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Smart Energy Meter with Real Time Monitoring System

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Abstract: **India is currently witnessing a revolution in the field of electricity metering, where electronic energy meters are fast replacing the conventional Ferraris meters. Energy metering is essential at all places where electricity is consumed, i.e. at homes, offices, shops, farms, workshops, factories, etc. Nowadays the wastage of energy is increased due to unawareness of energy usage. So there is a need of real time energy monitoring equipment which helps the consumers to know about how much energy they had used and what the cost of energy usage. Smart energy meter give you greater insight into how much energy we use compared with standard energy meter. With this knowledge, we can take positive steps to save more of energy at home. They help to make informed discussions about the energy we use. This can have a positive impact on our level of consumption and on the amount of money we spent.**

Keywords: **Microcontroller, LCD Display, Kiel C Programming, Energy Meter**

I. INTRODUCTION

Conventional energy meter indicates the energy consumed in a cumulative basis. Consumers are unaware of the tariff structure and the bill to be paid is only known once the meter reading collected by the utility [3]. The consumer gets information about the cost of energy consumed in a cumulative manner. Smart energy meter clearly give a warning to the consumer from wasting the energy as the display is in terms of cost.

Smart energy meter give you greater insight into how much energy we use compared with standard meters. With this knowledge we can 2 take positive steps to save more energy at home. They help to make informed discussions about the energy we use. Smart meter replace your standard electricity meter and it will automatically send us half hourly, daily or monthly usage. This means we will no longer receive estimated bills and only pay for the energy we use. With the most frequent half hourly usage records we can better understand the energy we use at home.

II. DESCRIPTION OF THE PROJECT:

2.1 BASIC BLOCK DIAGRAM:

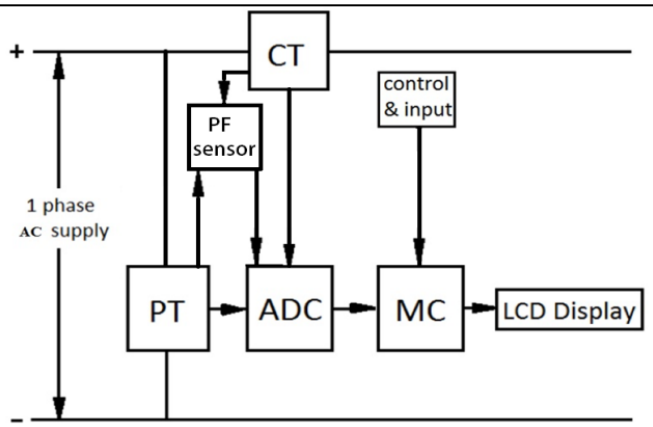

Fig 1: Basic block diagram of Smart Energy Meter

2.2 COMPONENTS USED:

MICROCONTROLLER UNIT:The main IC used is P89V51RD2, it is a 40 MHz,5 volt ,8051 based microcontroller with 32 I/O lines,3 timer/counter,9 interrupts,4 priority levels,64 k+8k flash,1k on chip RAM, SPI , Dual pointers,WDT,5 channel PCA

***LIQUID CRYSTAL DISPLAY*:** The LCD used in the circuit with 2 rows and 16 characters (2 16); meaning it has 2 lines of 16 characters each. The 44870 standard requires 3 control lines as well as either 4 or 8 I/O lines for the data bus. The 8-bit mode was used in this work. Thus, 11 data lines (3 control lines plus the 8 lines for data bus) are used because it is simpler for programming.

***ANALOG TO DIGITAL CONVERTER*:** Analog to Digital converter is used to convert the analog data obtained from the CT and PT into digital format. The ADC used in this work is ADC 0804LNC.The output of the ADC is given to the microcontroller.

***CURRENT SENSOR*:** The current sensor used in this work is ACS712; this is a breakout board for the fully integrated Hall Effect based linear ACS712 current sensor .The sensor gives precise current measurement for both AC and DC signals. The ACS712 outputs an analog voltage output signal that varies linearly with sensed current.

***POTENTIAL TRANSFORMER*:** It is used to measure the voltage, but here we directly take the voltage from the line and using a step down transformer we reduce the voltage for the working of ICs.

***POWER AND POWER FACTOR MEASUREMENT*:** With the help of CT and PT voltage and current are sensed. The output of each is given to the comparators LM 741 which measures the phase angle between the voltage and current and the other output from CT and PT is given to the microcontroller via ADC and both this outputs are given to input pins of microcontroller.

2.3. WORKING:

The main components used in the equipment are current sensor module (CT), potential transformer (PT), IC 89V51RD2, LCD display, ADC, DS 1307, Comparator LM 358.

With the help of current sensor module and potential transformer we could measure the current and the voltage. These values which are in analog form can be converted into digital form using ADC. The microcontroller(IC 89V51RD2) is programmed in such a way that (Kiel C Programming) we can input and output the data. The signals from the current transformer and potential transformer are given to the microcontroller via ADC and microcontroller is programmed to calculate the power. To find the power factor the signals form CT and PT are given to the comparator LM 358 which then measure the phase angle between voltage and current. The output of the power and power factor measurement circuit is given to the input pins of the microcontroller. With the help of all the data the power is calculated which is multiplied with the tariff rate to get the cost of energy consumed and is displayed in the LCD. Once the meter reading is taken by the utility we can reset to start the cost of calculation again. The clock DS1307 is provided to continue the operation of the meter when the supply is off.

2.4. FLOWCHART:

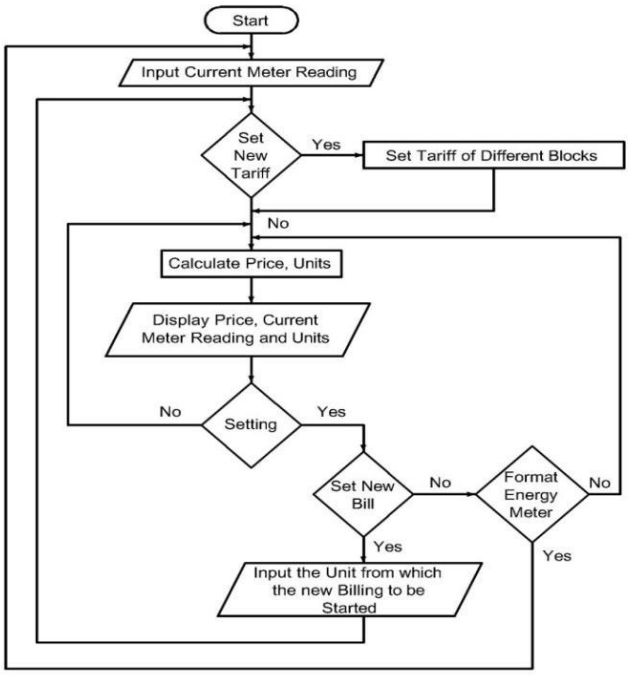

Fig 2: Flowchart

2.5 SIMULATION/TEST RESULT:

The results obtained from the simulation are shown in the Fig 3:

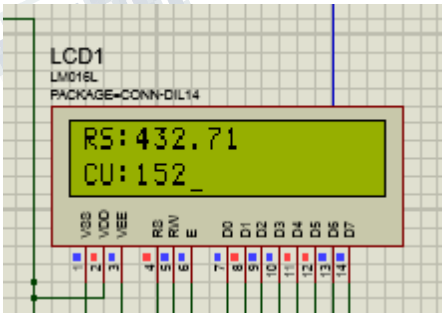

Fig 3: LCD display the cost of energy for current Unit

III. CONCLUSION:

The energy crisis is increasing day by day, so it is important to save energy. Proper energy management can be done through proper load management. This can be well supported through the introduction of smart energy meter.This is a real time monitoring equipment which help the consumer to know how much the consumption cost is.

IV. APPLICATION:

With this knowledge, we can take positive steps to save more of energy at home. This can have a positive impact on our levels of consumption and on the amount of money we spend.

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