Low Digital Cost Energy Meter With Energy 100 Unit Alarming System

Kazi Agharuddin, Mrinal Kanti Paria, Subhajit Devnath, Paritosh Malakar, Dipanjan Dutta

Abstract— This paper introduces a digital energy meter at a nominal cost. Analog to digital energy meter can be converted by the use of ir led, photodiode, IC cd 4033 and a seven segment display.a portionof the rotating disc of meter is made transparent and when the transparent portion comes under the IR LED the ray falls on the photodiode and the photodiode implies a signal to the IC and thus counting is made in the display.a buzzer is connected to the circuit and in every 100 unit the buzzer lines an alarm.

Index Terms— LED, Seven Segment Display, Buzzer, Energy meter.

1 INTRODUCTION

THE conventional mechanical energy meter is based on the phenomenon of "Magnetic Induction". It has a rotating aluminum Wheel called Ferriwheel and many toothed wheels. Based on the flow of current, the Ferriwheel rotates which makes rotation of other wheels. This will be converted into corresponding measurements in the display section. Since many mechanical parts are involved, mechanical defects and breakdown are common. More over chances of manipulation and current theft will be higher. Electronic Energy Meter is based on Digital Micro Technology (DMT) and uses no moving parts. So the EEM is known as "Static Energy Meter" In EEM the accurate functioning is controlled by a specially designed IC called ASIC (Application Specified Integrated Circuit). ASIC is constructed only for specific applications using Embedded System Technology. Similar ASIC are now used in Washing Machines, Air Conditioners, Automobiles, Digital Camera etc. In addition to ASIC, analogue circuits, Voltage transformer, Current transformer etc are also present in EEM to "Sample" current and voltage. The 'Input Data' (Voltage) is compared with a programmed "Reference Data' (Voltage) and finally a 'Voltage Rate' will be given to the output. This output is then converted into 'Digital Data' by the AD Converters (Analogue- Digital converter) present in the ASIC. The Digital Data is then converted into an "Average Value". Average Value / Mean Value is the measuring unit of power. The output of ASIC is available as "Pulses" indicated by the LED (Light Emitting Diode) placed on the front panel of EEM. These pulses are equal to Average Kilo Watt Hour (kWh/ unit). Different ASIC with various kWh are used in different makes of EEMs. But usually 800 to 3600 pulses / kWh generating ASIC s are used in EEMs.The output of ASIC is sufficient to drive a Stepper Motor to give display through the rotation of digits embossed wheels. The output pulses are indicated through LED [1].

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2 ENERGY METER

The energy meter is an electrical integrating instruments which is used to measure the total amount of electrical energy consume over a period of time. Utilities install these instruments at every place like homes, industries, organizations to charge the electricity consumption by loads such as lights, fans and other appliances. Most interesting type are used as prepaid electricity meters. This instrument are also known as supply meters or house service meters .There often referred as watt hour meter. The energy meter measure energy in KWH. Basic unit of power is watt. One thousand watts is one kilowatt. If we use one kilowatt in one hour, it is considered as one unit of energy consumed. These meters measure the instantaneous voltage and currents, calculate its product and gives instantaneous power. This power is integrated over a period which gives the energy utilized over that time period.

2.1 Analog Energy Meter

The basic working of Single phase induction type Energy Meter is only focused on two mechanisms:

1. Mechanism of rotation of an aluminum disc which is made to rotate at a speed proportional to the power.
2. Mechanism of counting and displaying the amount of energy transferred.

- Mechanism of rotation of an aluminum disc:

Which is made to rotate at a speed proportional to the power.
The metallic disc is acted upon by two coils. One coil is connected or arranged in such a way that it produces a magnetic flux in proportion to the voltage and the other produces a magnetic flux in proportion to the current. The field of the voltage coil is delayed by 90 degrees using a lag coil.
This produces eddy currents in the disc and the effect is such that a force is exerted on the disc in proportion to the product of the instantaneous current and voltage.
A permanent magnet exerts an opposing force proportional to the speed of rotation of the disc – this acts as a brake which causes the disc to stop spinning when power stops being drawn rather than allowing it to spin faster and faster. This causes the disc to rotate at a speed proportional to the power being used.
Mechanism of displaying the amount of energy transferred is

based on number of rotation of aluminum disc.
The aluminum disc is supported by a spindle which has a worm gear which drives the register. The register is a series of dials which record the amount of energy used.
The dials may be of the cyclometer type, an odometer-like display that is easy to read where for each dial a single digit is shown through a window in the face of the meter, or of the pointer type where a pointer indicates each digit.
It should be noted that with the dial pointer type, adjacent pointers generally rotate in opposite directions due to the gearing mechanism.

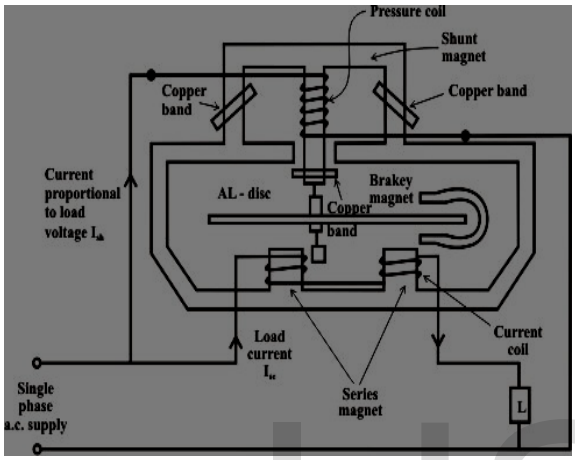

Fig. 1. Analog Enegrymeter

2.2 Digital Multimeter

1. They are more accurate than analog multimeters.
2. They reduce reading and interpolation errors.
3. The 'auto-polarity' function can prevent problems from connecting the meter to a test circuit with the wrong polarity.
4. Parallax errors are eliminated. If the pointer of an analog multimeter is viewed from a different angle, you will see a different value. This is parallax error. A digital multimeter's numerical display solves this problem
5. Digital multimeter displays have no moving parts. This makes them free from wear and shock failures.
6. The reading speed is increased as it is easier to read.
7. Unlike analog multimeters, zero adjustment is not required.
8. Digital output is suitable for further processing or recording and can be useful in a rapidly increasing range of computer controlled applications.
9. With the advent of Integrated circuits, the size, cost and power requirements of digital multimeters has been drastically reduced.
10. Accuracy is increased due to digital readout. You can make mistake in reading the scale in analogmultimeter, but digital multimeters have a LCD display to show accurate reading.

3 IC555 TIMER

IC 555 timer is a well-known component in the electronic circles but what is not known to most of the people is the internal circuitry of the IC and the function of various pins present there in the IC. Let me tell you a fact about why 555 timer is called so, the timer got its name from the three 5 kilo-ohm resistor in series employed in the internal circuit of the IC.
IC 555 timer is a one of the most widely used IC in electronics and is used in various electronic circuits for its robust and stable properties. It works as square-wave form generator with duty cycle varying from 50% to 100%, Oscillator and can also provide time delay in circuits. The 555 timer got its name from the three 5k ohm resistor connected in a voltage-divider pattern which is shown in the figure below. A simplified diagram of the internal circuit is given below for better understanding as the full internal circuit consists of over more than 16 resistors, 20 transistors, 2 diodes, a flip-flop and many other circuit components [2].
The 555 timer comes as 8 pin DIP (Dual In-line Package) device. There is also a 556 dual version of 555 timer which consists of two complete 555 timers in 14 DIP and a 558 quadruple timer which is consisting of four 555 timer in one IC and is available as a 16 pin DIP in the market.

3.1 Basic Concept

Comparator: The Comparator are the basic electronic component which compares the two input voltages i.e. between the inverting (-) and the non-inverting (+) input and if the non-inverting input is more than the inverting input then the output of the comparator is high. Also the input resistance of an ideal comparator is infinite.

- Voltage Divider: As we know that the input resistance of the comparators is infinite hence the input voltage is divided equally between the three resistors. The value being Vin/3 across each resistor.
- Flip/Flop: Flip/Flop is a memory element of Digital-electronics. The output (Q) of the flip/flop is 'high' if the input at 'S' terminal is 'high' and 'R' is at 'Low' and the output (Q) is 'low' when the input at 'S' is 'low' and at 'R' is high.

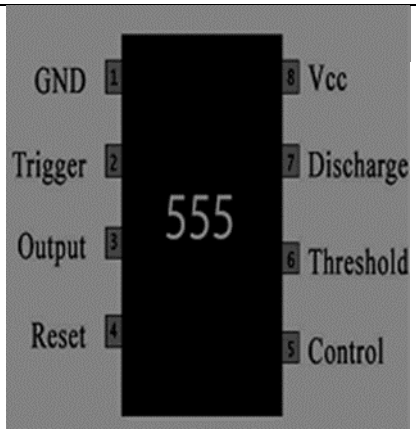

Fig. 2. IC555 Timer

- Function of different Pins:-

1) Ground: This pin is used to provide a zero voltage rail to the Integrated circuit to divide the supply potential between the three resistors shown in the diagram.
2) Trigger: As we can see that the voltage at the non-inverting end of the comparator is Vin/3, so if the trigger input is used to set the output of the F/F to 'high' state by applying a voltage equal to or less than

Vin/3 or any negative pulse, as the voltage at the non-inverting end of the comparator is Vin/3.

3) Output: It is the output pin of the IC, connected to the Q′ (Q-bar) of the F/F with an inverter in between as show in the figure.
4) Reset: This pin is used to reset the output of the F/F regardless of the initial condition of the F/F and also it is an active low Pin so it connected to 'high' state to avoid any noise interference, unless a reset operation is required. So most of the time it is connected to the Supply voltage as shown in the figure.
5) Control Voltage: As we can see that the pin 5 is connected to the inverting input having a voltage level of (2/3) Vin. It is used to override the inverting voltage to change the width of the output signal irrespective of the RC timing network.
6) Threshold: The pin is connected to the non-inverting input of the first comparator. The output of the comparator will be high when the threshold voltage will be more than (2/3) Vin thus resetting the output (Q) of the F/F from 'high' to 'low'.
7) Discharge: This pin is used to discharge the timing capacitors (capacitors involved in the external circuit to make the IC behave as a square wave generator) to ground when the output of Pin 3 is switched to 'low'.
8) Supply: This pin is used to provide the IC with the supply voltage for the functioning and carrying of the different operations to be fulfilled with the 555 timer.

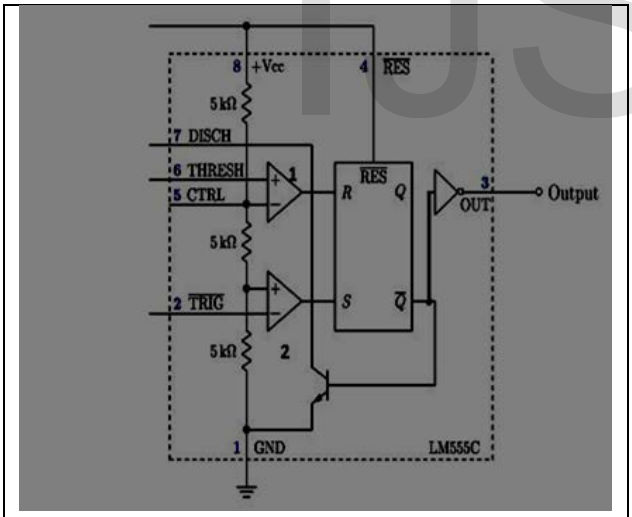

Fig. 3. Circuit Diagram

- Uses: - The IC 55 timer is used in many circuits, for example One-shot pulse generator in Monostable mode as an Oscillator in Astable Mode or in Bistable mode to produce a flip/flop type action. It is also used in many types of other circuit for achievement of various purposes for instance Pulse Amplitude Modulatin (PAM), Pulse Width Modulation (PWM) etc.

4 Seven Segment Display

A seven-segment display (SSD), or seven-segment indicator, is a form of electronic display device for displaying decimalnumerals that is an alternative to the more complex dot matrix displays.

Seven-segment displays are widely used in digital clocks, electronic meters, basic calculators, and other electronic devices that display numerical information.A seven-segment display is a set of seven bar-shaped LED (light-emitting diode) or LCD (liquid crystal display) elements, arranged to form a squared-off figure 8. A few seven-segment displays use other illumination devices, such as incandescent or gas-plasma ("neon") lamps. If all elements are activated, the display shows a numeral 8. When some of the elements are activated but not others, any single-digit numeral from 0 to 9, as well as most uppercase and lowercase letters of the English alphabet, can be portrayed. Seven-segment displays are commonly used in digital clocks, clock radios, timers, wristwatches, and calculators. They can also be found in motor-vehicle odometers, speedometers, radio frequency indicators, and practically any other display that makes use of alphanumeric characters alone (without the need for graphics). Some seven-segment displays produce an "italicized" (slanted) set of characters. Individual seven-segment display packages are available from a variety of vendors. Most take the form of rectangular boxes with protruding pins, with an appearance similar to that of an IC (integrated circuit) package, but larger. Some seven-segment displays include a decimal point (a small, dot-shaped element) to the lower right of the bar-shaped segments, so in fact the face of the package contains eight independent elements. A few seven-segment displays have even more dot-shaped elements to portray time in hour-and-minute format, e.g., 12:30. Multiple packages can be arranged in a horizontal row to render large decimal numbers, abbreviations, acronyms, and short words. The seven-segment concept is more than a century old. One of the earliest records of its use dates back to an electric power plant in the year 1910. That display comprised a large matrix of incandescent bulbs arranged in seven rows. The bulbs could be switched on and off, row by row, to inform engineers about the condition of the system.

5 IR LED

The IR LED (or infrared light-emitting diode) module sends out light with longer wavelengths than visible light, similar to the light in your remote control. It's invisible to the eye, but many digital cameras can see it! Try using it to activate the light sensor or remote trigger [3].

From the main supply of 230 volt. We arrange a step down transformer of 230/12 volt. Then here's a bridge rectifier to convert the ac I/p to dc o/p. After that here's a capacitor to reduce the existing unwanted ripples from the o/p of the bridge circuit. It goes into the IC 7805 & the o/p of 5 volt. Is separated into two parallel sections. One goes to the IC555 & another goes to the IC's (CD4033). We can see that there's one I/p of 5v. To the timer IC555. An IR LED is connected to that timer. At the right of the IR LED here's a rotating disk which has a certain resistive point over its own. When the point

passes the IR LED, the LED exerts a ray to the photo diode [5]. A certain pulse from that photo diode comes to the right most IC CD4033 (1) & terminal 5 of all the CD4033 IC's are mutually short circuited to the terminals 1 of others. Not only this, the terminals 2, 8 &14 are short circuited & are entered into the ground (0 volt.) The terminal 15 of all the IC (CD4033)'s are short circuited and is connected to the ground. After that we can see that below each IC CD4033 there is a 7 segment display. The terminals are connected as follows. There's one of the seven segment displays which counts a point & the terminal 5 of this is connected to the o/p of IC7805. The terminal 3 of the seven segment displays are short circuited &connected to the ground. The left most seven segment display is connected to a buzzer through its terminal 4. & another terminal of that buzzer is connected to the ground. When the seven segment display will reach 100 units the buzzer will ring. Thus in digital form we can have an alarm when our consumption will reach to 100 units.

TABLE 1
DISPLAY

Terminal of CD4033	Terminal of 7 segment display
10	7
12	6
13	4
9	2
11	1
6	9
7	10

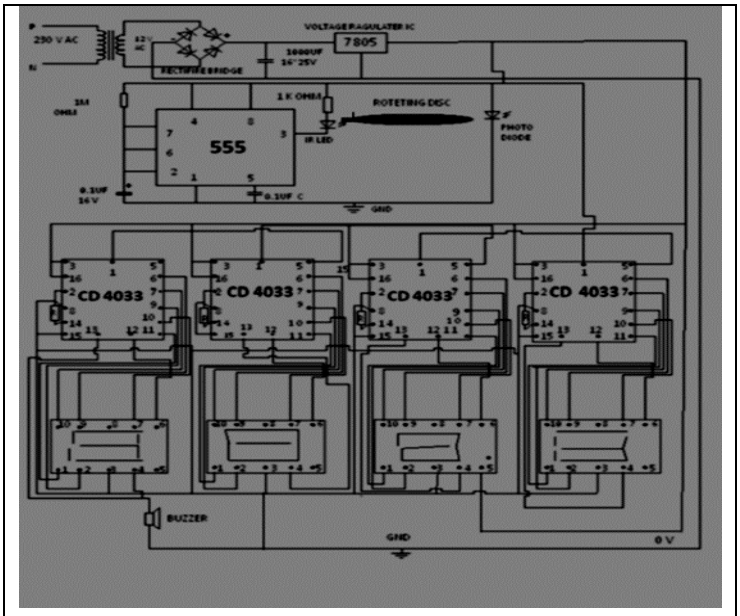

Fig. 4. Final Diagram

CONCLUSION

After discussing this project, we get a conclusions that if we can this energy meter refereed to normal energy, case after 100 units the alarm will ring. After all positive side of these energy meter is safer then other energy meter [4].

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