ELECTRICAL ENERGY THEFT MONITORING SYSTEM

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Abstract— the main aim of this project is to monitor any power drawn before the energy meter which is treated as power pilferage .Once such power is detected it results in disconnection of the power supply to the consumer and an SMS is sent to the control station to take penal action on the fraud consumer.

Electricity is a necessary energy for our daily life; with the increasing demand of electricity, power theft is also increasing that affects power sector across the whole country.

The objective of this project is to design a system that avoids such situation. For this project, an 8051 family of microcontroller is used to continuously monitor the load consumption before and after the energy meter. Any difference noticed between the input power and the output power from the meter is detected by a special CT feeding a signal to a through an Opto-coupler.

I. INTRODUCTION

Electrical energy theft and wastage of power are some of various major problems faced by people all over the world. People have to remain alert about security of their electrical energy thefts. Thus it is important to develop systems which provide solution to overcome these problems simultaneously.

The proposed system consists of digital energy meter, an Arduino (microcontroller), GSM modem and SSR. After switching power on the Arduino and the GSM modem, turn on the SSR and connects the energy meter to load. Arduino checks the readings Opto coupler and current sensors (CT). It measures the current sensor difference between CT and Opto coupler, supply voltage variation from the utility to protect the customer equipment. Solid state relay will disconnect and reconnect the supply by the microcontroller instruction given.

II. EXISTING SYSTEM: ENERGY METERING

A. Conventional system

Conventional System "Energy meters displays kilowatt- hour by continuously measuring the instantaneous voltage (volts) and current (amperes) to give energy used in joules''.

The primary type of electricity meter is the electromechanical induction meter and an electronic meter. In electromechanical induction meter, the total number of rotation of the aluminum disc is directly proportional to the power consumed.

Electronic meters shows the power consumed, power factor, the reactive power used digitally displayed on LCD or LED display, and also able to send the energy consumed readings to remote places through some communication network. It is a single way communication

In addition to measuring energy used, electronic meters can also record other parameters of the load and supply such as instantaneous and maximum rate of usage demands, voltages, power factor and reactive power used etc. . . .

"Traditionally, the electricity meters are installed on consumer's premises and Drawbacks of the regular energy meter:

1. Highly depends on meter reader.
2. Human error cannot be avoided for the manual meter reading.
3. Always there is no cross checking or recheck of human readers for energy utilization.
4. High chance of stealing and bribery always high to misuse it especially during events.
5. Possibility to change the reading when taking photos of energy meter by using software tools.

6. More number of meter reading employees is extra expenses to the company for hiring them and their expense on traveling too expensive one.
7. Wherever energy meter installed inside the house, which may lead to non-checking of reading due to lock.
8. The consumer is not receiving updates of his regular usage of energy.
9. The consumer may not receive his energy bill as per regular interval of the due date

B. Propose system

A smart energy meter works on communication directly with wireless data protocol, so there will be precise reading & there's no necessary for a meter reader to take energy meter reading in consumer premises. Smart energy meters can operate different ways with GSM Module. There are so many different advantages of smart energy meter such as:

1. User new smart energy meters send precise reading on a regular interval in sequence about customer's energy usage to utility (Electricity provider). So the bills will be proper.
2. If the consumer did not pay the energy bill within time, the utility can remotely disconnect the service of a particular consumer and after payment, the service continues to the consumer. So we can avoid sending an employee to cut off energy from the network and again to reconnect their connection.
3. We have connected lever switch for tampering attempt detect. When anyone tries to open the meter cover the button will release and send information to the service provider.
4. When the power quality is not maintained from the distribution supply, then the customer equipment can be protected by disconnecting and reconnecting to the supply by SSR.

The proposed system consists of digital energy meter, an Arduino (microcontroller), GSM modem, CT, Opto coupler and SSR. After switching power on the Arduino and the GSM modem, turn on the SSR and connects the energy meter to load via SSR. Then read the EEPROM and display the current data. Arduino checks the readings from Opto coupler and current sensor.

If there is any difference in value between CT's connected in phase and neutral line then Arduino turns OFF the relay sends SMS to the service provider using GSM module . Also, this Arduino helps the utility for power disconnection when the bill is not cleared by the customer. From customer point, this is a benefit to monitoring their daily/monthly consumption, voltage fluctuation and get disconnected from the supply.

S. No.	Reading before theft(load=100W)		Reading when theft ON(theft load=100W)	
	P.C. reading	C.C. reading	P.C. reading	C.C. reading
1.	43.0	40.0	43.0	131.0
2.	42.0	41.2	42.0	132.1
3.	40.0	39.8	40.0	130.0
4.	41.4	42.0	41.4	132.6
5.	42.5	41.9	42.5	133.2

6.	41.3	41.9	41.3	132.2

If gap between readings is more than 25% then it would take 5 continuous reading for checking propose. After 5 reading there is a gap maintain more than 25% then it will send SMS.

III. SYSTEM ARCHITECTURE

The system architecture of Adriano and GSM based smart energy meter. The energy consumption is being calculated using the energy meter IC and Arduino.

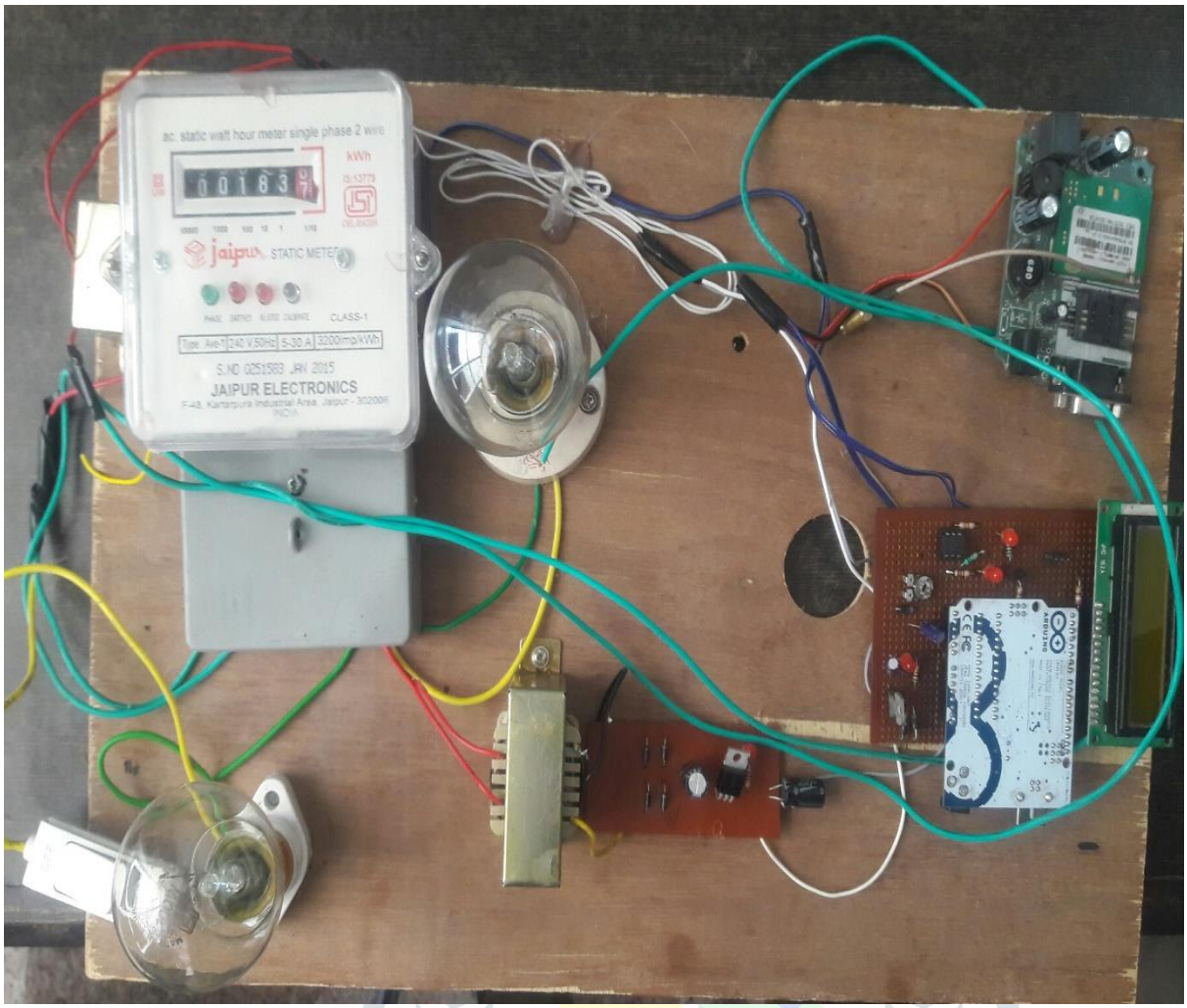
In order to prevent a power theft, detection program is present in the Arduino. Arduino and GSM based smart energy meter can be divided into several parts as Energy Meter IC, LCD, Arduino, GSM modem, Relay, Optocoupler, Lever switch, Display Unit and Power Supply Unit etc.

Current transformers are also called as CT. It is fundamentally step down transformers very accurate turn's ratio. A standard measuring device used to measure the change in high magnitude to lower current for step down transformer. It works in technique with more number of primary turns and less number of secondary turns. Higher value voltage and current cannot be measured directly.

To connect and disconnect the supply a relay is used. To blow away the various disadvantages for the electrical relay, alternative relay type called a Solid State Relay or (SSR) can be established which a solid state contactless, pure electronic relay is.

"The SSR is completely an electronic device which has no moving parts with its design. The mechanical contacts have been replaced with power transistors parts, thyristors or triac's. The electrical partition between the input control and the output load voltage is adept with the optocoupler type Light Sensor."

"The high-performance Atmel Pico Power 8-bit AVR RISC-based microcontroller combines 32KB ISP flash memory with read-while-write capabilities, 1024B EEPROM, 2KB SRAM, 23 general purposes I/O lines, 32 general purpose working registers, three flexible timer/counters with compare modes, internal and external interrupts, serial programmable USART" The use of Opto coupler and CT reading with have to match otherwise it generally open the circuit.



IV. HARDWARE IMPLEMENTATION

Conventional single phase energy meter use one current sensor and voltage sensor to estimate the KWhr consumed by the electrical load by the product of current and voltage. During unauthorized tapping in the lines then any of these sensors gives zero value and certainly the product of voltage and current will also be zero resulting in no energy measured in the energy meter.

By connecting one more current sensor with solid state relay with minimal variation in the energy meter helps to track down power theft, connect/disconnect the supply. A constant

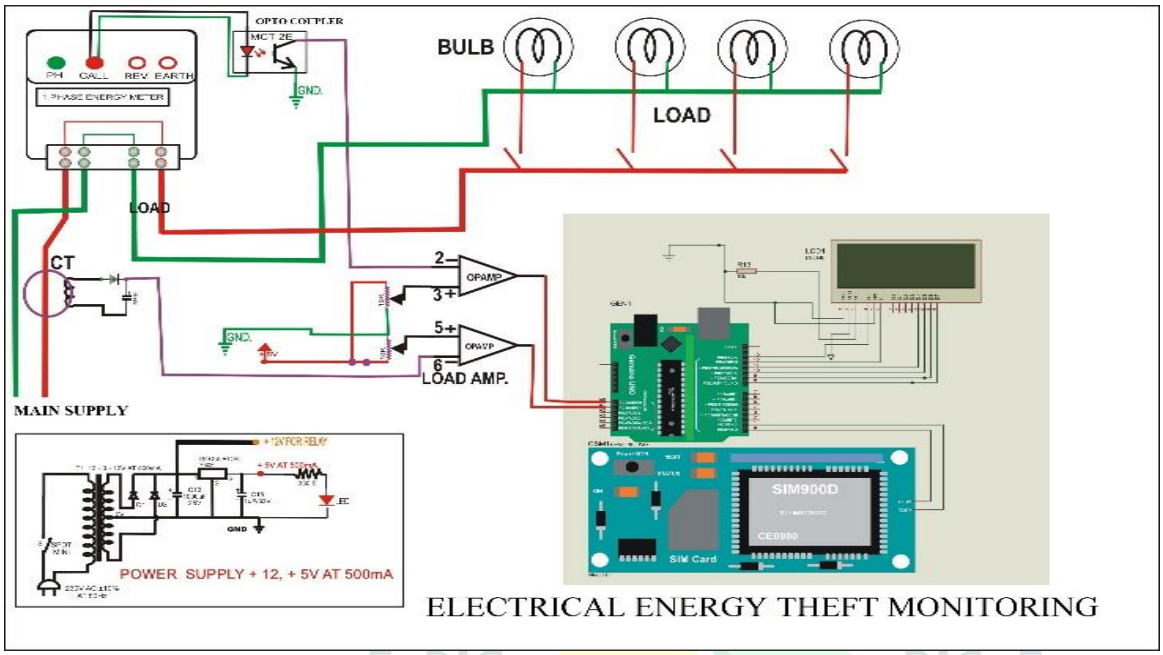
5V DC supply given to Microcontroller and LCD unit. Communication will be connected between microcontroller and utility center through GSM modem. Lever switch provided to detect the physical disturbance (tampering) given to the smart meter. To track down the unauthorized loads tapped before the meter is beyond the scope of this proposed concept.

V. SOFTWARE USED

Arduino programs are used to write in any programming language with a compiler concept that produces executable binary machine code. Atmel affords an improvement of this environment for proposed system's microcontrollers, AVR Studio and the newer Atmel Studio.

The Arduino development using project with IDE works on cross-platform application concepts in Java. IDE is useful for a beginner of any programming languages. Arduino programmer called as Sketch. Arduino library most useful to add many readymade predefined inputs to our project. It supports C & C++ using special organize code.

"A typical Arduino C/C++ sketch consist of two functions that are compiled and linked with a program stub main() into an executable cyclic executive program: setup(): is used for initializing settings which run one time at the start of a program. Loop (): is used to run the same function multiple times till the board powers off."



VI. CONCLUSION

Conclusion Electricity theft (or pilferage) leads to commercial-loss involving: tampering of energy-meters to miss-lead bill-information or direct-connections to power-lines. It's impossible to read the Commercial-losses by employing good-old power-system analysis-techniques because of the weak information of commercial and the genuine loads in the market-system, which is insufficient-for any valuable calculations of persisting losses. The hard efforts to find commercial-losses are in-accurate since the figures are redundant in the records of detected cases, rather than by actual measurement of the electrical-power system. Employment of proposed system may lead to the betterment of power utilization. All the civilians are affected by power pilferage where, the detection and reporting illegitimate-activities might surely provide a hand to reduce the price paid which would be full-filled successfully by the proposed system involving 'automated message alert' and 'load-cutoff' whenever tampering attempts are made to energy-meters

VII. References

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