



Automatic Power Theft detection and Protection on Distribution Line

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ABSTRACT_ In this paper Arduino based power theft detection and protection system is designed. An increase in the demand of electric power for household, commercial and industrial loads lead to management of electric distribution system become more complicated. Lack of information at the bases station regarding status of the distribution network has been identified as the major bottleneck to its effective monitoring and controlling. Electrical power theft detection and protection system is used to detect and protect an unauthorized tapping on distribution line. In this paper ACS712 series current sensor has been used as the interfacing instrument between the power line current and Arduino. To isolate power line from power theft system relay used as switching gear. Arduino control all operations that all devices do. This system would provide a simple way to detect and prevent an electrical power theft without any human interference, maximize the profit margin of power utility company and Prevent fault due to over load. The theft detection of electricity also became possible by using this system through which server received the message when users by passed the meter. This system provides billing activity in addition to detection and protection power theft.

Keywords__ Power theft, current sensor ACS712, Arduino

I. INTRODUCTION

Generation, transmission and distribution of electrical energy involve many operational losses. Whereas, losses implicated in generation can be technically defined, but transmission and distribution losses cannot be precisely quantified with the sending end information. This illustrates the involvement of nontechnical parameter in transmission and distribution system. Overall technical losses occur naturally and caused because of power dissipation in transmission lines, transformers, and other power system components was discussed in [1]. Technical losses in transmission and distributions computed with the information about total load and energy billed.

On the other hand, nontechnical losses cannot be precisely computed. It can be estimated from the difference between the total energy supplied to the customers and the total energy billed. This kind of loss can be a power theft in the form of meter tampering, stealing or illegal connections billing irregularities, and unpaid bills. power theft, so has become a serious concern for the utility company and the

government [2]. It has also different impact like financial and quality of supplied power.

The financial impact of power theft has two fold manifestations, first there is income lost or not collected after delivery of the service, second the income lost due to not charging customers more. If there is power theft, it also leads to non-efficient utilization of generated power. So, now a day merely generating more power is not enough, controlling the electrical system has become very important. This can improve power quality to a great extent and prevent power theft of different forms. But some forms of electricity are difficulty to measure, and thus to control. For example, theft that involves tampering with meter to distort the billing information or direct information to the power system results in commercial loss, is nearly impossible to measure.

Since there is lack of information on both commercial and the legitimate loads in the system, it is difficult to measure commercial loss. This is due to insufficient inputs for any meaningful loss calculation. Despite the best efforts by utility, the current results of commercial losses measurements are often inaccurate, because the figure rely heavily on the records of detected cases, rather than actual measurement of the electrical power system [3]. Even if utility do have some control over the magnitude of commercial losses, they are not able to have full control. This has led to a huge lose for electric utilities.

In the future, electricity supply has to be reliable, quality and secured. In order to do so, utilities need to have better information about the operation and the state of the distribution networks. For this to materialize, in the future, there will an increasing penetration of distributed generation connected to customer's premises and a shift from the traditional dominant large central power plants electricity generation concept to more complex power delivery [4].

When electricity theft happens getting information is the first step for controlling and taking measure. In this study an electricity theft detection system has been designed. It can be used to detect when the transmission line was taped by unauthorized person through a piece of wire. In system the current sensors are used to sense the total amount of current consumed by the load. If any tapping has had happened in the line during transmission, the two current sensors read different values, which indicates that electricity theft has been occurred. The theft information is then quickly accessed by the Arduino

and sends SMS to the concerned body through the GSM module.

II. PROPOSED SYSTEM DESIGN

The block diagram of Arduino based energy theft detection system to be used in this paper is demonstrated in the Figure 1. This is very important for the success full completion of the study. Besides this, an explanation about the component used and the process be followed is discussed as follows.

In this paper two current sensor are used, one on the pole line and the second one installed on the energy meter. The current sensors measure the current across the line. These values are converted to dc inside the sensors and provided to the ADC (Analog to Digital Conversion) input of the Arduino.

The program written for the Arduino to compare these two values in Arduino language.

If there is any difference between the two values, it will detect the occurrence of power theft between the two current sensors. Then the Arduino will detect and display the status on LCD module. At the time of theft occurrence on the load side the power line of the customer that try to steal will be interrupted. In the block diagram of this paper the Key pad module is present and used to turn ON the interrupted power line by setting correct password. In this paper the electricity metering system, Arduino based GSM is used for the detection of electricity theft and save human labor and time by reading how much the energy is consumed by the customer. To protect the electricity energy meter from this theft, a relay is used at the opening of the meter.

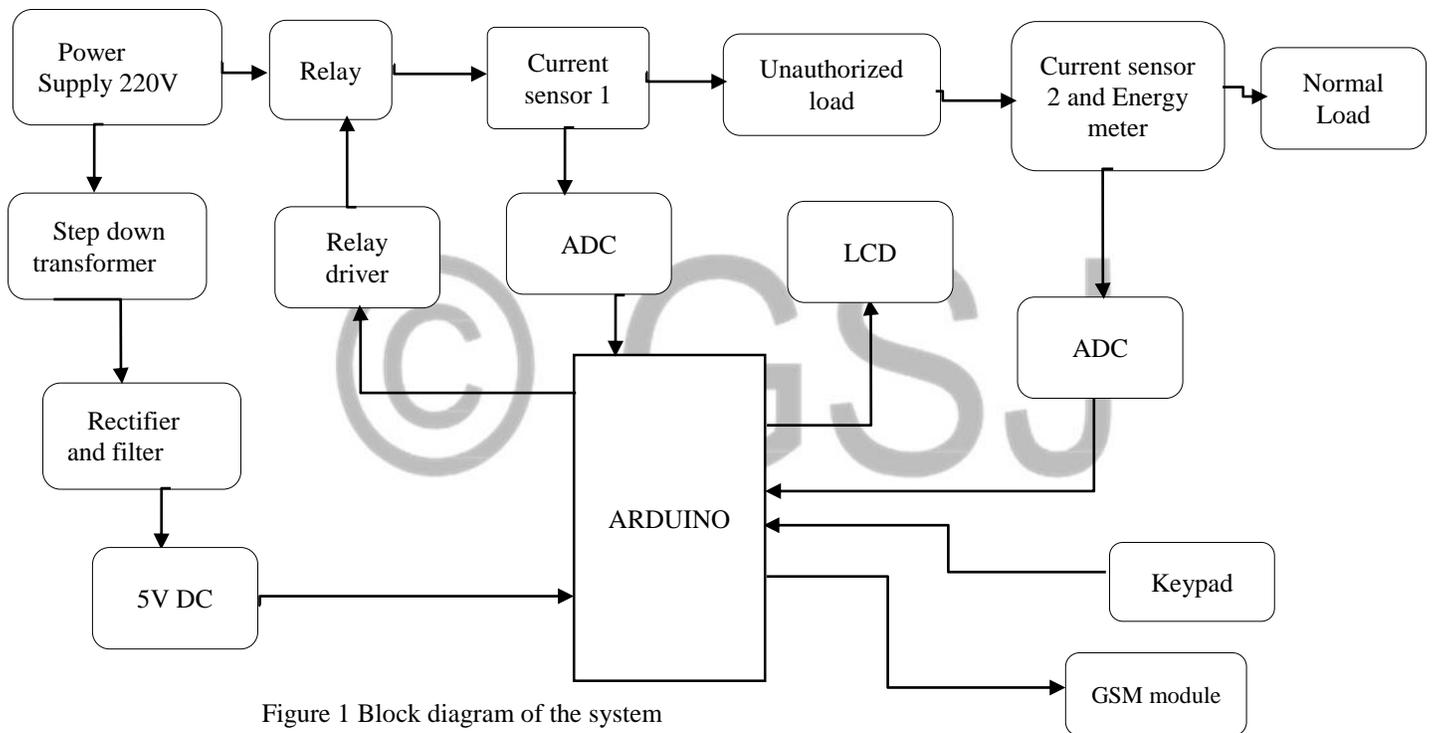


Figure 1 Block diagram of the system

a) SYSTEM FLOW CHART

The flowchart gives a diagram representation of the program algorithm. The system flowchart is as shown in Figure 2.

The software design plays a vital role in the working of the entire system; the system doesn't operate without the software. An algorithm was developed to enable Arduino controllers read the input and respond accordingly. The programming language selected for this project C. The C compiler enable communication between the current sensor, Arduino and PC with other different interfaces in the system. Within software programed into it, Arduino acts as brain of

the whole system to protect and transmit its parameter for system needs to be take action. It interfaces the power line information through PC via the RS232 serial port as well as display on the LCD.

The module was designed successfully with wireless data transmission capability using GSM module. Design of electricity theft monitoring system is as per flowchart shown in Figure 2.

The main program is divided into multiple of parts, these parts are initialization of ports and pins, initialization of ADC, configuration of the serial communication protocol ports and finally configuration of LCD display.

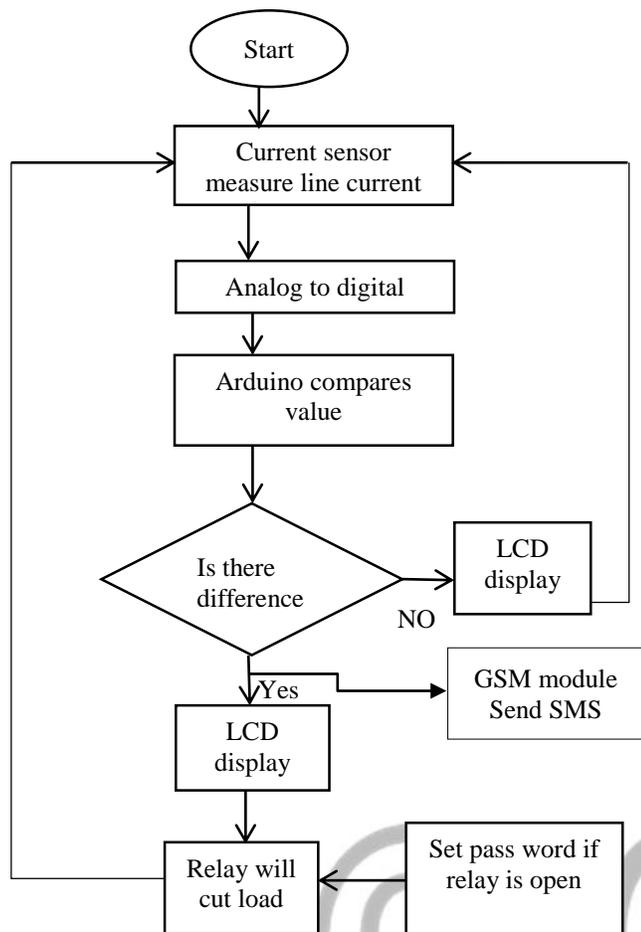


Figure 2 Flowchart description of the system

Arduino acts as the brain of the entire system. it monitors the voltage, current of the line, display the parameters on LCD and PC through RS232 serial port. whenever a theft occurs, it automatically sends a trip signal to the relay and thereby protecting the distribution power line from theft. An algorithm has been developed which makes the Arduino reads the input analogue signals and responds consequently. The algorithms have been represented by the flowchart shown in Figure 2, and now the flowchart has been interpreted into c language and compiled using the Arduino for integrated kit.

III. RESULT AND DISCUSSION

Simulation results are presented and discussed to show the effectiveness of the proposed drive system based on Arduino based automatic power theft detection and prevention from distribution line. For studying the performances of proposed system, a series of simulations and measurements have been carried out. in this respect, the dynamic response of the propose current estimation algorithm is studied under different condition.

As shown in Figure 3 Arduino based automatic power theft detection technique for electricity is proposed. In electricity metering system, tampering is done basically for the purpose of electricity theft. To protect the electricity energy meter from this theft, attempt a relay is used at the opening of the meter. The relay is connected to interrupt pin of the driver. Hence closed switch applies 12V to the interrupt pin and opened relay drives the voltage to zero. The relay normally closed when the meter chassis is closed. If someone tries to open or tamper with electricity energy meter, that switch gets opened and the interrupt pin gets triggered as 0V is sensed by it. The Arduino immediately sends to GSM module for sending SMS. Upon receiving SMS, the authority can take further legal action against it and penalize the theft person as shown in Figure 4

Thus simulation result shown in Figure 3 and 4 indicate that sensing value of current, voltage and amount of power that customer used and payment /revenue/ of the consumed power. In thus simulation there is no theft which exist on the distribution line due to that green LED indicator is become bright and there is no need power interruption on the line.

With the exclusive feature of the Proteus simulation software, it helps in easy development of software. The Proteus design enables us to progress in our project more rapid, giving us the ability to make hardware or software changes which reduces software troubleshooting problems. The paper was built and tested in Proteus just by using the software prototype components. Therefore, using Proteus software, the voltage sensing circuit, current sensing circuit, relays, LED's, LCD display and serial communication were all developed and tested as shown Figure 5 during power theft exist.

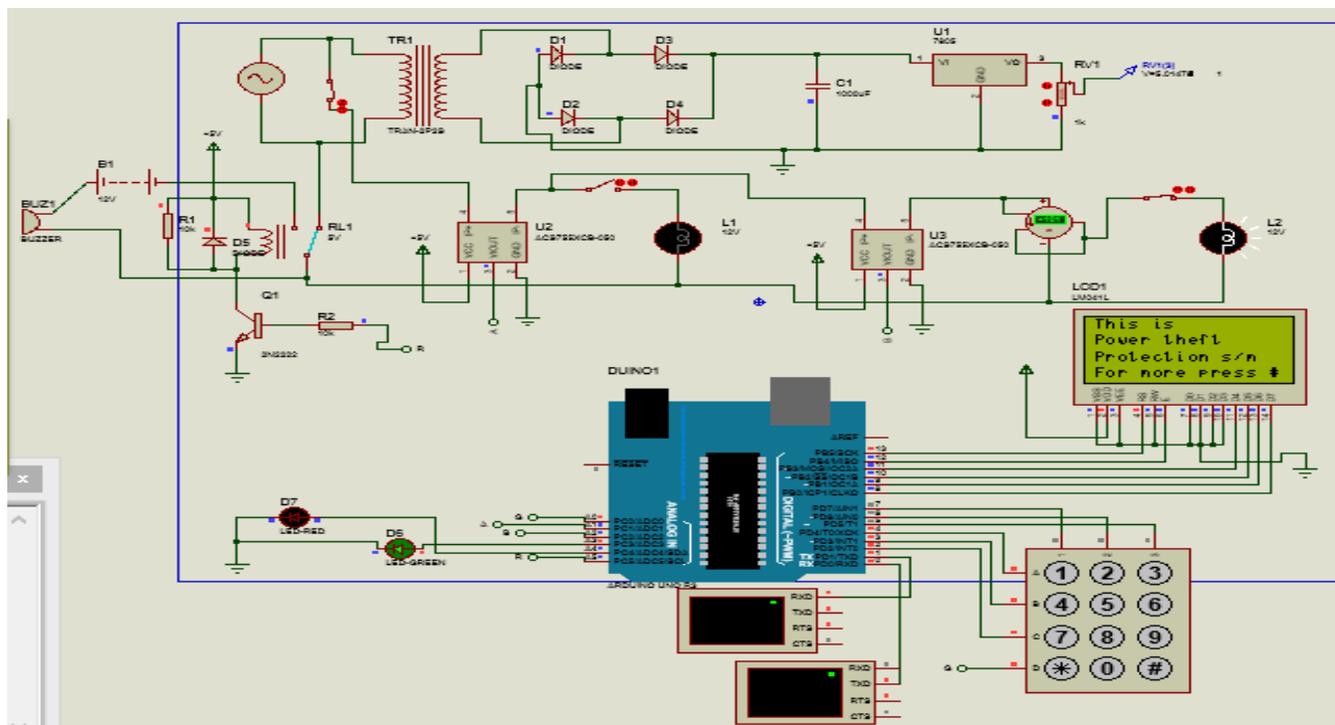


Figure 3 power theft detection and protection system design without theft

As shown in Figure 4 during unauthorized load is exist and send to the Arduino and based on the value of sensed arduino current sensor sense the amount of current on the line value arduino decide desission for relay as well as for LCD

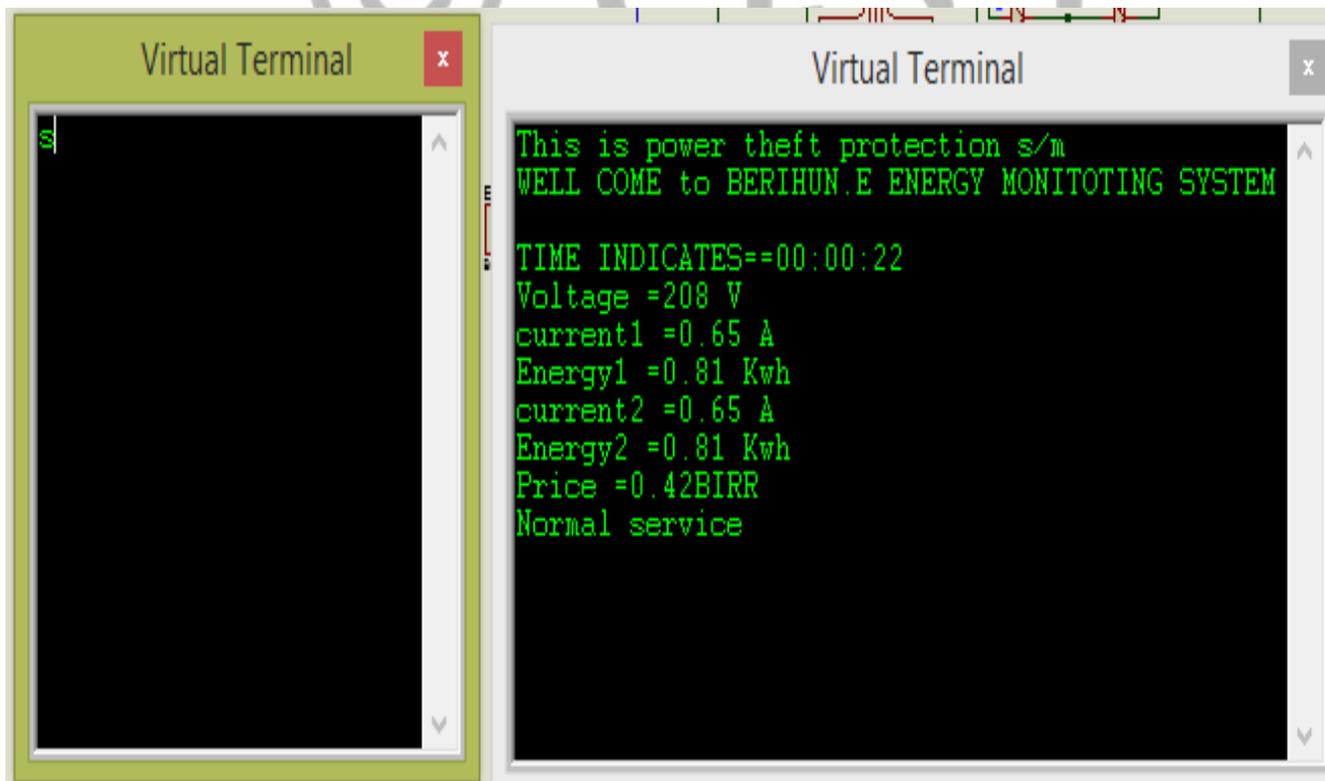


Figure 4 GSM display

Using Arduino and GSM, the illegal usage of power can be solved electronically without any human intervention and wirelessly. The simple working principle of this method is the comparison of the current passed through the current sensor value and the total algebraic sum of current sensor values the consumers connected to that line. A current sensor and relay with GSM module is placed at each of the consumer terminal. It measures the total current consumed by the consumers and

it transfers to the utility using the GSM module shown in Figure 4. It compared with the current sensors reading value. If both the values are equivalent, then there is no theft (Transmission and distribution losses are neglected). However, if the value of the pole line current sensor reading is greater than the consumer's current sensor reading, then the theft is acquired. By the help of this mismatching error readings, we can detect the power theft as shown in Figure 5.

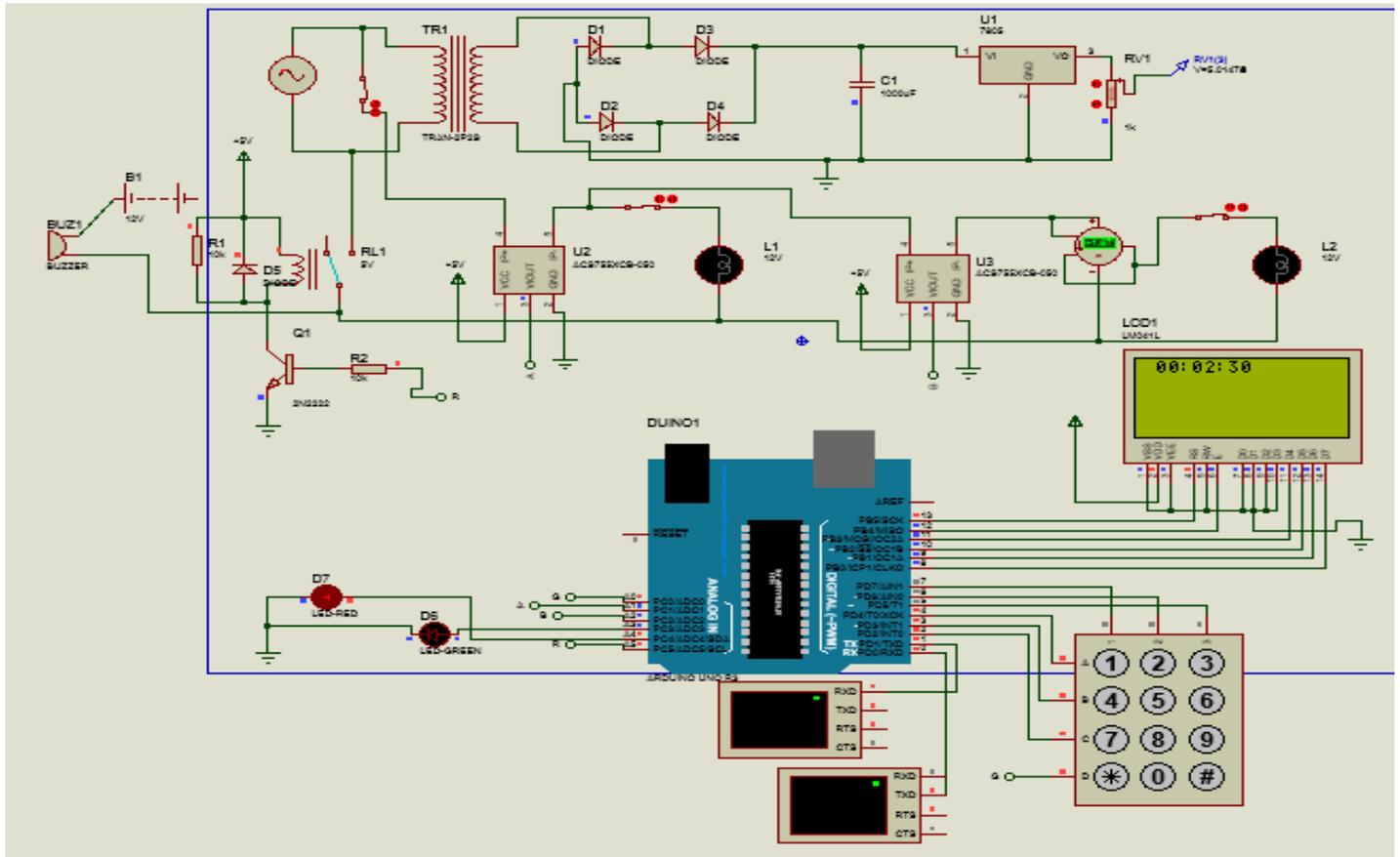


Figure 5 power theft detection and protection system design when theft present

If the theft is existing on the line the difference of the two current sensors sensed values different from zero. during this time the relay automatically open and the power disconnect from the theft as shown in Figure 7. The utility can adjust the interrupted power remotely if the theft removed the bypass connection and continue in the normal situation also can access the amount of Kwh and price of it. If the theft doesn't remove the bypass connection the relay close and immediately open which leads to the theft stay without power source.

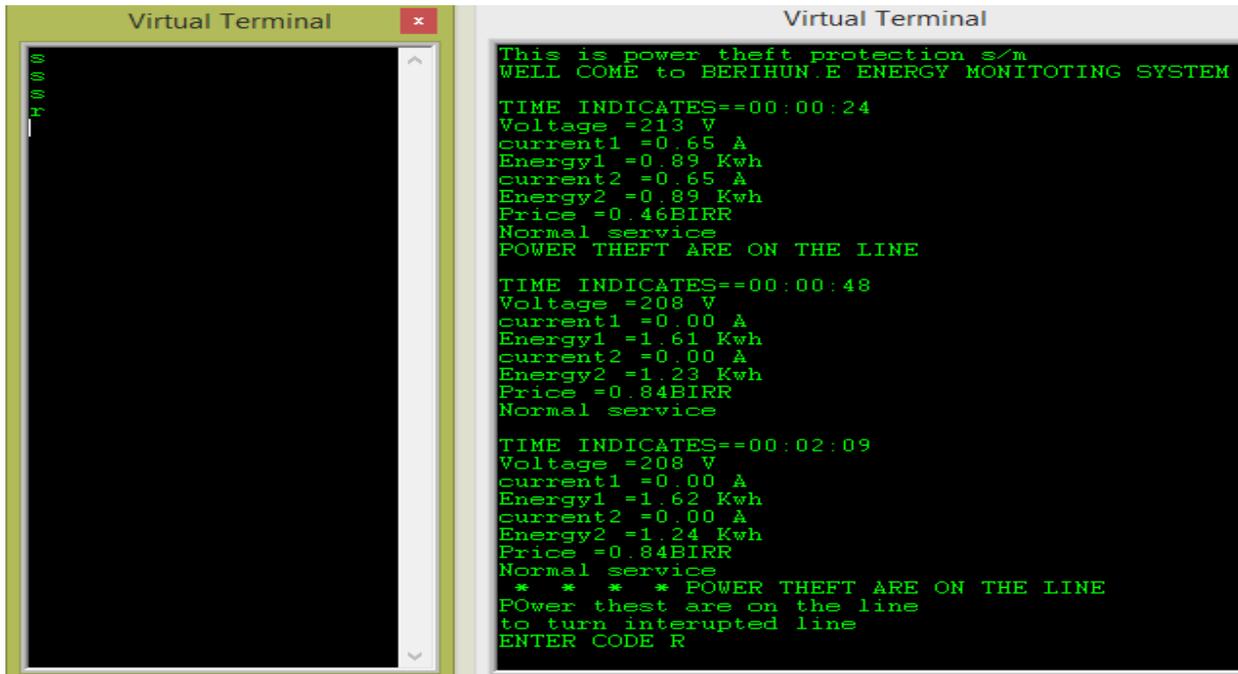


Figure 6 GSM display when theft exist on the line

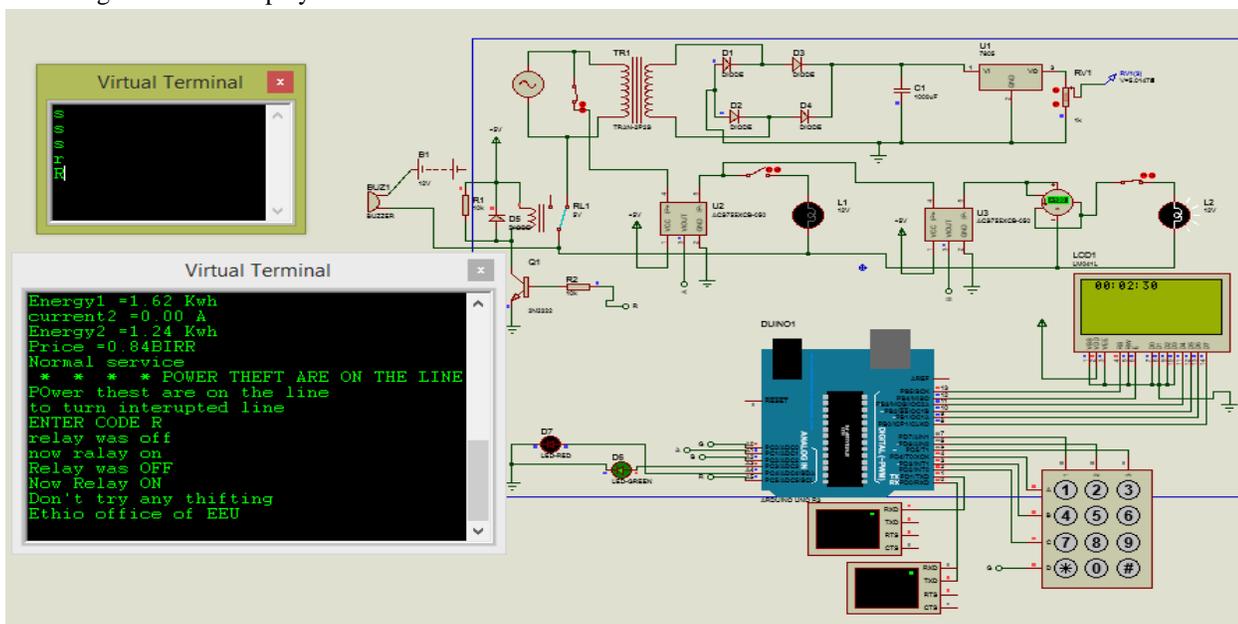


Figure 7 power theft detection and protection system when theft removed and relay turn to closed at relay code enters by GSM

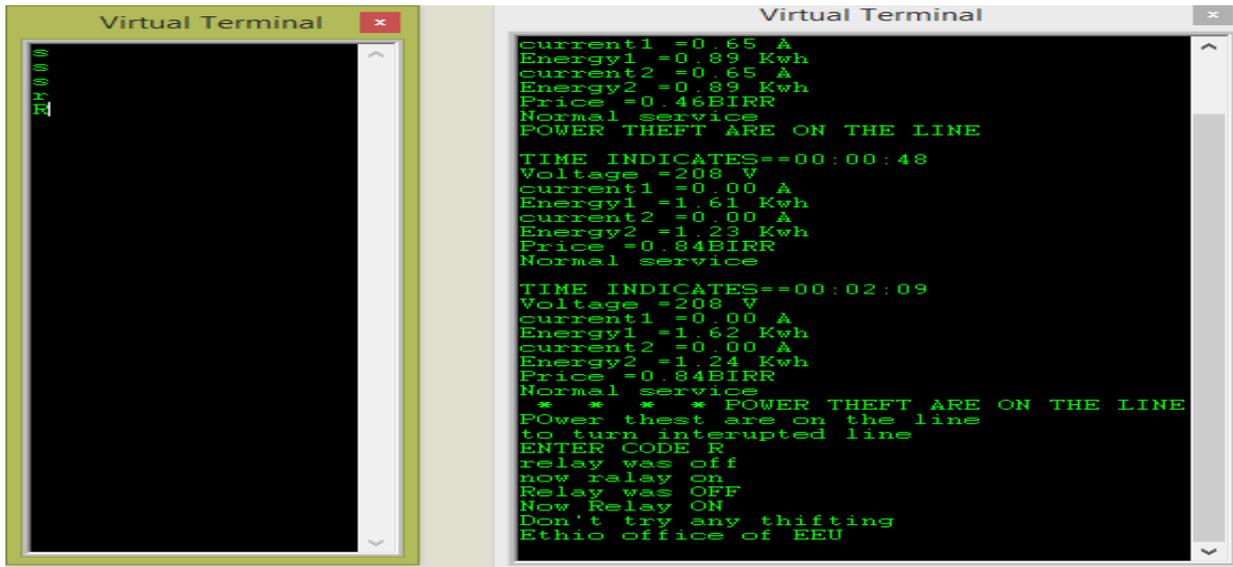


Figure 8 GSM display when code(password) send to the Arduino and its response

IV Conclusion

This paper is the combined the advantage for both utility and the customer. Arduino, current sensor, and GSM, power theft detection, and voltage variation is built which is able to read and send data via wireless protocol using GSM technology through GSM modem, capable of managing and controlling the supply to the Energy meter. Electrical power theft detection and control system is used to detect the consumer when they try to use the power illegally.

To control the revenue losses, the authorized officials needs to detect the theft of the electricity it means the theft of the bypassing tampering is the most effective one over the whole as a country comparing to the disconnecting the neutral line or magnetic tampering used to steal the electricity i.e. the unauthorized consumption of the electricity. This system ensures the accurate billing of the electricity consumed hence to provide the best way to prevent from the electricity theft. This Arduino based system is providing much better results at short haul as well as long haul.

Electricity theft, a common form of commercial losses, involves tampering with meters to distort the billing information of the power system. Commercial losses are nearly impossible to measure using traditional power system analysis tools. This is due to the lack of information on both commercial and the legitimate loads in the system, which translates to insufficient inputs for any meaningful loss calculations. By this design it can be concluded that power theft can be effectively curbed by detecting when the power theft occurs and informing the authority. Also an automatic relay is integrated to the unit so as to remotely cut off the power to the house or customer when someone tries to indulge in power theft.

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