Smart Electricity Meter Data Intelligence for Future Energy System

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ABSTRACT

In this paper, a smart electricity meter is developed to avoid the power theft in power system. There is a criminal act for electricity theft. This leads to lose in millions of rupees for a nation. To avoid those thefts, a smart electricity meter is designed with Internet of Things (IoT). The aim of this is to design implementation model of electrical energy theft detection without human interaction. The device comprises of sensing device, Arduino, GSM module, power circuit, and LCD display. The devices monitors the unit and send the used data to the user mobile and also display the data in the LCD display. Based on the reference current, the controller detects the current and if it is higher than the limit the theft message is send to the nearby Electricity Board. The shutdown switch is also provided with the device if there is a shutdown the message will send to the corresponding house before a day. The purpose of this framework is to reduce the energy theft cases and accidents occur due to the electricity.

Keywords- Electricity meter, Internet of Things, GPS module

I. INTRODUCTION

Electricity theft is a very common problem in most of the countries like India, where the population is very high and the users of electricity are ultimately tremendous. In India, every year there is a large amount of electricity thefts held across the domestic electricity connections as well as industrial electricity supply, which results in loss for electricity board and energy generation companies. Because of which we are facing a frequent problems of load shading in urban as well as a rural area so as to overcome the need of electricity for the whole country. The theft can be done are also innumerable so we can never keep track of how a theft has occurred, and this issue is needed to be solved as early as possible.

In this paper, we propose an electricity theft detection system to detect the theft which is made in the most common place. The way of doing the theft and that is bypassing the energy meter using pieces of wire, people simply bypass the electricity meter which is counting the current units by placing a wire before and after the meter reading unit. The proposed system will be hidden in such meters and as soon as an attempt is made for the theft, it will send an SMS to control unit of electricity board. The input and output current of a particular pole is compared by using a current transformer. If there is any negative

value means it is indicated that the particular pole has drawn more current as theft. Here one current transformer is placed on the input side of the post line. Other current transformers are placed at the distribution points of the house lines. The output of current transformer values is given as input to Arduino. The controller converts these analog inputs into digital using inbuilt ADC converter. The error detector compares the input current and sum of the output currents. If a compared result has any negative value then this particular post is detected as theft point. This compared value is transmitted to electricity board through GSM module. In the form of message, it is send to the electricity board office. The Arduino also send signal to displays this value in LCD display. In addition, the shutdown information is also send to the respective house a day before. On monitoring the usage of current value many accidents due to the electricity are reduced.

II. SMART ELECTRICITY METER

The developed smart electricity meter provides the following facilities
It detects an electrical power theft automatically.

1. Get information about power theft and usage of electricity via internet on Smartphone's using IoT.
2. Make the system cost effective and very compact so as it can be added advantages compare to existing energy meter.

The block diagram of Smart Electricity meter is shown in figure 1. The device consists of power unit, current sensor, Arduino, GSM module and LCD display.
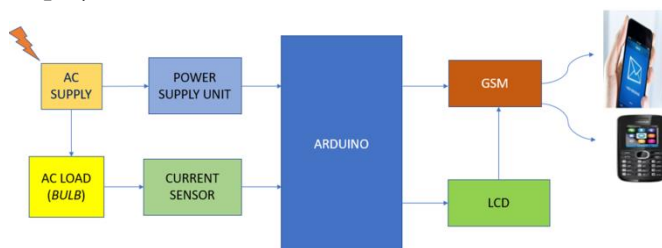

Figure 1 Block diagram of Smart Electricity Meter

A. Power supply unit

The power supply unit is used to produce in low DC voltage to provide the appropriate voltage supply to the electronic components for their proper functioning. This unit consists of transformer, rectifier, filter and regulator. The AC rms voltage of typically 230V is connected to the step down transformer to reduce the AC voltage level. A diode rectifier that provides the full wave rectified voltage that is initially filtered by a simple capacitor filter to produce a dc voltage. This resulting dc voltage usually has some ripple or ac voltage variation . A regulator circuit can use this dc input to provide dc voltage that not only has much less ripple voltage but also remains the same dc value even the dc voltage varies somewhat, or the load connected to the output dc voltages changes.

B. Arduino

Arduino interface boards provide the engineers, artists, designers, hobbyists and anyone who tinker with technology with a low-cost, easy-to-use technology to create their creative, interactive objects, useful projects etc., A whole new breed of projects can now be built that can be controlled from a computer.

C. GSM module

GSM could be a mobile communication modem; it stands for a worldwide system for mobile communication (GSM). A GSM digitizes and reduces the information, then sends it down through a channel with two completely different streams of client information, every in its own specific interval. The GSM performances for voice, SMS, Data, and Fax in an exceedingly small form factor and with low power consumption. A GSM modem requires a SIM card to be operated and operates over a network range subscribed by the network operator. It will be connected to a computer through serial, USB or Bluetooth connection.

D. Current Sensor

A current sensor is a device that detects electric current (AC or DC) in a wire, and generates a signal proportional to it. The generated signal could be analog voltage or current or even digital output. It can be then utilized to display the measured current in an ammeter or can be stored for further analysis in a data acquisition system or can be utilized for control purpose.

E. Working

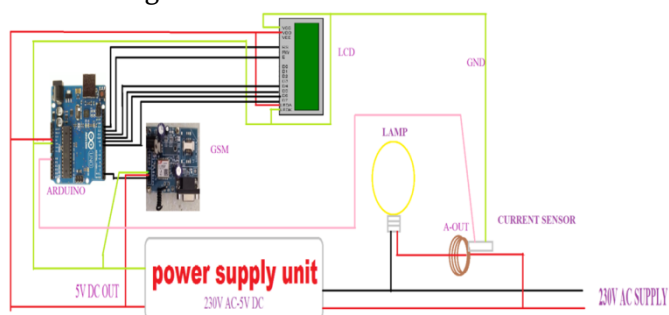The circuit diagram of the Smart Electricity meter is shown in figure 2.

Figure 2. Circuit diagram of Smart Electricity meter

The 230V AC supply is connected to the power supply unit to convert the 230 V to 5 V DC. The load is monitored by the current sensor and send the signal to the Arduino. The reference current limit is set in the Arduino controller. It compares the signal and generate the output signal. If the error signal is negative the theft signal is send to the Electricity Board through the GSM module. The unit generated is also send to the corresponding user mobile and also displayed in LCD display. Furthermore, a push button is there to intimate the area shutdown through the message to there mobile.

III. RESULT AND DISCUSSION

The prototype model of Smart Electricity Meter is shown in figure 3.

Figure 3 Prototype model of Smart Electricity Meter

The Set point for the controller is given as 1400 Units. If it is less, the power consumption by load is displayed in LCD display and the corresponding message is send to the user through the GSM module. The figure 4 shows the load consumption display both the power and in unit form.
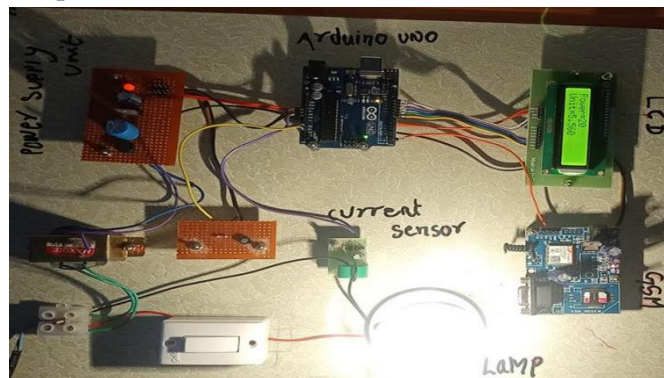

Figure 4 Load Consumption and LCD display

If the load is above the set point the theft message is displayed in LCD display and send message to the Electricity Board through GSM module which is shown in figure 5.
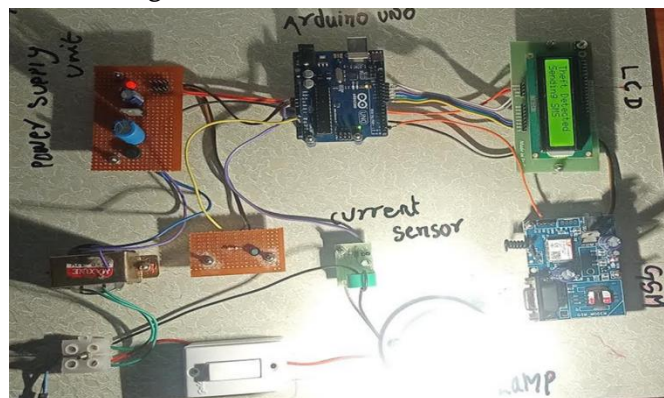

Figure 5 Theft message if load is above the limit

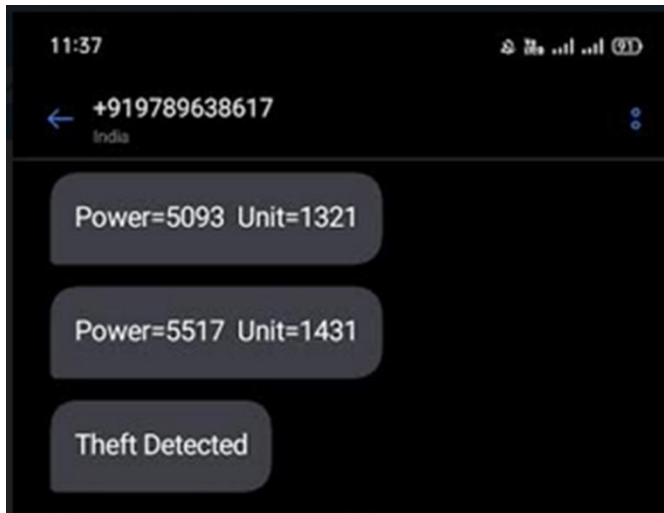The corresponding SMS message obtained in the mobile is shown in figure 6.

Figure 6 SMS message to the mobile

In this prototype model an addition flexibility is there that the shutdown of the area is intimated to the user through the SMS message a day before. The figure 7 shows the shutdown SMS message given by the Electricity Board.
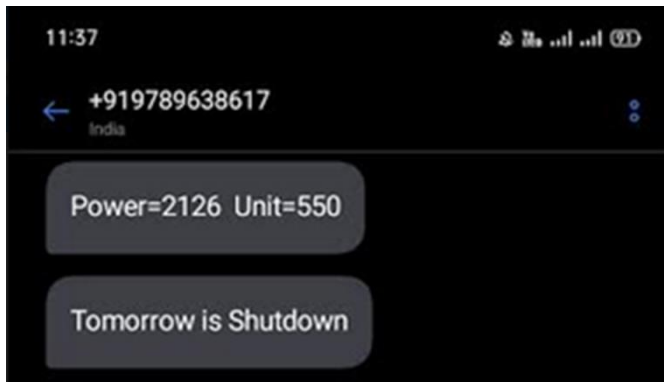

Figure 7 The Shutdown SMS message recevied from the Electricity Board

IV.CONCLUSION

In the present scenario, one of the major problem in the Electricity Board is power theft and electrical accident. An effective method is carried out to protect the power theft and accident. By using the simple devices such as Arduino, current sensors and GSM module the smart electricity meter is implemented in the prototype model. This is economically low cost and can be easily fitted and man power to monitor is also not required. This system is basically developed to reduce the Electricity theft issue to reduce the commercial losses, direct hooking on power line this issues can be also eliminated.

V. REFERENCES

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