

Enhanced Smart Energy Meter using IOT

Niharika Banerjee, Preety Manna, K. Surendhirababu, K. Venkatasubramani

Abstract--- In our day to day life electricity plays a vital role. India has power generating capacity of 334.4 gigawatt as of January 2018. The primary energy consumption of India is the 3rd biggest after China and U.S.A with 5.6% of the global share in 2018. The main objective of this project is to make people aware about the power consumption in our day to day life so that we can save energy. There will be a particular peak value set in the system and if the power consumption exceeds the particular value set, then the alarm will start buzzing. And also, the project will give notification about the power theft, power cut and overloading by using PIC16F877A micro-controller and a GSM module (Global System for Mobile Communication). The advantage of this system is that it reduces human dependency, labour and it helps in bringing awareness about the usage of energy in household and private sectors.

I. INTRODUCTION

Energy is needed in different forms but the most important form of energy is electrical energy. It is the superior among all form of energies. Electrical energy is the basic necessity in the economic development of our country. India has surplus power generation capacity. The total electricity generated in the year 2017-2018 was 1,486.5 TWh. India is the 3rd biggest country in the power consumption. Hence, conservation of power is necessary. It can save money and also reduces the emission of greenhouse gas. To conserve electrical energy, this project will bring awareness about the power consumption usage by using PIC16F877A and GSM module.

Smart Energy Meter

Smart energy meter is a device which is used to record and display electric power consumption in terms of unit[18]. Energy meter is necessary in houses, shops, factories for registering power consumption [1]. The main purpose of smart energy meter is to monitor the instantaneous power consumed and also sending useful information to the consumers about the power consumption [2]. The methods and ports for Communication are GSM-GPRS and WiFi module, for the bigger area of approach, ZigBee Bluetooth model can be used [12][17]. A chip named as Energy Meter Chip is used to convert analog signal to the digital signal which helps to record and observe the amount of energy consumed [13][20].

PIC16F877A Micro-controller

PIC stands for Peripheral Interface Controller developed by microchip. It is used in 8-bit micro-controller devices. Microchip technology has constantly changed its architecture and added the peripherals according to customers' needs [3]. It consists of RAM, ROM, counters, timers, ADC (analog to digital convertors), DAC (digital to analog convertors). PIC uses Harvard Architecture and supports RISC (Reduced Instruction Set Computer) [4]. It contains 40 pins and 5 Ports, which can be referred as Port A, Port B, Port C, Port D and Port E. SPI Protocol is supported by the PIC16F877A micro-controller. The data is transferred from the TX and is received from the RX and it consists of 2 pins [11].

GSM

GSM stands for Global System for Mobile. It is used for the digital cellular communication. GSM is divided into three parts: The Switching System (SS), the Base Station System (BSS) and the Operation and Support System (OSS) [5]. It is an open source system. GSM operates on the 900 MHz, 1800 MHz and 1900 MHz [6]. It uses the Time Division Multiple Access (TDMA). Its working has been further studied from the other reference works [14]. The services including voice and text-based services is provided through mobile phone networking. Its simulation is done in the proteus[15]. In the real time, the GSM is supporting more than five billion mobile subscriptions. It is used in more than 200 countries [8].

IOT

IOT stands for Internet of Things. It involves billions of devices inter-connected to each other. The connected devices can be smart phones, computers, sensors [7]. The three main aspects of the IOT can be referred as Communication, Control and Automation and Cost Savings [9]. The field of IOT can be beneficial to the all the service sector, public sector, supply chain industry, construction, manufacturing, agriculture and environment, energy services and National security, smart cities and transportation and intelligent buildings [10].

II. EXISTING SYSTEM

The existing model's working is time consuming and it requires human labour. It increases the dependency on the human for the collection of the monthly reading of the meter. Its reading can be noted in the digital form. It can't be interlinked with the consumers personal mobile phone or with the GSM module.

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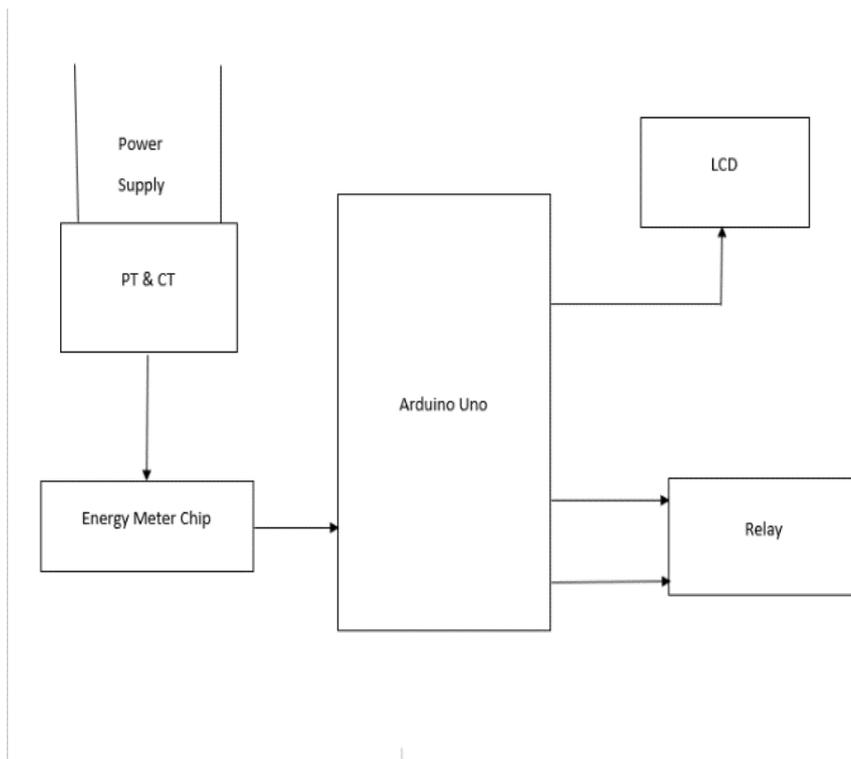


Figure 1: Existing system Block model

III. PROPOSED SYSTEM

The energy meter presented before are time consuming, and needs a lot of human labour. The presented model is fast, effective and it gives out various information regarding the consumption of power units in the demanded amount of time lapse. The various information about power consumption (in units), power theft, overloading, power-cut can be seen in the LCD and also in the costumer’s respective mobile phones using the GSM module. This system will also be helpful in controlling the electricity power which is supplied to their home by switching the power supply On or Off with the use of their mobile phones from a long distance from their respective home. The new system will also enable users to get the pre-intimidation of the power shutting down detail from the electricity board office.

IV. SYSTEM DESCRIPTION

The proposed systems greatest advantage over any other energy meters are the major different applications which link the costumers with the knowledge of any aspect of their power consumption and notification alarms with the use of the IOT which can be seen in their respective mobile phones. A special ID is set for each of the energy meters which are linked with the costumer’s mobile numbers. Thus, each of the information about the energy usage and notifications can be sent easily and directly to the costumers with the use of the GSM module. From this, we can also reduce the wastage of the energy, as we can monitor the usage of the consumption of energy with respect to the needed time period.

Alert and Notification System using IOT

In the present electricity billing system, there has been cases of fraud which increases the charges which are collected by almost the double part of the original billing amount.

Thus, with the frequent notification system, the costumer will be well informed and aware about the actual usage of the energy and direct billing payment could be done through the e-payment. Also, the costumer can set a primary peak value of the energy to consumed in a particular period of time. If the consumed energy gets more than the given peak limit, the notification will be shown in the LCD, also an alarm would be present in the registered mobile phones. This receiving and transmission of the data can be done with use of the GSM module SIM900A.

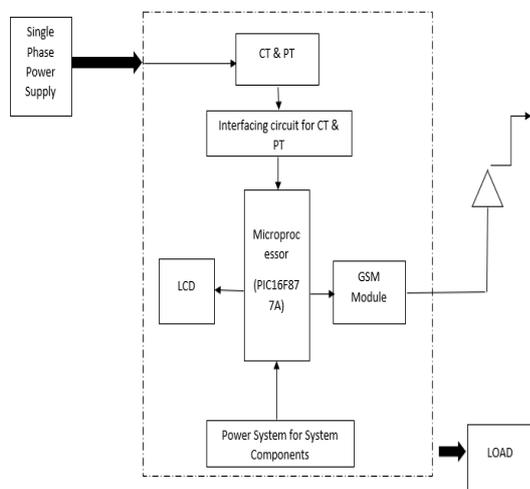


Figure 2: Proposed system block diagram

Energy usage awareness

In the recent times, we have seen a large amount of energy to be used in the household or other places. This has actually resulted in wastage of the power and also paying large sum of money for the billing which are both unwanted. But with the use of the presented energy meter, the amount of the power used can be monitored with the help of the IOT.

Overloading

Many times, it has been seen that the lifespan of a device is reduced or the working condition of the device is degraded. A major reason for its happening can be due to overloading of the power. Thus, when overloading of the system is detected, the LCD notifies with the overload message and it can also be detected in the mobile phones notification. This would help in the well-functioning of the devices and also in the decrease in the wastage of power.

Power theft awareness

The power theft is a punishable offence and it should be made well aware among the consumers of power. Also, the electricity distribution losses are caused mainly due to the theft of the supplied electricity at the consumer premises or the locality. Thus, the case of power theft can we well analysed and located.

Pre-Notification of Shutting down

The power cut in places like hospitals, industries and other workplace can be a big risk. In case of the hospital, the life of the patients can be in stake. In this process, the announcement of the power cut is done in advance, so that the needed actions are done to cause no harm and damage to the workplace or the people. This notification can be seen in the LCD after the notification is sent to the mobile phones.

V. ADVANTAGES

- It removes the role of human interruption in the meter reading, hence reducing human labour
- It is used to control and monitor the electric system more accurately and effectively.
- It provides the present and real time power usage information.
- It helps the users to monitor the energy usage and it can be used to reduce the electricity billing.
- It will help in the reducing of hazards and risks in the private sector during the shut-down process of electricity.
- Overloading will be reduced and thus no devices will be deteriorated of their quality.
- The notification related to the energy meter can be seen at a distance far away from their respective energy meters.

VI. SIMULATION CIRCUIT

The simulation circuit is made in the Proteus software. Mainly, the circuit can be divided into two halves. The first part can be defined as the receiver. It consists of the current and voltage transformers, LED, and the PIC microcontroller (PIC 16F877A). This part is used for analysing the case of overvoltage.

The second part of the circuit can be defined as the transmitter. It also consists of a microcontroller PIC 16F877A, and GSM Module (SIM900A). This part is used for the role of identifying power theft and pre-intimidation of shutting down of power from the electricity board.

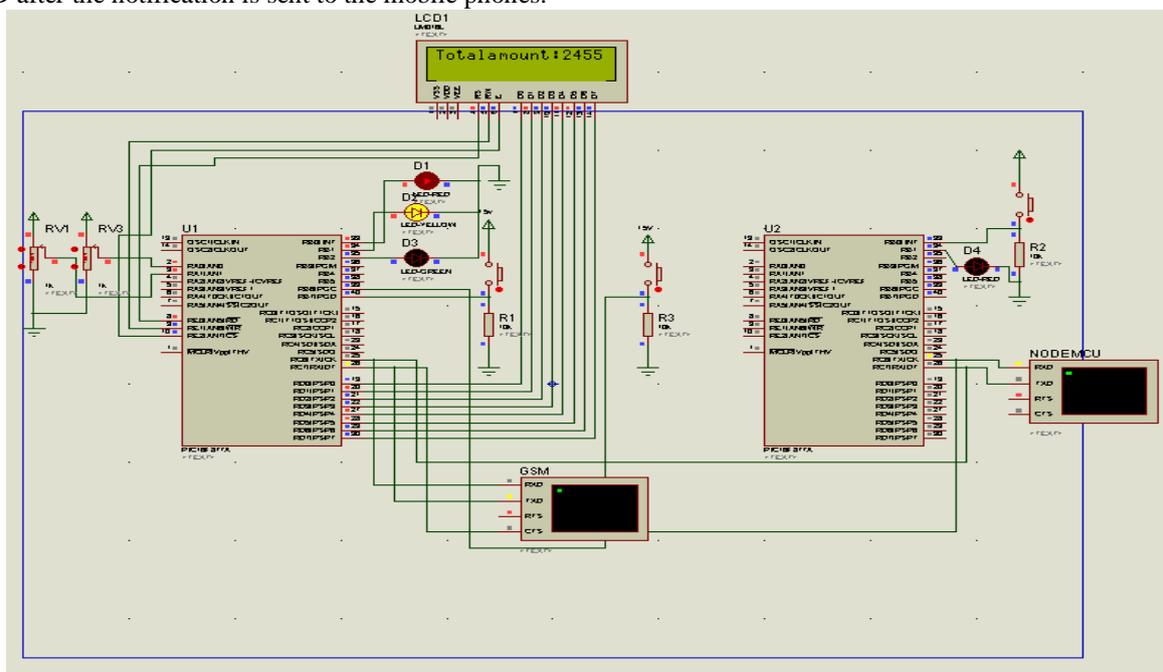


Figure 3: Simulation circuit



VII. SIMULATION RESULT

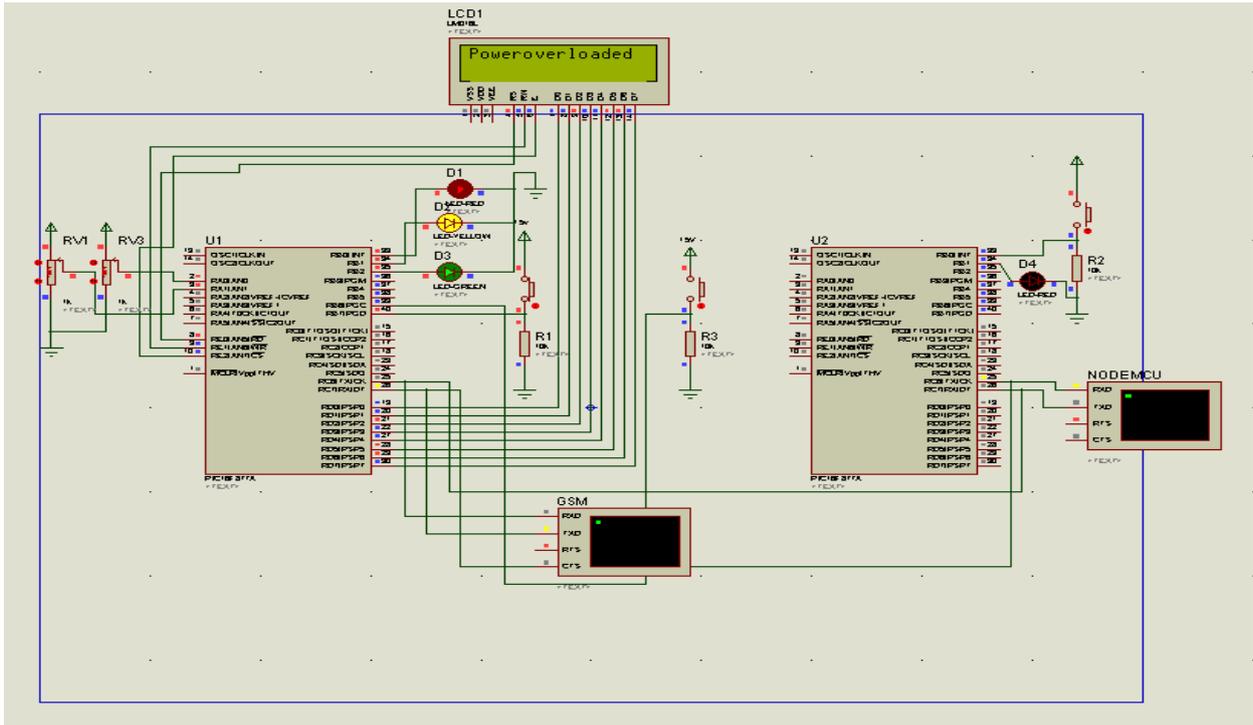


Figure 4: Simulation Result of overloading

When the switch connected to U1 is tripped, overall system will be overloaded and hence it will be displayed on the LCD display. Hence, from this, the customer would be aware about the case of the overloading and hence appropriate measures would be taken.

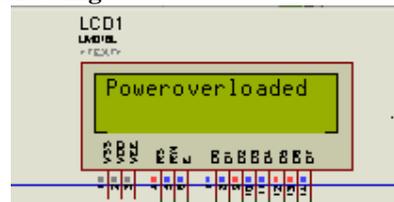


Figure 5: Result of power overloaded on LCD

Power theft

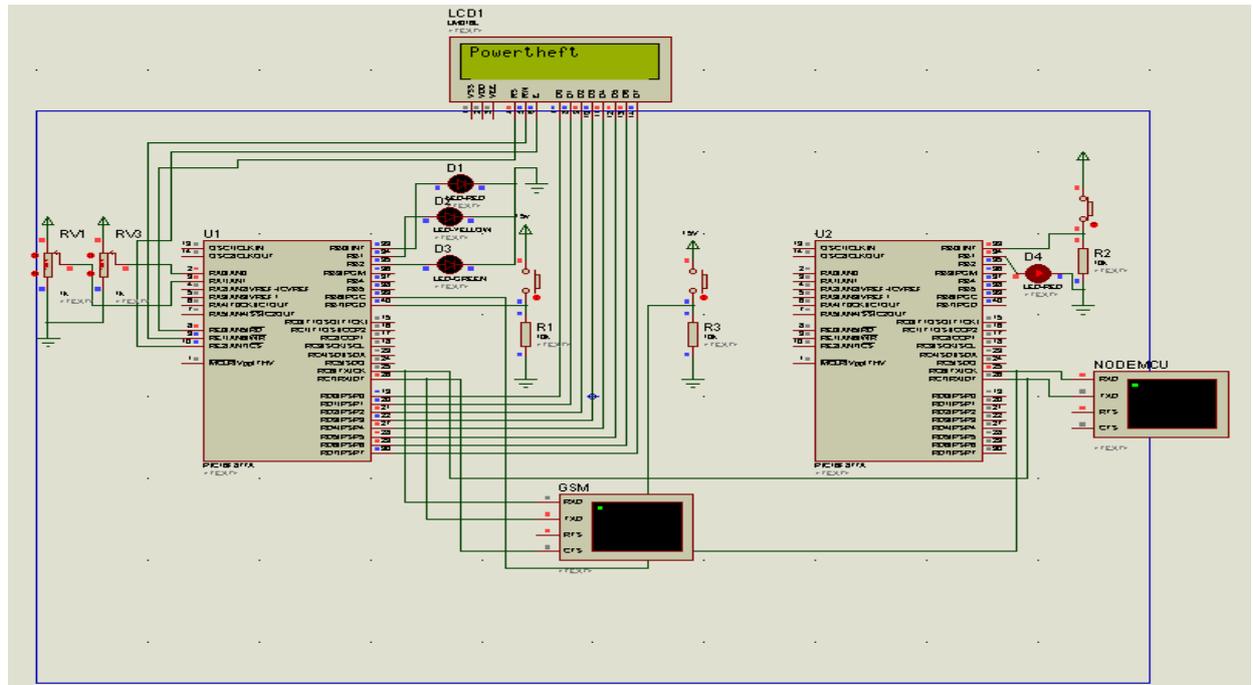


Figure 6: Simulation Result of power theft

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