Prepaid Energy Meter Using Labview on TOD Basis

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Abstract- The demand of electricity is increasing very rapidly and the difference between demand and a supply of energy is growing day by day. The concept of this project is to create a demand side time of the day (TOD) based energy monitoring system. In which we will provide the user a facility to charge different, in different time slots of the day for the energy. Where we can bill the user based on his energy consumption in particular time slots during the day. So we can decide that in peak hours the energy per unit cost can be high and can be low in normal hours or off-peak hours and it can lead to the balance system supply and demand, energy efficiency and can reduce overall system demand. In this project energy meter uses a recharge in various ranges (i.e. Rs.20, Rs.50, Rs.100, etc.). As per the consumption of power, the amount will be charged. We have choose a flexible pricing offer, different rates will apply at different times throughout the day. In this system, we want to create a system where the electricity billing can be charged according the used number of units on the particular time of the day using Labview.

KEYWORDS- Energy management, TOD, LabVIEW, Zigbee, GUI.

I. INTRODUCTION

Electricity is one of the vital requirment for sustainment of comfort of life. It should be used very carefully for its proper utilization. But in our country we have lot of localities where we have excess supply for the electricity while many areas do not even have access to it. People spend much more power than what they actually need and that result in huge loss of energy. Moreover the constant increase in the universal energy prices has resulted in a tremendous economical loss. Preventive steps to be taken of electricity theft and saving of electricity is required to use the electricity continuously. Even to reduce the cost obtain for the manual collection of electricity bills needs a change. Thus we are proposing a prepaid electricity billing system on TOD basis using labview. So, people can purchase specific amount of energy to use it only when they need.

Electricity consumption is increasing rapidly and production is not growing at that pace. It is very important for economical development of country and development is linked to the energy availability. Accuracy in meter reading, detection of energy theft and implementation of proper billing as well as traiff system are very important in wise energy management. Load curve of Indian utility is on-peak in morning and evening hours. Differential between demand and supply is increasing day by day. Naturally cost of generation of energy will also increase in order to meet the peak demand. To reduce this difference it is necessary to shift the load of certain consumer categories to off peak hours. The major load on utility system is industrial sector, and hence if industries would take initiatives for flattening the load curve by shifting their loads from peak hours to off peak hours, it will be profitable to both utility and industry.

Time of the day metering (TOD), also known as Time of usage (TOU) or seasonal time of day (STOD), metering involves dividing the day, month, and year into tariff slots and with higher rates at peak load hours and low tariff rates at off peak load hour. This can be used to monitor and control the usage of the customer (resulting in automatic load control), it is often simply the customers responsibility to control his own usage, or pay according to the usage (voluntary load control). This also allows the utilities to plan their transmission appropriately.

A. Concept of TOD Metering

Time of Day (TOD) metering is a concept which gives a pecuniary incentive to the consumers in deliberately shifting a part of their overall electricity use from the hours of peak demand to those of lean demand daily. As the consumer intentionally move a part of electricity usage to the hours of lean demand, the electricity requirement during the two peak times of a day – morning and evening can be reduced. Hence TOD metering concept is an exit for the consumers from frequent power outages. The TOD metering involves dividing the day into tariff slots and assigning higher rates at peak load periods (hours of peak demand) and lower tariff rates at off-peak load periods (hours of lean demand). Hence LabVIEW based automated system to monitor demand side energy utilization will signal the consumers that the electricity is pricey during the two peak times of a day – morning and evening. During the peak times the consumers will have to pay more money for consuming more than required or will have to use it economically.

B. LABVIEW BASED TOD METERING

LabVIEW based automated system facilitates centralized demand side energy meter data collection and energy utilization computation on TOD basis. This will enable remote monitoring and analysis of demand side energy utilization. This system comprises of a microcontroller based energy utilization recorder on TOD basis, LabVIEW based remote end demand side management system, ZigBee based transceiver and energy meter. Microcontroller based energy utilization recorder is a real time clock based system that performs electronic tracking of demand side energy utilization on TOD basis. During the end of each day, the electronically tracked information is transmitted to LabVIEW based remote end energy monitoring system. The electronically transmitted information comprises of meter ID, energy consumed during the hours of peak demand and the hours of lean demand. Since LabVIEW application is customized to monitor demand side energy utilization, it can be referred to as a Graphical User Interface (GUI) or Human Machine Interface (HMI). This application is designed with functionalities like data acquisition via wireless communication, graphical analysis of demand side energy utilization, auto-data collection of energy meter readings for billing purpose. As a HMI, this application enables the remote end operator to select the tariff per unit consumed during the hours of peak demand and the hours of lean demand. Demand side energy utilization data acquired through wireless communication will be used by the LabVIEW application to perform automatic tariff calculation and report generation for monthly billing. ZigBee based wireless communication technology is used for the communication between the energy utilization recorder and the LabVIEW application. The above description implies that the mentioned LabVIEW application will circumvent the role of meter readers.

C. LabVIEW Application

The LabVIEW application for remote end demand side monitoring system is designed with following functionalities.
• Automatic wireless data acquisition for graphical analysis of energy utilization during the periods of peak demand and lean demand
• Energy utilization consumer details registration for billing purpose.
• Tariff selection for energy utilization billing.
• Automatic bill statement generation as Microsoft word document.

II. LITERATURE SURVEY

K.Thiyagarajan, the energy management is the process of monitoring, controlling, and conserving energy in building or organization, In this paper a real time energy management and load forecasting in smart grid based on the NI Compatriot platform is done. The RIO is used to get the real time data from different loads and the data is transferred and stored through console via Ethernet. Load forecasting is done by past and present data of electrical load connected with the grid using artificial neural networks.
An effective vitality protection show is intended for working by checking and control through Lab VIEW. The programmed control of fan and light associated through Ethernet has been accomplished dependent on the contribution from sensors and power checking module for effective vitality the executives. The pressure of machine information from ARM empowers the correspondence quicker without information blockage. This can be additionally upgraded for different machines too.

Prashanth B.V, 2013, Wireless energy meter is a system developed to serve as a basic single-phase energy meter with advanced functionalities such as Peak hour setting, Peak load setting; further the system eliminates the role of a Meter Reader.
This investigation moved toward the impacts of DMS concerning higher supportability in the BM, in light of contextual investigations performed with a nearby blow film maker and a lattice administrator. The examined DSM potential is connected to money related, ecological and social advantages for each organization and its partners. Under thought of environmental change, the outcomes feature the need of an all encompassing methodology in the vitality advertise. While mechanical vitality productivity procedures may have early monetary points of interest, long haul systems might be required. The connection between various measures and interests can be utilized to make an extra incentive by utilizing collaborations. Working from current state (esteem catch and esteem missed/wrecked), prompting conceivable BM (esteem opportunity), the utilization of VTM conveyed proof to the union of significant worth open doors from industry and lattice administrators. From this arrangement, new BMs dependent on DSM that incorporates mechanical and framework administrator accomplices could be sent. Past investigations in the vitality area, found helpful application to the accompanying BM components: offer, client interface, framework and income demonstrate. The hardware design of the energy meter has been completed and implemented. The code at meter side completed and tested. The front end is designed using Visual basic. Mobile phones are used instead of GSM modules.

Sanjeev Kumar, To glean the benefits of Smart Grid concepts of Demand Side Management and Demand Response to the fullest, it is imperative that innovative dynamic tariff structures be designed through which the benefits of Smart grids can be realized by all the stakeholders at the revenue generation end of the electricity value chain right from consumer, distribution company, state governments and the nation. This white paper highlights one such Dynamic tariff structure which may help in the wider application of smart grid technologies such as demand side management and demand response. Proposed Dynamic tariff structure includes frequency based tariff component as well as preannounced Time of Day tariff charging higher price for peak load periods based on historical data. Reliability surcharge and discounts on pre-payment are also proposed to be included in the tariff. Consumers may be given an option to participate in the new tariff scheme with a cap that the revised bill amount will not exceed the amount payable as per existing tariff plan in that area. After further discussions with utilities, the proposed dynamic price structure can be implemented for smart grid pilots in parallel to the existing billing mechanism in order to test actual impact on load profile, tariff, and revenue for the utility from that area. In order to avoid resistance to change, consumers may be given an option to opt out of the new price structure and a commitment that the bill as per new tariff structure shall not exceed the bill as per conventional tariff structure except for reliability surcharge that will be payable only if agreed mutually by a group of consumers served by same Distribution transformer. Further improvement of the price mechanism can be based on the outcome of pilots.

Andrew Grzelak, The goal of this project was to learn about and develop an energy monitoring system at a manufacturing machine level. This applied research project has concluded in the development of such a system. Overall this project was successful, both from an educational standpoint as well as from a practical standpoint. Throughout all the research and the project work at all the different universities; there has been much to learn. Primarily, much has been learned regarding energy management systems, the thought and work that goes into them and what information they should provide to an end user. Some of the major difficulties experienced in this project were due to the international mobility aspect of the Atlantis graduate program. However, it has all been a successful endeavor and the conclusion of the project has been a prosperous one.

Abubakar, Background/Objective: The major purpose of a smart house is to ensure proper usage of the electricity in an economic and optimized manner, apart from the home automation and communication capability of the smart system. In an effort to promote the energy management capability of the smart house, this paper describes the design and implementation of an automatic single phase energy consumption management of a smart house. Methods/Statistical Analysis: The system uses the instantaneous power calculation method to calculate the total power, voltage, current and power factor consumption of the house using arguing microcontroller. It displays the results and through the actions of the relays that supply the house, the loads will be reduced based on the priority to ensure that the total KW consumption of the house is not more than the threshold value.

The work also provides the analysis on the voltage sensor using Polynomial Curve Fitting. Findings: Experimental analysis on the system shows that it is capable of maintaining the house loads below 2KW (the set threshold value), automatic reconnection of the loads and a special alarm if all the relays cut out. It also displays the real time power consumption, Voltage, Current and power factor of the loads. The system has a maximum error of 2.47% in voltage measurement (above 10V AC) and a maximum error of 1.89% in current measurement when compared with a standard FLUKE meter. Applications/Improvements: When properly applied in a smart house, the system will significantly reduce the total energy consumption of the house resulting into a significant saving in the electricity bill.

Mohit John, This paper depicts the usage of remote observing framework for the interest side vitality use utilizing the graphical framework structure stage – LabVIEW. This LabVIEW application utilizes the idea of Time of Day (TOD) metering to follow how much power a buyer utilizes and the season of utilization. Request side vitality usage is followed electronically utilizing a microcontroller based framework. The electronically followed data is obtained by the LabVIEW application utilizing ZigBee based remote correspondence. This LabVIEW based remote application empowers the administrator to fix the shopper's vitality unit costs which shift at various occasions of the day. At last this robotized framework likewise produces a definite articulation of the interest side vitality use which thusly causes the interest side to deal with the power usage.

The graphical framework structure stage – LabVIEW is utilized for executing the independent remote information obtaining framework that plays out the checking of interest side vitality usage on TOD premise. The present framework empowers the administrator to have graphical examination of vitality usage amid the distinctive times of interest, levy determination lastly robotized charge articulation age. Future work will incorporate electronic observing and control of interest side vitality usage

III. System Design

The idea behind this system is to control the billing of electricity consumption based on the time of the day (TOD) activity of the user. In this we are creating a system where the electricity billing can be charged according the used number of units on the particular time of the day. This system consists of an electricity meter, which can measure the electricity passing through it and we have connected some pre-known loads, which are bulbs for the consumption of electricity. The energy meter has an LED which blinks 3600 times whenever one unit of electricity is consumed. We have replaced this LED with an opto coupler to read the signal from meter into the microcontroller unit.

Arduino nano (atmega328p) microcontroller has been used. The signal from meter is fed to the microcontroller as input for counting the number of units consumed by the loads. This is then displayed on a 16x2 Liquid crystal display which is connected to the same arduino microcontroller unit. This display can show total 32 characters at a time. To select between various time zones throughout the day and to change the days 4 switches are required, 3 of them used for time of the day selection, and one toggle switch is used to select the day from day 1 to day 5. The readings of each time zone of each day are transmitted through zigbee transceiver to the computer. To interface with the zigbee transceiver, RS232 IC section is required to convert the signal from TTL level to 232 level and back from it.

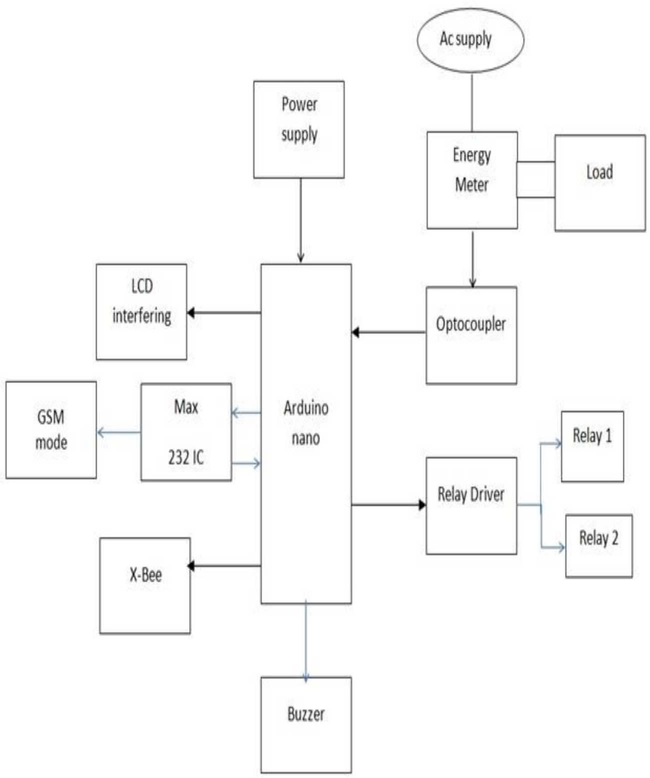

Figure 1 Block Diagram

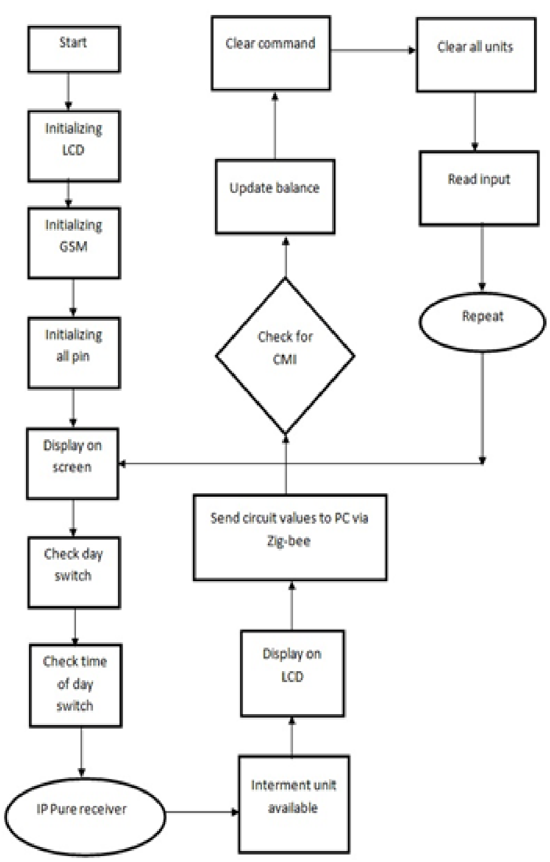

Figure 2 Flow chart of proposed system

Results

There are two different units that was combined to make the system. The two units that was combined were circuit for interfacing energy meter to arduino and interface from zigbee module to Arduino. Circuit operation was in good condition with the right sequence of program that uploaded into microcontroller. For the light to voltage sensor part, Arduino with microcontroller was used to count the input, calculate the bill and store it into EEPROM. The value of unit and bill price was display at the monitor using the Lab view display.

Graphical representation of readings on Labview GUI.

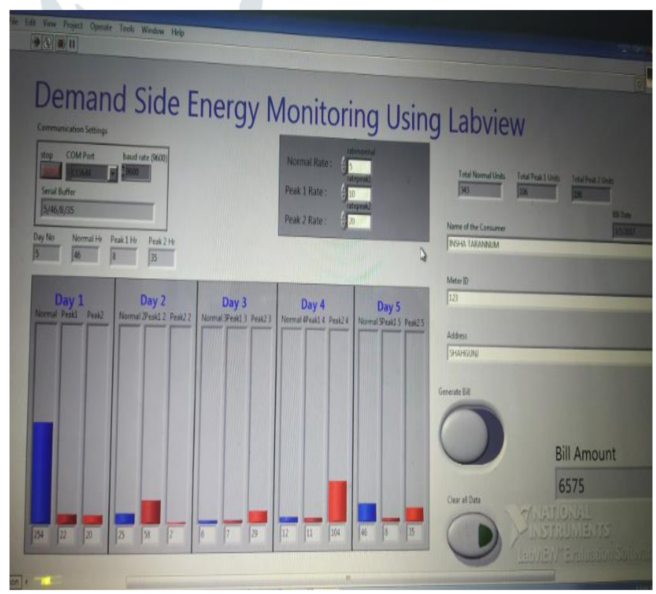

Figure 3 Graphical representation output on Labview

Low balance alert pop-ups if balance is insufficient or low.

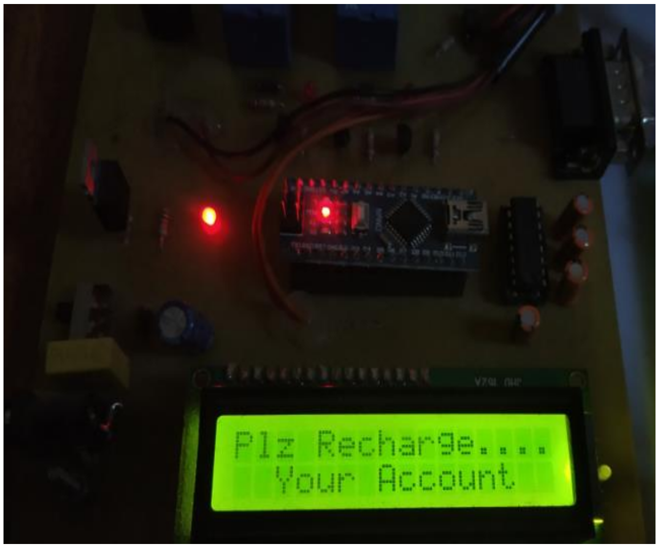

Figure 4 Low balance alert

Analyzation and Generation of bill is done on the Labview GUI.

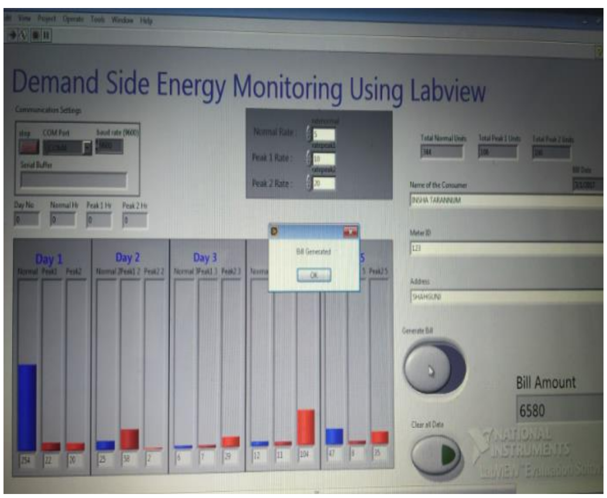

Figure 5 Value of unit and Bill price generation

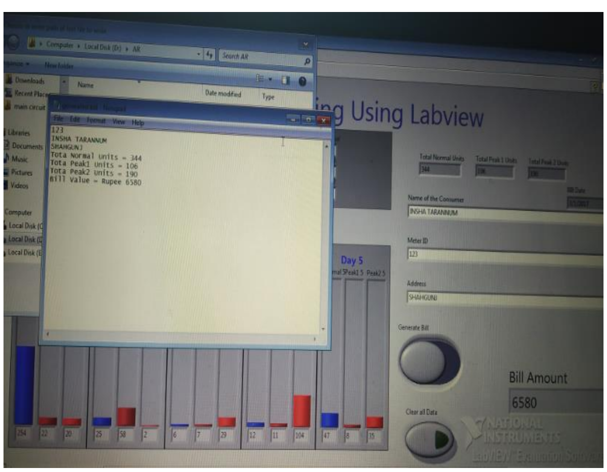

Figure 6 Final Bill generation

CONCLISION

Power factor correction offers an opportunity for energy cost reductions at facilities by reducing losses from their distribution systems. Since power factor correction reduces the apparent demand, the saved demand is therefore made available for other needy consumers.

However, facility and commercial center owners find it difficult to implement power factor correction due to the up-front capital required to purchase the necessary equipment. The scarce financial resources available to managers and owners are usually allocated to the most pressing issues at hand and power factor correction is often neglected. Awareness-raising on the long-term benefits of power factor correction needs be carried out, followed up by innovative policies that create incentives and make resources available for power factor correction implementation.

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