

# RFID BASED PREPAID ENERGY METER

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**Abstract**— World is looking towards automation and we achieve a step towards it by using radio frequency identification (RFID) based prepaid energy meter and home automation system with an android application running at subscriber's mobile station. The energy meter is credited through RFID technology and the automation of different appliances are controlled by the subscriber via an android mobile application. The subscribers may check their current credit, consumed units, current load and they can manage appliances remotely. A load management system is introduced, when load exceeds a certain defined level then appliances are automatically shut down. Fire sensor alerts the subscriber via GSM whenever a fire accident occurs.

**Keywords** — Android application, home automation, load management, prepaid energy meter, Radio Frequency Identification (RFID).

## I. INTRODUCTION

Electricity plays a vital role in growth of our country. Even though power production corporations focusing highly on generation, transmission and distribution, they are meeting power loss due to illegal consumption of electrical power from the transmission lines by the consumers. Power theft has become a great challenge to the electricity board. The dailies report says that Electricity Board suffers a total loss of 8 % in revenue due to power theft every year, which has to be controlled. In case of Industries, the industrialists have to monitor and control the usage of electrical energy level. The main objective is to prevent energy usage beyond the maximum allotted energy by the power supplier, by preventing from over load usage. In this paper we proposed and designed a prepaid energy meter using a microcontroller PIC16F877A from microchip. Energy consumption is audited by using current transformer connected series to the load The reason for using this microcontroller is its high performance, power efficiency.

The additional feature of this system is that there is no need of manual interface as the entire system is fully automated and also meter reading also accurately calculated in this system, which overcomes the traditional manual meter reading

Then the current is measured by implementing Analog to Digital Conversion (ADC) techniques of the PIC (Peripheral Interface Controller) microcontroller, if any invariance is found tripping device takes the charge there by removing the excess load and invariance. Microcontroller is giving control signals to tripping various equipment provides controlling feature. Output can then be displayed in the LCD (Liquid Crystal Display).

RFID is a contactless wireless technology which uses radio waves for the automatic remote identification of different objects; we can differentiate between RFID systems according to the operating ranges of 0-1 cm for close coupling, 0-1m for remote-coupling, and greater than 1m for long-range systems. RFID technology allows the transmission of data through a small portable tag; an RFID reader reads the data from this tag and consequently processed as per the requirement of the given application. There are two major categories of RFID tags, either active or passive.

## II. EXISTING SYSTEMS

The equipment of electricity defense energy meter is designed, which adopts Atmega128 as the control core and with low power consumption and high accuracy. It is showed that this system can not only accurate measurement of electrical energy but also to accurately determine the occurrence of electricity stealing and time of stealing is also recorded, which brings great convince to the power system [1]. The design scheme of a three-phase multi-purpose standard electrical energy meter, The experiment results indicates that the tested model compiles with national standards of 0.02 standard electrical energy meter and has already been put into application. due to modular structure designing, simple combination of different modules can produce series products of three-phase standard electrical energy meter [2]. A wireless digital energy meter will definitely offer greater convenience to the meter reading task. Bluetooth technology is chosen as a possible wireless solution to this issue [3]. The communication system is connected with electricity regional/sub-regional office which will rather act as a base station. Base office can verify the energy meters performance by checking the day to day consumption of energy. This helped to avoid any tampering or break down of energy meter [4].The consumer will purchase a cash-card of amount depending on consumption of energy and after the full consumption, the consumer will purchase a cash-card of amount depending on the energy consumption [5]. Smart meter is introduced to minimize electricity theft, because of its high security, best efficiency, and excellent resistance towards many of theft ideas in electromechanical meters [9]

In existing systems, either an electronic energy meter or an electro-mechanical meter is fixed in the premise for measuring the energy usage. This method of electricity billing involves a person from the distribution unit reading the number of units of electricity consumed in the energy meter, conveying this information to the distribution unit and then preparing the bill according to the units consumed for a fixed amount of time. Still accuracy cannot be guaranteed as there can be errors in human reading. Even though digital meters are being replacing conventional electromechanical meters and provide much accurate readings, still the problem of deliberately making a false reading can exist. Despite this, the task of billing for every consumer is a time consuming job for the distribution grid.

Also, the consumer can deliberately consume more amount of power than required and still refrain from paying the bill and nothing can be done to severe the electric power supply. To eliminate all these problems, the most convenient method is making the whole system prepaid similar to a mobile phone recharge or a DTH recharge. Many systems built on various platforms have been proposed by different research groups all over the world for Prepaid Energy Meter.

### III. PROPOSED SYSTEM

Based on the earlier studies, we proposed a most effective and efficient method to reduce human resources. The proposed prepaid energy metering and home automation system mainly depends on a central microcontroller, RFID module, electromechanical energy meter, EPS8266, thing speak software, GSM modem and an Android application as depicted in Fig.3.1. Microcontroller is the central module of this work, it stores the information of instantaneous energy, units credited, units remaining, tariff, current load and all relevant information is stored and updated in the microcontroller.

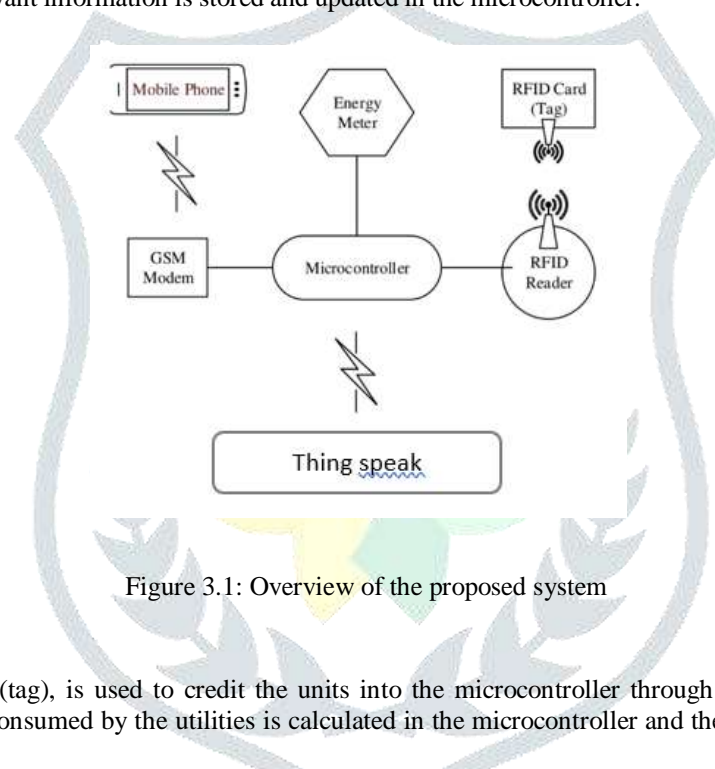


Figure 3.1: Overview of the proposed system

A RFID smart card (tag), is used to credit the units into the microcontroller through a RFID reader attached to the microcontroller. The energy consumed by the utilities is calculated in the microcontroller and the units for the consumed energy are automatically deducted.

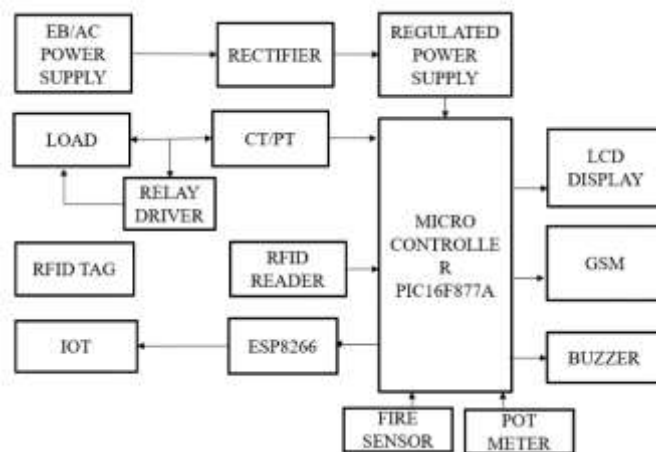


Figure 3.2 : Proposed block diagram

In this work, PIC16F877A Microcontroller has been used since it has strong built in modules like Timers, Electrically Erasable Programmable Read-Only Memory (EEPROM), analogue comparators, Serial Peripheral Interface (SPI), Universal

Asynchronous Receiver/Transmitter (UART) and 8 channels 10 bit Analogue to Digital Converter (ADC). A certain limit is set for the loads in terms of watts. If this limit is reached, a warning Short Message Service (SMS) is sent to the user and authorities. Relays are implemented to turn on or off the appliances through android application, control signal is sent to the microcontroller and it acts according to the received command. Relays also turn off the loads if the prepaid credit balance goes down to zero.

RFID technology does not call for physical contact between the tag and reader, information onto the tag is written through a RFID controller/programmer module. Once the tag is in the magnetic field of the reader, it collects information from valid tag only and rejects the invalid ones.

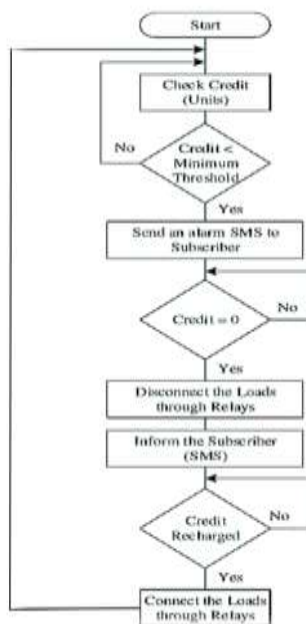


Figure 3.3 : Algorithm for prepaid metering

The objective of implementing a prepaid system is achieved through an algorithm illustrated in Fig The fundamental idea was to develop an algorithm which allows the subscriber to be connected to the electricity network as long as they have a credit or prepaid units and the electricity is detached if the remaining credit goes down to zero. However, the subscriber is informed, through a SMS alert, about the remaining low credit. A minimum threshold (e.g. 10 units) is set, once credit is less than 10 units, a SMS alert is sent after 2 units of power consumption. If the subscriber fails to credit the meter, all the appliances are disconnected via relays.

#### IV. RESULTS

An android application (Thing speak) was developed to remotely monitor the energy consumption and to control the appliances through home automation. We can see the real time current, power usage, remaining balance and the temperature in think speak software. some of the observed values is shown in fig 4.1, 4.2, 4.3, 4.4 respectively. We have shown a prototype (fig 4.5,4.6) of the presented work and successful testing of the prototype was performed. This prepaid energy metering is highly effective because it eliminates manual meter readings, equips users to be updated about their electricity consumption and remaining prepaid units though a remote application running on their mobile phones. It also delivers effective load management to make it more versatile for the practical deployments.



Figure 4.1: current consumed with respect to time

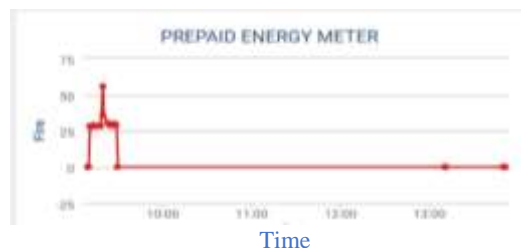


Figure 4.3: temperature with respect to time



Figure 4.2: units consumed with respect to time

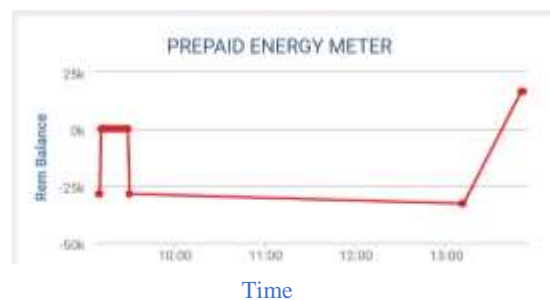


Figure 4.4: remaining balance with respect to time

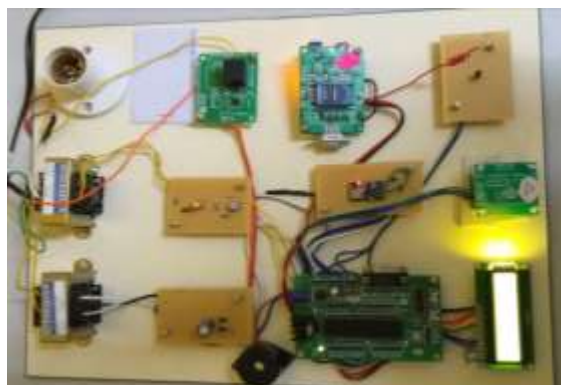


Figure 4.5 : complete hardware



Figure 4.6 : readings of the meter

## V. CONCLUSION

In this paper, a new economical prepaid energy metering system using RFID technology has been presented. An android application was developed to remotely monitor the energy consumption. This prepaid energy metering is highly effective because it eliminates manual meter readings, equips users to be updated about their electricity consumption and remaining prepaid units through a remote application running on their mobile phones. It also delivers effective load management to make it more versatile for the practical deployments. Large scale implementation of this system will reduce power theft, false meter reading and may be valuable if integrated within future smart grid systems.

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