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Modelling and Control of Energy Meter Tampering System for Efficient Energy Management

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***Abstract* — Electricity generated in Pakistan is too costly. One (kWh) of electrical energy generated in Pakistan costs almost 14 Rupees. According to a Survey, about 22 percent of the total generated electricity is lost due to these distribution and transmission losses. The efficient energy management of the distribution system has been improved day by day, but the energy measurement and billing section is still ignored which is the biggest cause of reported cases of power theft and huge financial loss to the distribution companies. The objective of this study is based on implementation of an effective energy measurement system that prevents the theft attempts and provides over and under voltage protection to consumer. By using state of the art communication technologies illegal use of electric power can be resolved electronically via real time SMS alert, which reduces the processing time and over and under voltage protection can be made possible, another achievement towards power quality benchmark.**

***Index Terms*— Power theft, Control, Energy Meter, Current Sensor, Efficient Energy Management.**

I. INTRODUCTION

Electricity being major source of energy is used for domestic, commercial, industrial and many other purposes. Electricity theft is major concern in transmission and distribution section which greatly contributes in the line losses of electricity to the whole world. Currently in Pakistan, there are increasing number of electricity thefts across domestic and electricity supply to industries which contributes to loss of energy and its revenue to be earned at greater extent. Due to electricity thefts Pakistan is facing the issues of load shedding for large time intervals in rural as well as in urban areas.

Mainly electricity theft is carried out by two ways; one is via bypassing the energy meter using a piece of wire another is by tapping the transmission line. Therefore, this system is used to resolve the issue of electrical theft and has numerous advantages for authorization and control of its revenue loss by the authorized agencies. The present energy meters are unable to detect the input and output current differences so that if the consumer bypasses the line, then the energy meters are unable to detect the electrical power theft.

The consumer end protection from voltage instability issues is also ignored which results in damage to consumer appliances. Thus, this issue needs to be addressed to increase trust level of consumer and encourage them to use electrical power without any fear of damage.

II. METHODLOGY

Methodology adopted to obtain the research objectives:

- Wires were used to connect energy meter with the main supply and also jumper wires (Male to Female) were used to connect different sensors with Arduino board.
- Using Arduino, the current, voltage and IR sensors were controlled to sense current and voltage levels and also obstacle sensing was performed for seal break detection.
- GSM Module was used as transceiver to send and receive messages when the theft or any voltage instability is sensed.
- An LCD was also used to display the input current, output current and voltage level of the supply.

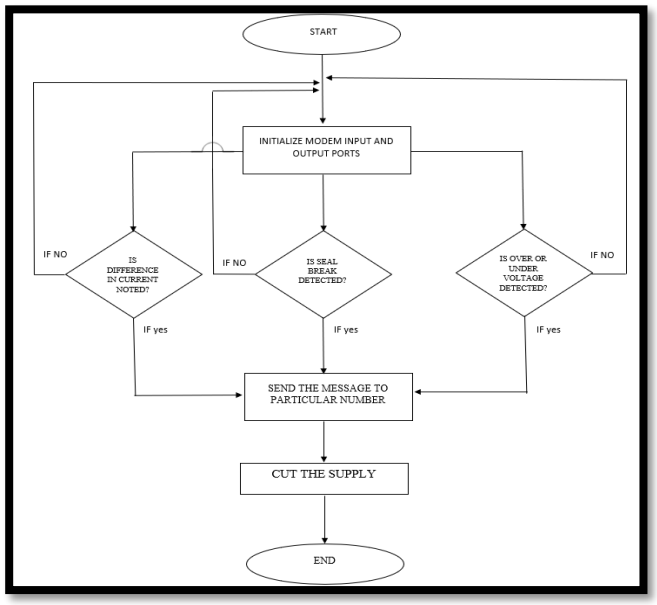

Fig 1: Flow Chart

III. SYSTEM DESIGN

Electronic circuitry which consists of Arduino Board, Current sensors, voltage sensor, IR sensor, LCD and a GSM module was developed. Arduino program was then written and uploaded to the Arduino board for communication between GSM, sensors and Arduino.

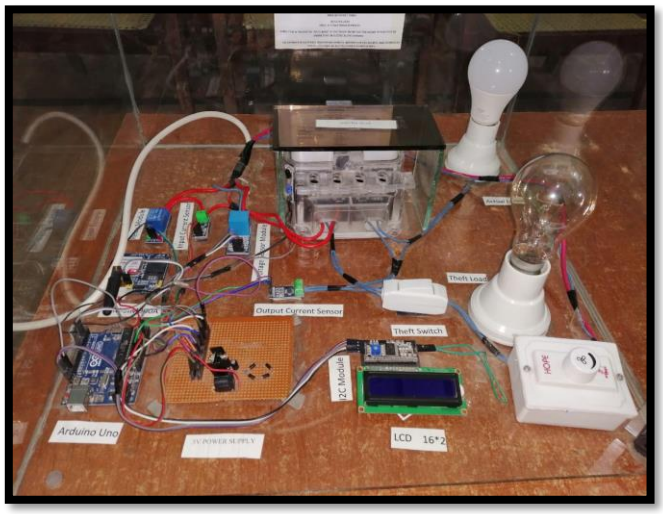

Fig 2: Hardware Design

A. Current Sensors:
ACS 712 Current sensor modules are used for current sensing at the input and output of Energy Meter.
B. Voltage Sensor:
ZMPT101B Voltage sensor module is used to monitor voltage at the supply end.
C. IR Sensor:
IR Sensor is used to detect seal break if any obstacle (i.e: seal of energy meter) is broken.

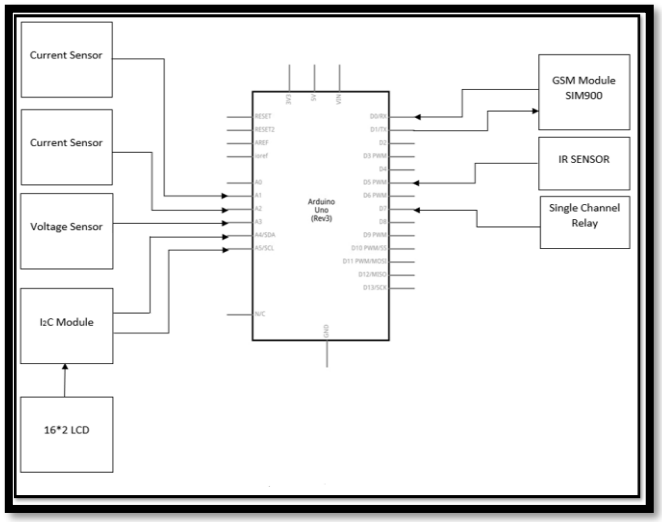

Fig 3: Connection Diagram

D. GSM Module:
GSM Module sim900A is used to establish communication between the energy meter and the power utility.
E. I2C Module:
This module is used to connect LCD with Arduino by using only two pins of Arduino Uno.
F. LCD:
A 16*2 LCD is used to display the values of currents and voltage.

IV. Results and Discussion

When an external load is attached before the meter. The supply is disconnected, and an alert message is sent to the utility.

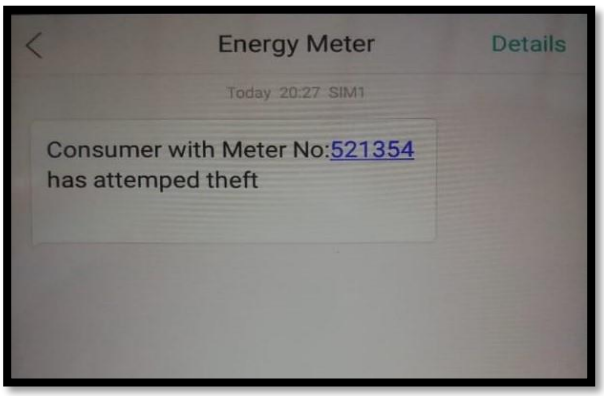

Fig 4. Alert Message when theft attempt is made

When Seal break attempt is made by the consumer. The supply is disconnected, and an alert message is sent to the utility.

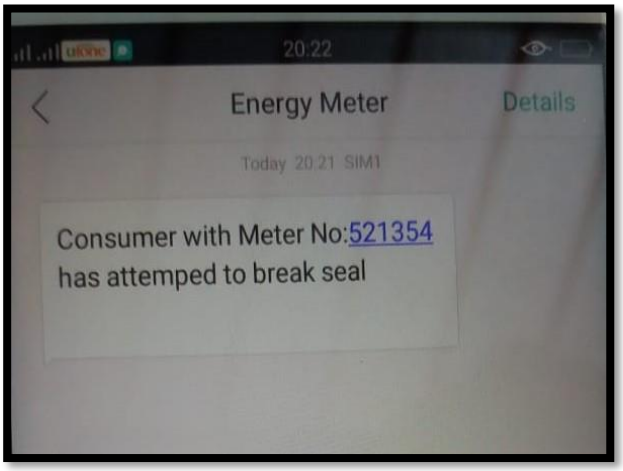

Fig 5. Alert Message when seal break attempt is made

In both the above cases the supply is reconnected by just sending a single message by the utility.

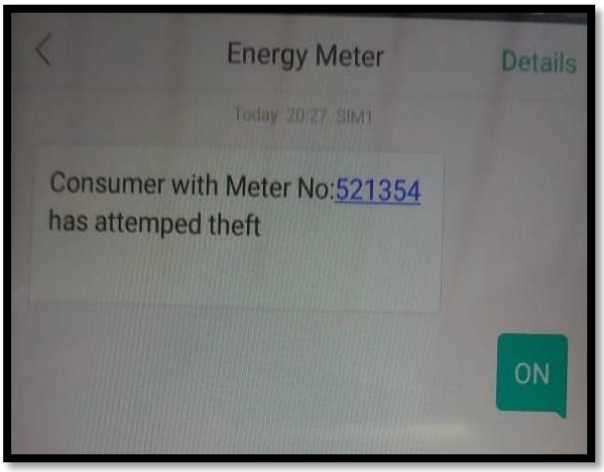

Fig 6. Message from utility to reconnect supply

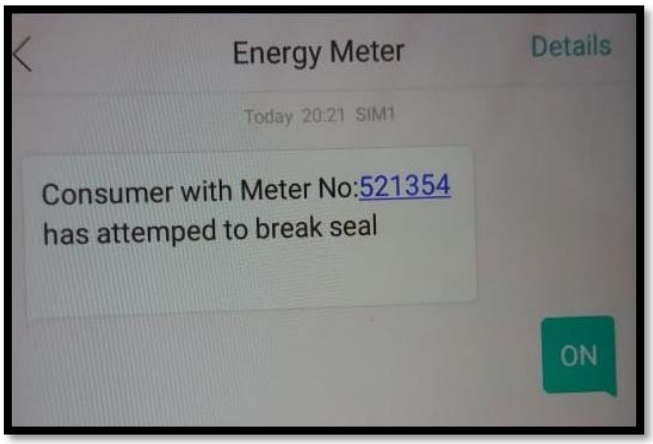

Fig 7. Message from utility to reconnect supply

There are two aspects of voltage instability (Over-voltage and Under-voltage) for simulation value of voltage for under-voltage is set to be less than 190 v and for over-voltage the value of voltage is to be greater than 210 v. In both cases the supply to the consumer is disconnected and an alert message is sent to the utility.

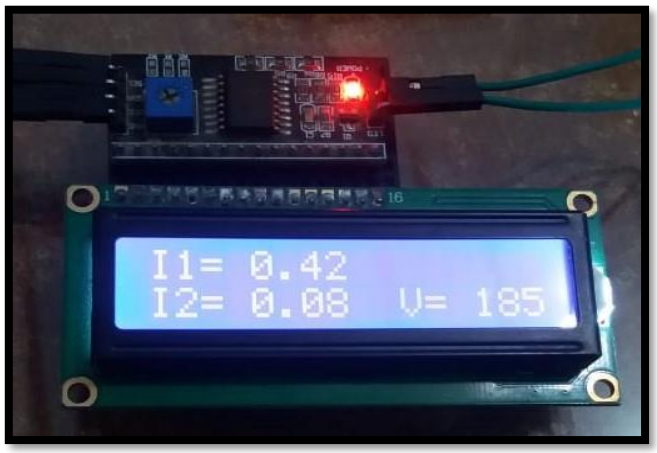

Fig 8. Under-voltage detection

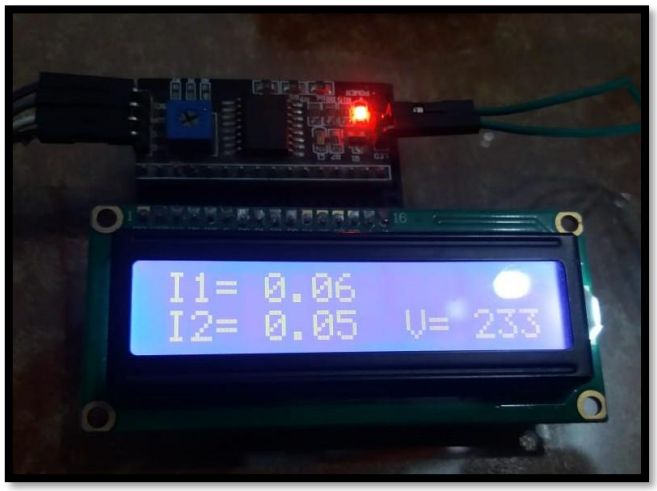

Fig 8. Over-voltage detection

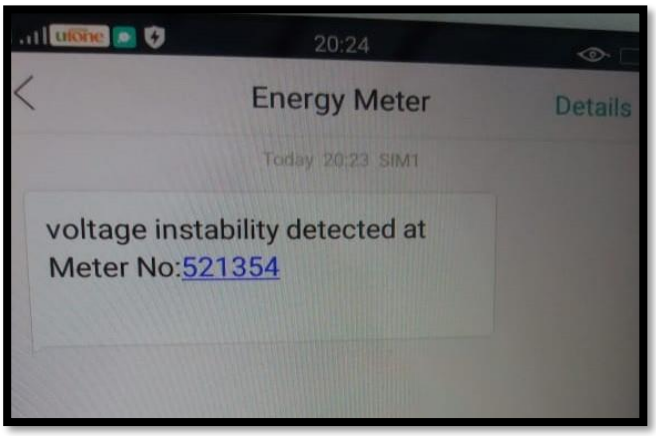

Fig 9. Alert Message when voltage instability is detected

V. CONCLUSION

By using Arduino Uno R3 and different sensors the theft within the energy meter (i.e. energy meter bypassing and seal break) was successfully detected and the utility was informed by an alert message sent via a GSM Module. Also, the consumer end safety against instable voltages was achieved successfully by using a voltage sensor and relay module. Thus, the objectives of the study were successfully achieved.

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