Power Line Communication Based Current Theft With Device Control

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Abstract— *Countries over the world facing endemic electrical energy shortages have an added bane of power theft. Power shortages have a very detrimental effect on the overall economic growth of the country. This project has been developed as a smart meter that would make an effort to curb power theft prevailing in the distribution segment of power systems with the added benefit of detection of current overload and a notification via SMS to the main station indicating the same. Applications such as smart billing and home automation are features of this project. Overloads due to power theft detected, automate an SMS generation program that alerts concerned authorities. Consumer usage units for billing can be checked with just an SMS. Non-payment of dues by individual households may enable authorities to shut down power supply to the defaulting consumer from source. Devices can be switched ON/OFF by the user with a single SMS. Concepts of power line communication (PLC) and GSM modules along with controllers such as PIC and Arduino controllers have been used as the basis and support structure to this project.*

***Keywords*: smart meter, power theft, overload, smart billing, home automation, power-line communication (PLC), GSM module, PIC controller, Arduino.**

1.INTRODUCTION

According to the International Energy Agency (IEA), the world generates more than 66% of its electricity from fossil fuels and another 8% from nuclear energy. All of which are non-renewable. Hence there would be a time when there would be no fossil fuels left, and the world would have to go in darkness. It's difficult to imagine the world without electricity. Therefore there is a need for legitimate use of energy. This won't be possible as long as current theft occurs. According to The Times of India Power thefts cost India Rs 45k core in 2009-10. Hence there is a need to implement a successful power theft detection module.

Our project uses a GSM module to communicate with the authorities. Normally current theft is done by direct hooking from line or by bypassing the energy meter. To detect this we continuously monitor the power that is being delivered by the main transformer and comparing this value to the power consumed by each consumer using power line communication concept. If any mismatch occurs in between the readings, it would indicate power theft and the transformer would send a SMS to the authorities indicating current theft is occurring at that transformer. Also, if a customer is using more power than his meter rating. Then a SMS will be sent to the authorities indicating current overload.

A bill is commercial document indicating the used units of power. Normally to check the consumed units from the meter, a officer had to be sent to each house to get the consumed units. This method is very lengthy and also sometimes he may not be able to gain access to the meter. Our project can send the consumed units of the customer with help of a SMS. The authorities would have to send a SMS to the main transformer asking for consumed units of each meter connected to it. The transformer would communicate to each and every meter connected to it with the help of power line communication and then send a message to the electricity department indicating the consumed units of each user.

In case of non-payment of any previous dues, the authorities can disconnect current getting delivered to the customer by sending a single message. Also control of any devices in the household is possible from a remote end my sending a single SMS. Thus, making it a successful home automation system as well.

At the transformer section we have used a PIC microcontroller along with a GSM module and a PLC module. We have also used a current sensor to detect the power getting delivered from the transformer.

At the consumer section we have used a Arduino controller along with a few relays, PLC module and a basic power meter to calculate the consumed units. Also we have used a current sensor to detect the power consumed by the consumer. Note, only PLC modem is used to communicate between distribution transformer section and consumer section. And a single GSM unit is present at the distribution transformer section.

2. REALTED WORK

Previously, the projects existing to control device was either using ZIG-BEE or by establishing additional node sensors for checking data collected by the sensor at node. In order to use this Bluetooth, Wi-Fi or zigbee the transmitter had to be present in a certain range, which was not possible every time. This project directly will use the existing present power line and therefore will be significantly cheaper Even though if the controller and devices are placed far apart they can be easily controlled. Projects are also present on current theft using power line communication they use PLC to communicate directly to the authorities. But the disadvantage of PLC is that it has a minimum range for transmission. So in case the receiver is located very far from the sender then the signal of current theft module would not be delivered properly. Our project overcomes this disadvantage by using GSM along with PLC, hence ensuring there delivering of message. Also projects exciting on current theft have proven to be costly and difficult to implement. Also, our project is cheap, economical and very simple to implement.

3. PRODUCT ANALYSIS

3.1 TRANSMITTER SECTION

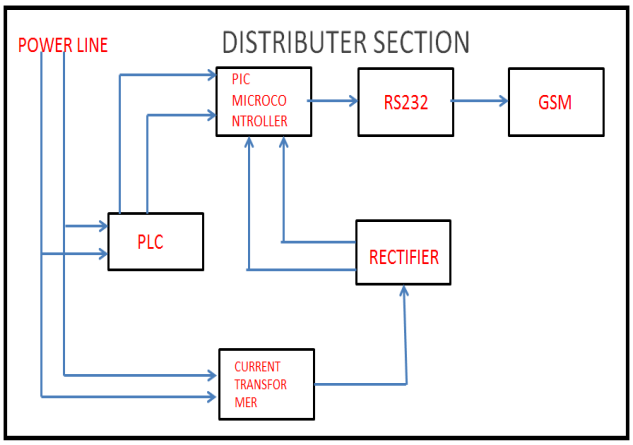

Fig-1:-Block diagram: [distribution side unit]

PIC MICROCONTROLLER (16F886)

Here we use PIC IC16f886 which is a 40 Pin IC. The IC WORK ON 5V of operating voltage. The IC is the Main part of system were the checking is done of whether the transmitted and received current is same. The PLC input come from PIC micro controller which is used by transmitter and receiver to communicate with each.

GSM MODULE

Here we use SIM900 as modem which is provided with RS232 so that is can communicate with PIC microcontroller. This unit is required to send error / fault signals towards authority when circuit detects any mischief in power use. This unit also sends the consumed units towards authority for billing.

PLC MODULE

Here we use PLCV4.0 carrier communication module using FSK communication, the Software uses super fuzzy algorithm, , the technical parameters are the Operating temperature is40- 85 °C.The working voltage is around 5V-20V .Operating current is around 12-300mA. Here the module uses single-byte encryption and verification technology, effectively reducing the full transparent transmission of data. Here we choose baud rate of 9600bpm.The single packet data should be less than 9.6 kilobytes.

RS-232 TRANSCIEVER

RS-232 is a standard for serial communication transmission of data. It formally defines the signals connecting between a DTE (data terminal equipment) such as a computer terminal, and a DCE (data circuit-terminating equipment or data communication equipment), in our case it is used as a modem. The RS-232 standard is commonly used in computer serial ports. The IC max 232 is used to convert the signal coming from the modem that is in analog form to the PIC microcontroller input which should be in TTL logic so it converts the incoming signal to PIC microcontroller TTL logic.

BRIDGE RECTIFIER

The bridge rectifier is used to convert the AC signal into DC signal as the electronics equipment works on constant DC voltage.

CURRENT SENSOR OR TRANSFORMER

The current sensor is used at the transmitter side for keep ON checking the amount of current send to receiver side .This current sensor help in checking if there is any mismatch in current send and received by the receiver.

OVERLOADING

Overloading happen when there is a current consumption cross the rated value for a given consumer.

3.2 RECEIVER SECTION

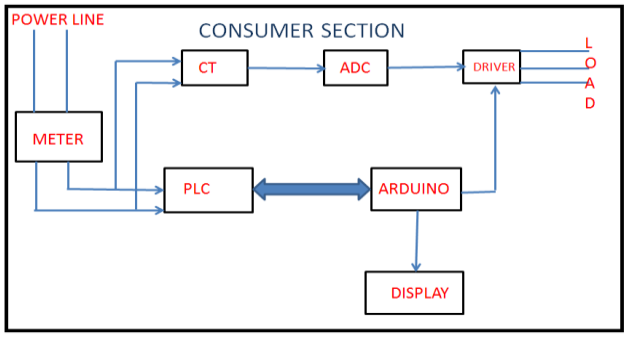

Fig-2 **Block diagram: [Consumer side unit]**

ARDUINO

Here we use ATMEGA328P-PU this is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. This ATMEGA328P-PU has rich instruction set with 32 general purpose working register .It has 23 Programmable I/O.Pin 0 and 1 is connected to the transmitter and the receiver of PLC module Pin no 2,3,5 of is connected to the Pin no 11,12,13,14 of PLC module respectively ,Pin no 7 ATMEGA is connected timer 555 so that it can take count read by the meter and display on the LCD.
These controller units are the heart units in respective circuits. Both the controllers has built in ADC channels which are used to check the current rating.

PLC MODULE

Here we use PLC16F886 carrier communication module so all the specification are same.

BRIDGE RECTIFIER

This circuit is used for the same purpose as the transmitter side.

LCD Display

Module PLCM-1610CT Liquid crystal display has been used here. It is of 16 x 2 line, input data of 8bit or 4bit is available for interface. Single Power Supply of [5V (+/-) 5%] is required for the proper display of a particular number, it has a duty cycle of 1/16 Duty.

METER PULSE

This is a normal meter which is placed by the EB, This system works same as it work at your home its count goes on increasing as we consume the electricity. The output of the meter goes to the 555 timer, ADC and then to the arduino.

LOAD DRIVER

Here we use ULN 2003 which works on 5V TTL input This is an IC which is used by the controller to send load trip / reconnect signals then this unit is require doing the action as controller cannot drive any load directly.

4. MATHEMATICAL MODEL

Whenever input power is passing from supplier to the receiver, at that time if the total amount of power is not received by the receiver then there is possibility of theft of energy.

$\sum Psent = \sum Pconsumed + Loss$.....No Theft ("1.1")

$\sum Psent \neq \sum Pconsumed + Loss$...Theft Occurred ("1.2")

Here, Psent = Power measured by transformer side energy meter
Pconsumed = Power measured by consumer side energy meter.

5.RESULT

The successful development of the prototype hardware has been done and correctly tested for the purpose it is being implemented. When there is fault like there is a overload or current theft it inform the concern authority about the theft with proper location and amount of energy consumed in terms of unit.

This prototype also used for home automation by sending sms the consumer can switch on/off the devices in the house. It also provide the information about how much unit of electricity the consumer has used also known as smart billing.

FIG:- Working Model Of The Project

6. FUTURE SCOPE

In future this project can be implemented in Remote area. Future enhancements can be incorporated to suit the system for three phase electric distribution system in India. Along with all this new architectural components

can be incorporated, so that the system can be completely used for optimizing the energy consumption. This method will reduce the energy wastage and save a lot of energy for future use.
One can decide the resolution of this system. Due to economic consideration, instead of installing this system for each consumer utility company can install one system for one colony. Then power theft on any line in that colony will be identified by this system

7.CONCLUSION

The successful development of power line based current theft detection with smart home automation described in this article is based on the high performance, extremely low power consumption, high level of integration, and low price of GSM technology. This paper is aimed at reducing the heavy power and revenue losses that occur due to power theft by the customers. By this design it can be concluded that power theft can be effectively curbed by detecting where the power theft occurs and informing the authorities. The proposed system provides the solution for some of the main problem faced by the existing grids such as wastage of energy, power theft. The proposed system is found to be little bit complex as far the distribution network is concerned, but it's an automated system for theft detection it saves time as well as helps to maximize the profit margin for utility company working in the electrical distribution network. Utility company can keep a constant eye on the customer. Plus the system comes with a smart home automation which will help the consumer to control the devices in the house from any remote location.

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