Smart Energy Meter Using NI Lab VIEW

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Abstract: The aim of this project is to provide two way communication between consumer and energy board Reducing both manual work and operating cost, Identifying theft of energy, voltage fluctuations and providing better reliability. Billing of traditional energy meters can be done by workers from home to home, it requires large number of workers and working time to collect the data, Also annually world loses some billion dollars of money due to electricity theft , Above conditions made replacement of traditional meters with automatic metering system, Arduino can be used to monitor and record the meter readings , The cost amount for energy consumption can be calculated by MICROCONTROLLER and power theft can be identified by MyRio, Then it can be sent to GSM module, Meter readings from GSM can be sent back and the details are updated in central data base, This details can be sent to consumer mobile phone like SMS through GSM module using Internet of Things(IOT) .Therefore the proposed Smart Meter reduces human effort and cost of utility by providing two way communication, Identifies theft of power, fluctuations and efficiency can be improved.

Key Words: Two Way Communication (Consumer and Energy Board), Reduces Manual Work, Identify Theft of Energy, Traditional Meters, Smart Meter, MyRio, Arduino, GSM Module, Internet of Things(IOT).

I. Introduction

In the present era, Power crisis is the major
Problem of the world. Due to increase in the Electronic commodities, Energy consumption Increasing day by day this causes generation of power by non-renewable energy sources elevated, which leads to depletion of non-renewable energy sources and creates adverse affect upon the environment. Study conducted by the Northeast Group, LLC revealed truth that annually world loses$89.3 billion due to power theft.

On behalf of that, the highest losses were in India i.e.,approximately $16.2 billion. Also total transmission and distribution losses approached to 23% and in some states loses exceeds up to 50%. For billing utility grid workers has to go home to home to collect data and it takes more time and operating cost also huge, there are some users who don't pay bills intime and this causes lot of problem to utility grid which leads to increase in penalty. During monsoon season or in any fault conditions, there will be fluctuations in the system which causes damage to our home appliances. Also there is a huge problem of power management.
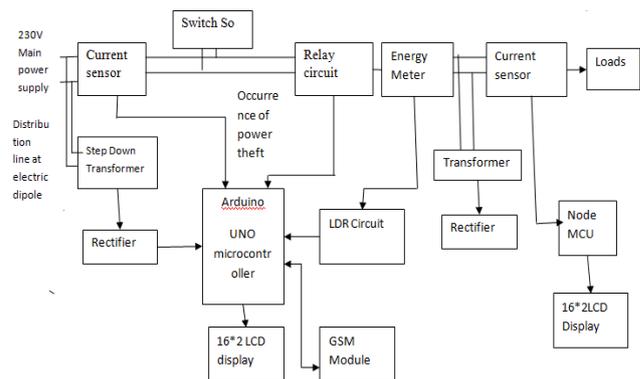
II. Proposed System

Fig.1 Block diagram of proposed system

In the proposed system, In order to use energy we have to recharge energy meter based on our requirement and user gets alerts about consumption using GSM Module. We made high voltage detection circuit which automatically detects voltage fluctuations and the value exceeds prescribed value then circuits trips automatically by using relay, if any theft of energy happens in system then MyRio detects the theft and then indicates to utility grid.
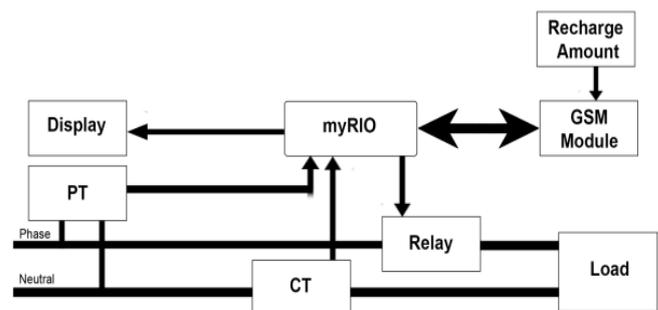
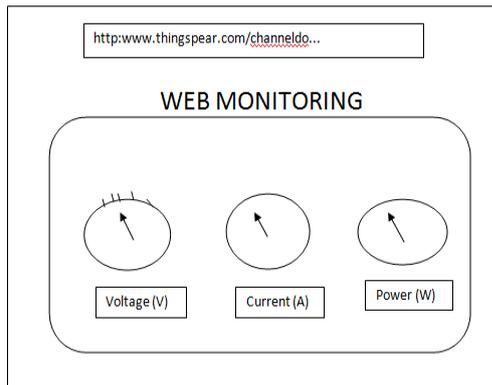

Fig.1.1 Generalised block diagram

Fig.1.3 Web Monitoring

Above Fig.1.3 shown is the sample web monitoring used in the project which is used for monitoring of entire system voltage, current, power with the help Internet of Things(IOT).

III. Methodology

1.Recharge of Smart Energy Meter:

    After the energy meter installed at user premises user can recharge their smart meter based on requirement and the consumption can be viewed using IOT in the Ubidots server.
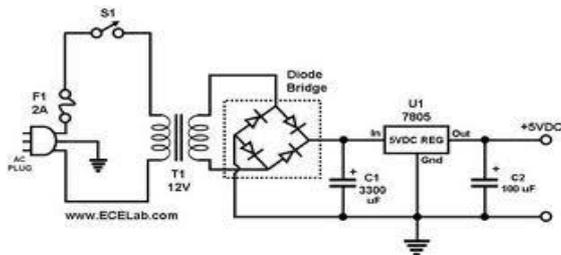

Fig.2 Circuit diagram of LPC2148

With the help of LPC2148 module we can interface with Internet for transmitting and receiving data. By using Internet of Things as seen in Fig 2.1.we can integrate all the home appliances consumption can be viewed in Ubidots server.
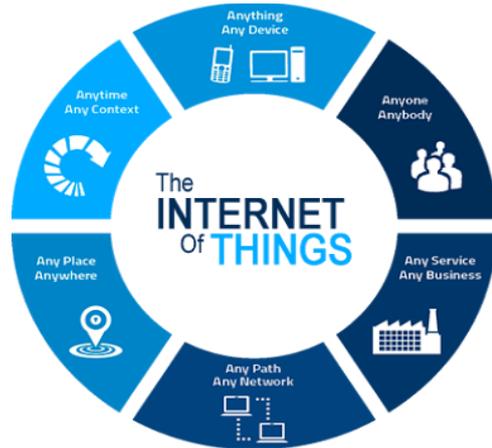

Fig.2.1 IOT

Generally three parameters required to calculate electrical energy- voltage, current and power factor, these parameters can be measured by Voltage sensor, Current sensor and Zero crossing detector. Smart energy metermeasures the amount of electrical energy supplied to consumer in kilo watt hour or Wh as well as real power, reactive power, apparent power, voltage, current. Energy consumption can be calculated as

$$E=\int v(t)i(t)dt= \int VI \sin(wt)\cos(wt-\alpha)$$

Since digital processor cannot manipulate analogue data, but sampled data can be manipulated. ADC gives analogue voltage and current into digital form.

$$P= \sum(V[n]I[n])/(N)$$

Phase angle is enbedded in the voltage and current samples.Energy in terms of watt seconds can be written as

$$E= \sum(V[n]I[n])/(Fs)$$

Fs= F1/(PER+1)
Where Fs is sampling frequency,PES is timer period register value andF1 is timer frequency
Apparent power can be obtained by multiplying instantaneous voltage and current then power factor can be obtained by dividing real power by apparent power.Thus all the electrical measuring parameters obtained by using MyRio with sampled values of voltage and current.
Fractional delay introduced in voltage sample by single zero FIR filter is given by

$$Y[n]= X[n]+\beta x[n-1] --> 1$$

Apply Z-transforms for equation-1 then obtained calibration constants.

Finally calibrated power can be obtained as

P = KvKi√∑(V[n]I[n])/(N)

Where Kv and Ki are calibration constants

2) Detection of voltage fluctuation:

When any fault occurs in the system there will be voltage fluctuations produced which can be identified by voltage sensor as shown in Fig.2.2, then voltage sensor sends signal to relay circuit which gets activated and trips the circuit again when normal supply detected system automatically turned on.

Fig.2.2 Voltage Sensor

3) Indication of power theft:

Whenever input given to the system equal to ouput including losses then there will no power theft. When there is difference in input and output power then theft of power occurred which can be indicated and message sent to utility grid.

IV. Software and Hardware Overview

1) Fig.3 shows how the recharge of energy meter can be done step by step which can be done by user in mobile phone.
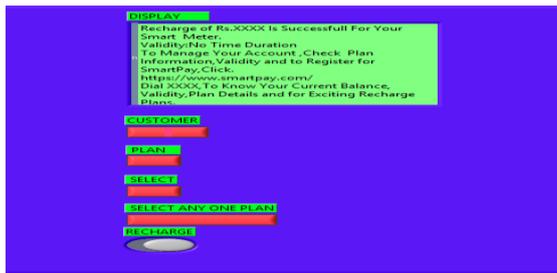

Fig.3 Recharge of Energy Meter

2) Fig.3.1 shows when no power theft and no high current detected such that sensing devices in off position,there will be no indication
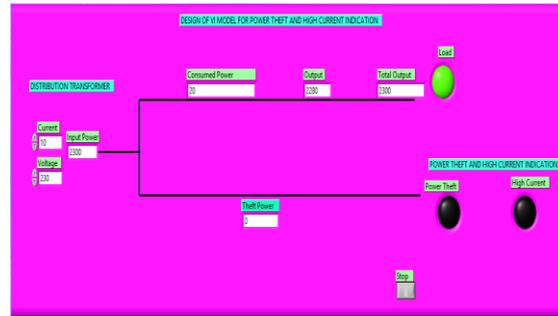

Fig.3.1 VI of Power Theft and High Current Indication.

3) Whenever power theft happens which can be indicated in the system with indication as shown in Fig.3.2.
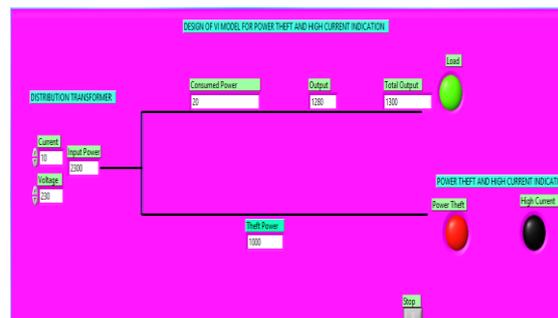

Fig.3.2 Power theft indication.

4) Whenever high currents are detected then system automatically trips system and indicated as shown in Fig.3.3.

Fig.3.3 High Current Indication

5) Fig.3.4 shows developed prototype with all the three problems can be solved by using the prototype.

Fig.3.4 Developed Prototype

V. Conclusion

The paper mainly concentrates on three major problems Billing system,Power Theft and Voltage Fluctuations by eradicating above problems by using above mentioned techniques makes the system to function properly without any disturbance. Thus the proposed Smart Meter reduces human effort and cost of utility by providing two way communication, identifies theft of energy, fluctuations and efficiency can be improved.

ACKNOWLEDGEMENT

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