IOSR Journal of Engineering (IOSR JEN) **www.iosrjen.org**
ISSN (e): 2250-3021, ISSN (p): 2278-8719
PP 25-30

Implementation of Iot Based Smart Energy Meter Using Plc and Scada for Industrial Applications

V.Anandakumar[1], Anagha K P[2], Aswini M[3],and Jayabharathy I[4]
[1](Assistant Professor in Department of Electrical and Electronics Engineering),
[2,3,4](Students in Department of Electrical and Electronics Engineering,)
Achariya College of Engineering Technology, Puducherry, India.

Abstract: *Over the past decades with the increase in population, demand for power have raised to a great extent. The intervention of latest technologies haveinfluenced the generation, transmission and distribution of the power produced and still it is an issue all over the world in dealing with the wastage of electrical energy in accordance with the shortage of power and also traditionally we have followed the electrical billing system of manual reading whereas chances of human errors, fraud billing and power theft have occurred. Although the power theft is a major issue which results in overloading and power shortage, the proposed system is to recognize and overcome the serious problems in the existing. Here we are replacing the existing postpaid energy meter with the prepaid billing system, with the solution for the major issues in the existing system by facilitating with PLC and SCADA based on IoT and enables the customer live monitoring of the energy usage and bill payment.*

Keywords*–GSM, PLC, Prepaid System, SCADA, Smart energy meter.*

I. INTRODUCTION

From the time of urbanization itself substantial development have been occurring in the electrical energy meter technologies. Power management is one of the concerned issues confronted by the electrical sector. With the rapid increase in power demand, electricity have beenserving a requisited role in human life. While considering the electrical metering system, the conventional energy meter system is replaced with the analog and digital energy meters proposed with the various technologies. Conventional energy meter system was based on the manual meter reading provided by the electricity board while there is a possibility of human error. Thus arduino and GSM based smart energy meter is proposed to the traditional billing system to overcome the above drawbacks. The GSM based smart energy meter provides facilities to the customer to monitor their current bills.

Although the preceding system can only give the information on the bill payment and the arduino based system cannot be suggested for the huge area power development since arduino can be only operated at 6-20 volts. So here we are introducing our proposed system of IoT based smart energy meter using PLC and SCADA for industrial application. The SCADA system controls and monitors the entire energy system with real time data processing. The existing postpaid system is replaced with prepaid energy meter in the proposed system. The customer can use the power accordingly to the payment they have done and if there is a substantial decrease in the amount, regardingly the customer will be notified with the corresponding warning message. It also suggests to overcome the serious issues of power theft, i.e. the unauthorized users will be detected by the SCADA system and it automatically reconnects to the authorized customer itself. The proposed system ensures with the optimized energy consumption and the live monitoring of the power usage.

II. Existing System

The existing system was proposed of a arduino and GSM based smart energy meter for billing. The system consists of energy meter, opto coupler circuit, GSM module, real time clock circuit, arduino& a LCD display. The system imperatively consists of both the hardware and software part in which they are interfaced with the program done in arduino controller. The block diagram of the existing system which is GSM based smart energy meter is represented in the below diagram Fig.1.

An energy meter or electric meter is a device that measures the amount of electrical energy consumed by a residence, business or an electrically powered devices. Taking on account of the software part, arduino, as the main controller where a program in C language is interfaced, connects the energy meter using the GSM technology with the help of GSM module.

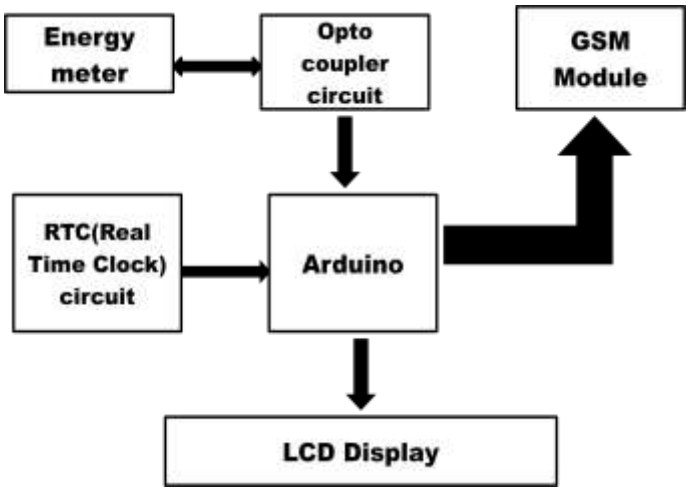

Fig.1 Block diagram of the existing system.

An opto coupler has been connected between the energy meter and arduino in order to detect an electrical signal coming from the energy meter. Accordingly arduino associated with GSM module receives and sends SMS to consumers accordingly. The real time clock circuit connected to the arduino side is a timing device which generates system interrupts at regular intervals on each time out of the clock in order to initiate the current time and date. This timing device never resets as changed once it have started whereas it can store every single timing data. As considering with the GSM, which is the secondgeneration digital cellular system with FDMA & TDMA technology receives and sends SMS through mobile phone where the customer can get the clear evidence of the energy metering. The LCD is connected to the arduino board to display the status of the metering system accordingly customer can have an acknowledge of the current connection.

Even though the existing system has a technique of GSM, Arduino it can be used only in the residential areas. This system is not applicable for the industrial areas. Because arduino has its input limits (say) 6 to 20volts. But the industrial input limitstarts from 230V, thereby the existing system seems to be a greater disadvantage. So that we are introducing a proposed system with technologically developed components like PLC, SCADA, IoT, GSM, RFID.

III. Proposed System

The ardent demand for the power has inadequately increased with maximum wastage of electricity. The time of providing power with optimized manner has arrived. The proposed system of IoT based smart energy meter using PLC & SCADA for industrial application has a goal of implementing with optimized usage of power and to reduce the power wastage.The block diagram of the proposed system consists of LCD, RFID card, PLC, SCADA, GSM with IoT concept.The smart energy meter can be replaced with 5volts DC LCD for monitoring live power status which is bi-directionally connected with a load. The block diagram explains that the consumer & distribution center will be connected together through SCADA, which can be automatically control and monitor the entire metering system anywhere at anytime. PLC defined as the small scale computer used in industries which can performs on both hardware and software for monitoring the data.

The proposed system offers a prepaid energy metering and billing where the customer can use the power in an optimized manner, whereas if it exceeds the limit of power consumption then the sanctioned power connection will be automatically cut off and will be warned before the prepaid amount has decreased inadequately.

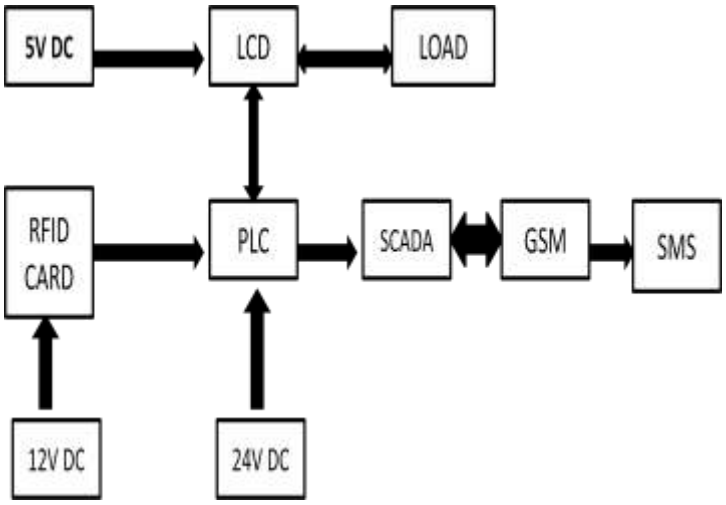

Fig.2 Block diagram of proposed system

The best adoption of IoT technology can be implemented here for the real time data processing of SCADA in order to monitor and control the entire system.Since in the existing system the real time data can't be analyzed whereas in the proposed one up to date data are available it is considered to be a great advantage of proposed system while comparing to the previous models. The SCADA can monitor and control a plant or equipment in industries. Similarly considering to the previous system the meter reading is a manual process there may be fraud billing whereas in the proposed it cannot happen. The proposed work includes the software, hardware session and the different technology are used for the proposed system.

1. Programmable Logic Controller (PLC)

A programmable Logic controller or programmable controller is a digital computer control used for automation of electromechanical process which continuously monitor the state of input devices and make decisions based on the program.

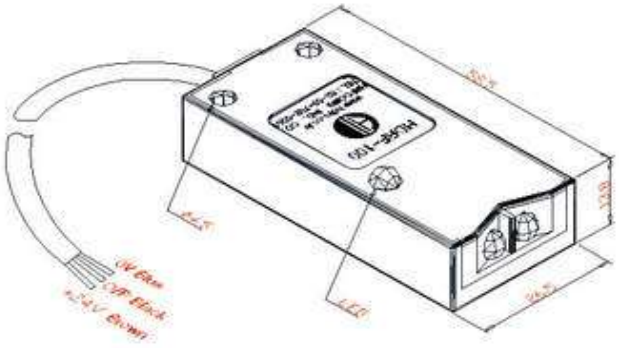

Fig.3 Programmable Logic Controller

A PLC consists of two basic sections: the CPU and the input,output interface system. The CPU controls all the PLC's activities which can act as both processor and memory system whereas the input,output system physically connected to the other devices and provide the interface between CPU and input& output system.

2. Supervisory Control And Data Acquisition (SCADA)

A SCADA is a system of software and hardware element that allows the industrial organization to monitor, gather and process real time data. SCADA system have proved that it can operate flexibly with highest level of functionality and performance. It is purely an industrial application which can be positioned to hardware device interface with PLC. Not only in industry sector, SCADA have recently approached experimental activities on nuclear fusion.The use of SCADA is also considered for management and operations of project driven process in constructions. It is used in industries such as telecommunications, water and waste control, oil and gas refining and transportation.

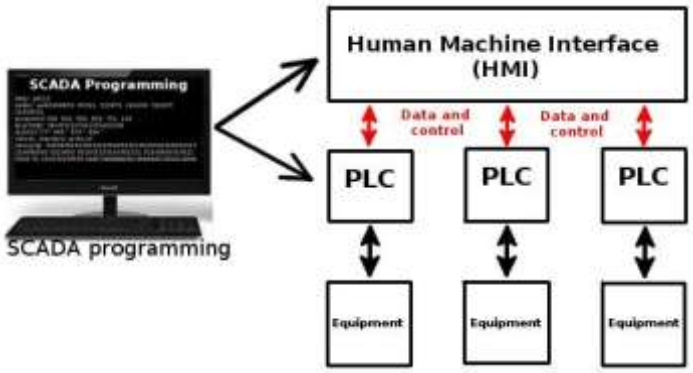

Fig.4 Block diagram of SCADA system

3. Internet of Things (IoT)

The advent of the internet and inherent technologies started from the preceding years have made the world into ease.IoT is the network of physical device, vehicles, home appliances and other embedded with electronics, software, sensors with which enable to connect and exchange the data. It includes adopting the internet connection beyond the electronic devices further to all physical devices also which implies with the goal of monitoring and controlling anywhere at anytime.

Fig.5 Internet of Things

4. Radio Frequency Identification (RFID):

Radio Frequency Identification enables electromagnetic field to identify and tracks the tag attached to the object. The tag contains the corresponding electronic data embedded to the identification. Since it can be attached to the value added things such as money, clothing, and possessions major privacy issued have arised in a concern with the personal details. Hence this has been developed into concerning the authorization of privacy and security activities. RFID tags are used in many industries, for example, an RFID tag attached to an automobile during protection can be used to track its program through the assembly line; RFID tagged pharmaceutical can be tracked through warehouses, and implanting RFID microchips in a livestock andpets enables positive identification of animals.

Fig.6 Model of RFID card

5. Global System for Mobile communication (GSM):

GSM is the second generation of the cellular system with the availability of FDMA & TDMA technologies. It can transmit and receives over mobile voices and data services at 850 MHz, 900 MHz, 1800 MHz, 1900 MHz frequency bands. It has the facility to carry data at the rate of 64 KPs to 120 Mbps.GSM is the standard developed by the European Telecommunication Standard Institute(ETSI). GSM was intended to be a secure wireless system. It has considered the user authentication using a pre-shared key and challenge-response, and over –the-air encryption.

Fig.7 GSM module

IV. Sample Program For Gsm

```
#include <SPI.h>
#include <MFRC522.h>
#include<SoftwareSerial.h>
SoftwareSerialgsm(2, 3);
#define SS_PIN 10
#define RST_PIN 9
MFRC522 mfrc522(SS_PIN, RST_PIN);
int state = 0;
bool hun = false;
bool fif = false;
int hun_no;
int fif_no;
void setup()
{
pinMode(4, OUTPUT);
hun_no = 4;
fif_no = 3;
SPI.begin();
mfrc522.PCD_Init();
gsm.begin(9600);
}
void loop()
{
if ( ! mfrc522.PICC_IsNewCardPresent())
{
return;
}
if ( ! mfrc522.PICC_ReadCardSerial())
{
return;
}
String content= "";
for (byte i = 0; i< mfrc522.uid.size; i++)
{
content.concat(mfrc522.uid.uidByte[i]);
}
if (content.substring(0) == "69423127")
{
hun = true;
digitalWrite(4, HIGH);
delay(1000);
```

V. Model Design For Scada

SCADA system monitors the entire system, so that it can be analyze the fault occurring whether on the consumer side or the distribution side. Whenever the fault occurs the SCADA will automatically detects and resolves the problem. In the proposed project, the SCADA connects the consumer and the supplier whereas there will be always the contact between them. The below diagram depicts the sample output of the SCADA system of the prepaid system. It mainly consists of four blocks.They are shown in the below diagram.

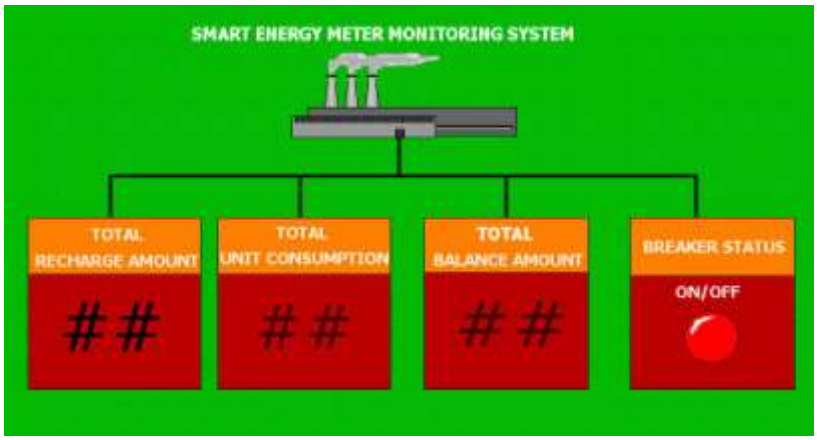

Fig.8 Sample output of SCADA design

The block explains about the power usage, recharged amount, balance amount, and breaker status. The amount recharged by the consumer side will be displayed in the total recharge amount block. According to the energy consumed by the consumer, the unit consumption will be displayed in the next block. The total balance amount block displays the balance amount of corresponding power usage. Whenever the balance amount exceeds the limit then the breaker will be changing its status to ON/OFF accordingly.

VI. Conclusion And Future Works

Taking an account to the energy management system, the main hindrance is the inaccurate metering, power theft, and improper billing to the energy consumption the proposed system is capable of overcoming the above constraints in the existing system. An attempt has been made to implement the practical system of IoT based smart energy meter system using PLC and SCADA. The proposed model enables the user for the live monitoring of power usage and if power theft across the SCADA system will automatically disconnect from the fraud used and reconnect to the existing user and also we are replacing the postpaid system with prepaid energy meter in order to reduce the wastage of energy and accordingly use the power in an optimized manner. The user is not made to pay excess amount of money, they can pay accordingly to energy requirement. The SCADA and PLC in a proposed system allows the user for the real time data processing and live monitoring of system.The GSM module provides an advantage of direct messaging system in order to make the user update with their power usage and the corresponding tariff for that, the proposed smart energy system is reliable and secured improved version of existing system.

Reference

[1]. L.C.Saika, H. Das, N.B Dev Choudhry, T.Malakar,2016 “GPRS enabled smart energy meter andautomation of home appliances”, IEEE Annual India Conference.
[2]. Himshekhar Das, L.C.Saikia,2015 “GSM Enabled Smart Energy Meter and Automation of Home Appliances”IEEE.
[3]. Dineshkumar.K,2015 “Development of ARM Processor based Electricity Theft Control System using GSM Network”, International Conference on Circuit, Power and Computing Technologies.
[4]. Darshan Iyer N and Dr. K A Radhakrishna Rao,2015 IoT Based Energy Meter Reading, Theft Detection and Disconnection using PLC modem and Power Optimization, Proc of IJAREEIE.
[5]. P.Thamarai, R.Amudhevalli,2014 “Energy Monitoring System USING PLC & SCADAS” International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering (An ISO 3297: 2007 Certified Organization) .
[6]. S. Jain, Vinoth Kumar N., A. Paventhan, V. Kumar Chinnaiyan, V. Arnachalam and Pradish M.,2014 Survey on smart grid technologies- smart metering, IoT and EMSl,IEEE Student‘s Conference on Electrical, Electronics and Computer Science Bhopal.
[7]. Kamaldeep Kaur, Prof. Ravinder Kaur,2014 “Energy Management System using PLC and SCADA” International Journal of Engineering Research & Technology.
[8]. K. Collins, M. Mallick, G. Volpe and W.G. Morsi,2012 “Smart Energy Monitoring and Management System for Industrial Applications,” IEEE Electrical
[9]. Abhinandan Jain, Dilip Kumar and Jyoti Kedia,2012 "Smart and Intelligent GSM based Automatic Meter Reading System", International Journal of Engineering Research &Technology.
[10]. Yujun Bao and Xiaoyan Jiang,2009 “Design of electric Energy Meter for long-distance data information transfers which based upon GPRS”, ISA .