTR) indicates the nature of the interrupt, and the interrupt enable register controls event that produces an output on the IRQ pin, an open-drain, active low logic output.

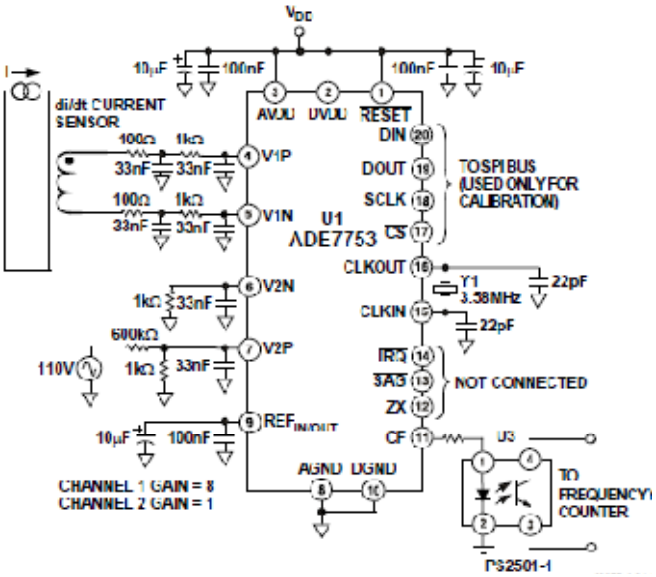

Fig.5 Functional Diagram of ADE7753

C) Microcontroller PIC 16F877

The microcontroller is programmed to read data from the metering IC ADE7753 after every half second. Microcontroller has three basic functions which include communication to ADE7753 and copy the register containing the data that corresponds to different energy values viz. active energy, reactive energy & apparent energy, rms voltage, rms current & instantaneous power. The second function of Microcontroller is to send the AT commands to GSM modem for sending SMS to remote end modem SIM. This SMS contains the data related to above said energy & power. Third & last function of microcontroller is to drive the display so as to display all the values locally.

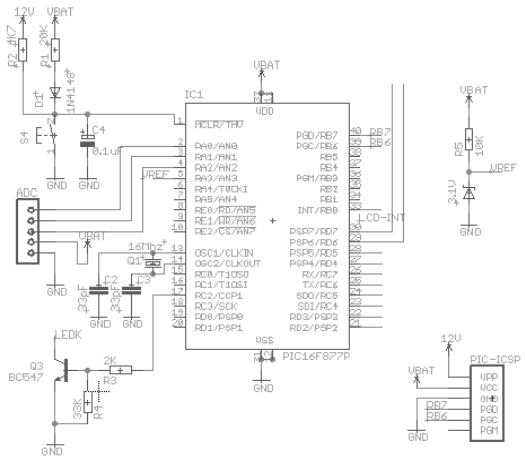

Fig.6 Microcontroller Connection Diagram

The software flash used for the PIC16F877 for the monitoring circuitry to program accordingly. The meter & PIC MCU is programmed via the In-System Programming (ISP) interface.GSM modem is controlled by using AT command for all kinds of measuring operations. The algorithm is created or program is created for taking out all data related to energy from ADE7753. The program can be modified. The firmware is written in embedded C.

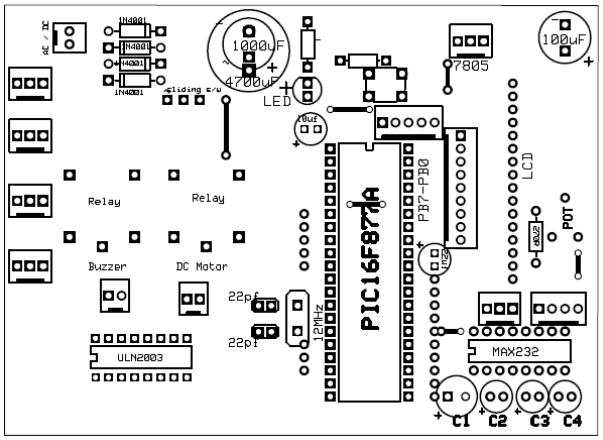

Fig.7 Microcontroller PCB layout

D) GSM modem (SIM900)

For the GSM communication used in the SIM900 is a very good, easy to use and cheap GSM module. It has serial port UART communication control with AT Commands. It works at 3.6 Volt and uses an external GSM antenna.

Fig.8 Modem Photo

GSM status (blinks) will be indicated by LED indicator LED1. The module can be powered on/off by the button [S3].

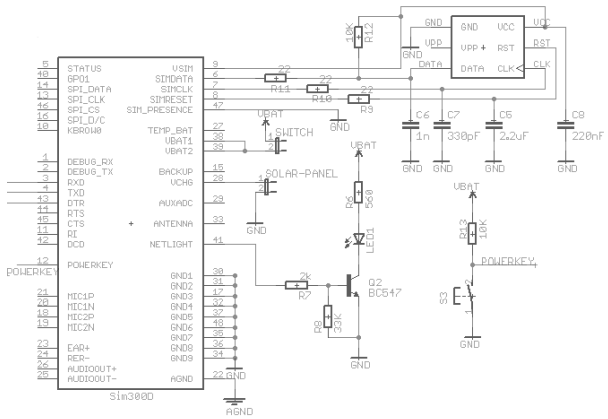

Fig.9 SIM 900 Daigram

E) 16X2 Segment Display

LCD (Liquid Crystal Display) screen is an electronic display and has wide range of applications. These modules are preferred over seven segments and other multi segment LEDs because of main advantages like LCDs are economical; programming is easy; no limitation of displaying special & even custom characters. A 16×2 LCD is used to display energy, RMS & power values and make the device easy to operate. The backlight jumper (POWER-LCD) at the LED's anode which provides the user option of turn off the backlight & limits power consumption. The command register stores the command instructions given to the LCD. A program commands is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. The data register used to stores the data to be displayed on the LCD. The data is in the ASCII format of character to be displayed on the LCD.

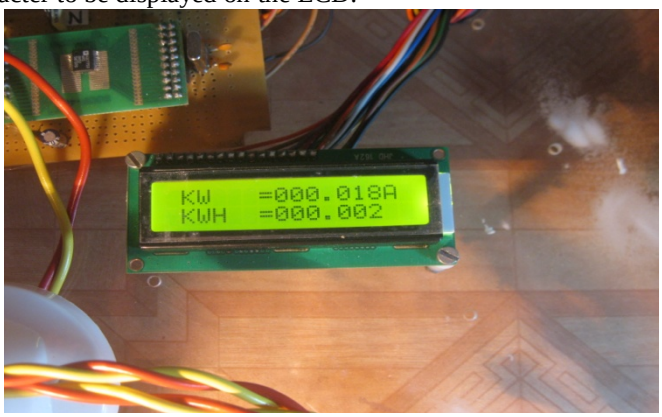

Fig.10 Display photo

F) Hyper Terminal Software

The continuous monitoring on the PC screen is done through hyper terminal. It is used for front end language. It is shown on PC comport. The energy consumed by all the three phases will be shown on PC's screen. Thus, PC acts as front end indicator.

V) RESULTS

The 15w CFL & 40W Bulb is connected as loads. Local LCD display refreshes the energy values after every second. Modem SIM 900 located at remote metering unit send SMS after every 2 mini. The SMS received from SIM900 is displayed through hyper terminal software. The main advantage of this software is records of every SMS consisting of all values of Energy, Voltage & Currents can be stored in PDF form. Meter is able to send the usage value at a predefined time and the status is displayed on hyper terminal after 2 minutes.

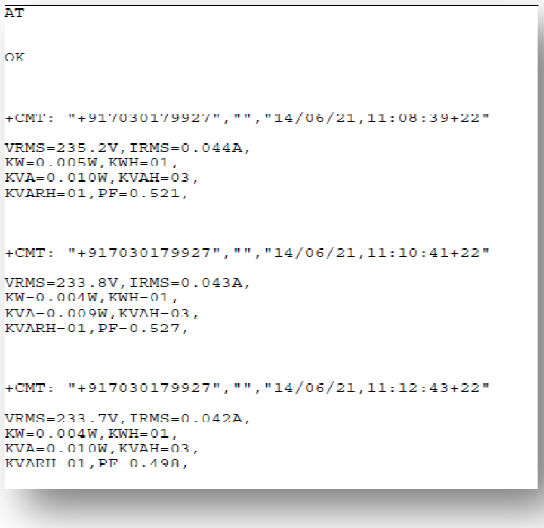

Fig 11 Hyper Terminal PDF Data

VI) CONCLUSION

Day by day the single phase electronic meters are more advanced. But GSM technology along with this electronic meters use is very advantages over old methods. The SMS rates are standard hence it is very cheap to transfer this energy data. The very efficient & low costly transmission of energy values via SMS can be done more frequently to a remote station. This helps to energy utilities to generate timely bills, better understand energy consumption, demand patterns, reduce meter failures more efficiently and manage fraud to reduce.

The main idea behind this paper is to reduce time for reading the consumer meter, same is found at the end of completion. The total energy reading time is just delay provided to send the SMS only. This can be minimize up to 2 sec. The reading of energy values & monitoring them is very less time consuming activity by this project.

The system developed is very accurate & effective. This system eliminates all disadvantages of serial communication. i. e. even though the circuit is not able to get the acknowledgement of the sent SMS it is not affecting system performance. If one of the message miss then also remote end can able to get the energy value as energy recording is cumulative same will be catch in next SMS . Human interface is minimum hence there is no possibility to manipulate reading. The hyper terminal data can be stored in pdf format. The same data can be used for analysis of consumption pattern. This system can be modified further for three phase by using latest SPI metering ICs which will provide more parameters. In future Automatic Power factor corrector circuit can be done using same circuit.

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