RESEARCHERID
THOMSON REUTERS

ISSN: 2277-9655
[ICEMESM-18] Impact Factor: 5.164
IC™ Value: 3.00 CODEN: IJESS7

IJESRT

INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

POWER THEFT PREVENTION USING SMART METER WITH GSM TECHNIQUE

S.L.Narnaware[#1], P.R.Mandape[#2], L.R.Sarate[#3] ,A.C.Lokhande[#4]
[#1#2#3#4]Electrical Engg. Dept, Govindrao wanjari College of Engg.,
Nagpur, Maharashtra, India

DOI: 10.5281/zenodo.1232257

ABSTRACT

Electricity theft is a major concern for the utilities. With the advent of smart meters, the frequency of collecting household energy consumption data has increased, making it possible for advanced data analysis, which was not possible earlier. In developing countries like India, power theft is one of the most prevalent issues which not only cause economic losses but also irregular supply of electricity. It hampers functioning of industries and factories, due to shortage of power supplied to them. It causes shortage of power supply to homes. It leads to loss of revenue by Government as individual enterprises may opt to install their own power generators, increases corruption in form of bribes and many more. Ultimately it is the country's economy which suffers along with the country's political reputation. We introduced here a GSM technique which gives proper power consumption massage in the end of month

Keywords: electricity power theft, advent, generators, corruption, and power consumption.

I. INTRODUCTION

Power is the basic necessity to do any work, in same way electric power is needed to run electric appliances. We receive electric power from substation through transmission line Power theft is major issue of concern these days , bad minded people do power thefting trough illegal ways such as hooking and by bypassing the electric meter.[1] such power theft causes huge loss of power and economy of the country and to resolve such problems is the task of priority of our the government and related to this cause many things has been done so far but there is continuous need of advances as power thefting is still continue.[2] Our Project is based on this problem and we through our project have tried to solve this problem.[3]

In our project we have added a smart meter which is capable of handling higher voltage greater than 230V passed by substation for few minutes and it maintain voltage at 230V across the loads and thus protect them from getting damage by higher voltage and those consumer who are running their appliance at ordinary meter and those who are doing power theft by hooking and bypassing the meter ,gets their appliances damage.[4] We also has provided GSM facility which gives information about power uses to the distributor company directly and mater tempering.[5]

II. WAYS OF POWER THEFT

There are many ways of power theft ranging from village areas to industries which causes huge losses of power and economy as well. Some of these power theft ways as below:

A. Power Tapping

Often power theft is done during transmission by illegal tapping of the power lines to divert the power to the required destinations. It is also done by illegal connections to the power grid stations, which are cut at the time of billing. [6]

B. Meter Fraud

In many areas where manual reading of the meter is done, the person is often bribed to give false readings and thus the amount paid is for lesser amount of power compared to the power actually consumed. Also meters are tempered by obstructing the motion of the disk (usually electro mechanical consists of slowly spinning disks to record the power consumed).

ISSN: 2277-9655
Impact Factor: 5.164
CODEN: IJESS7

Electric meters can be manipulated, thus causing them to stop, under-register or even bypassing the meter. Consumers, who are tamper with electric meter, effectively use power without paying for it. This theft or fraud can be dangerous as well as dishonest. Electric meter security is looked upon as major issue in many countries today. [7]

III. POWER THEFT PREVENTION USING SMART METER

The power theft by tapping transmission line and by meter tampering can be reduced to far extent by using advanced smart meter. These smart meters are capable of handling higher loads that are transferred by sub power station several times during the day and maintaining constant voltage of 230v across the appliances.

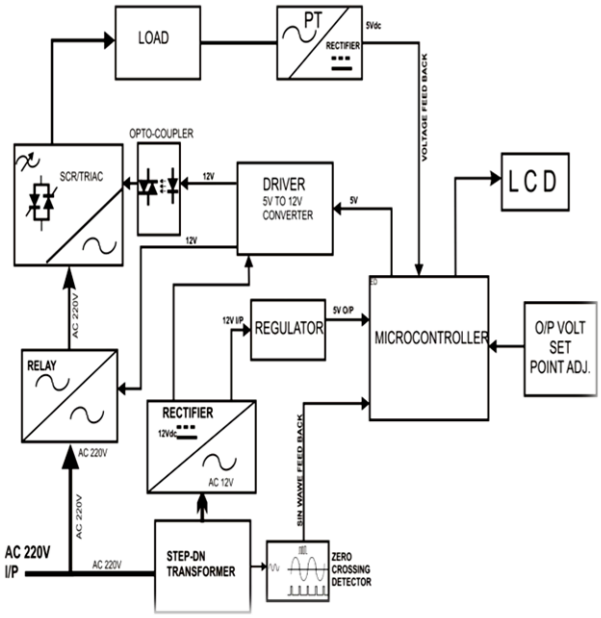


Fig 1. Smart Meter Block Diagram

IV. CONSTRUCTION OF BLOCK DIAGRAM

From the above block diagram the main aim is to control and keep balance the voltage across load. Initially controller checks the incoming voltage coming from line with the help of ADC (analog to digital converter) present inside the Microcontroller. Our aim is to control a +ve as well as –ve half cycle of incoming AC for that a Firing angle control method is used. For controlling a firing angle of any AC voltage it is necessary to monitor every +ve/-ve half cycles, hence a Sine Wave Cycle Monitor(Zero Crossing Detector) block is used in our project, which informs a controller about start point of every cycle.[8]

Once controller knows the voltage across the load and signals from sine wave cycle monitor, controller calculate the firing angle and gives firing pulse to the AC to AC converter in which a static switch formed by a SCR/TRIAC is used. Static switch can operated on high voltage and high frequency as compare to the mechanical switches like relay. The output of AC to AC converter is further give to load. The voltage across load is measured by the controller with the help of Potential Transformer (PT). Potential transformer is used to step down the voltage across the load to be measure and rectified to DC, because microcontroller can read a voltage upto 5vdc only. In our project we are using a Relay for tripping the input voltage in case of very high voltage and low voltage which is beyond control-able limits.

The relay used in our project is of 12 volts and controller can give maximum of 5V, hence it is necessary to amplify the 5V to 12V for which a Driver circuit is used Microcontroller requires a 5V DC to work, and same will be generated with the help of Power Supply which comprises of a Step down transformer, rectifier, filter and regulator. Transformer step down the 220 V AC to 12 V AC, rectifier and filter converts this 12 V AC to 12 V DC, and regulator converts a 12 V DC to a constant of 5 V DC. This way smart meter keep constant voltage across the loads and protect them from being damage by incoming higher voltage of transmission line.

ISSN: 2277-9655
Impact Factor: 5.164
CODEN: IJESS7

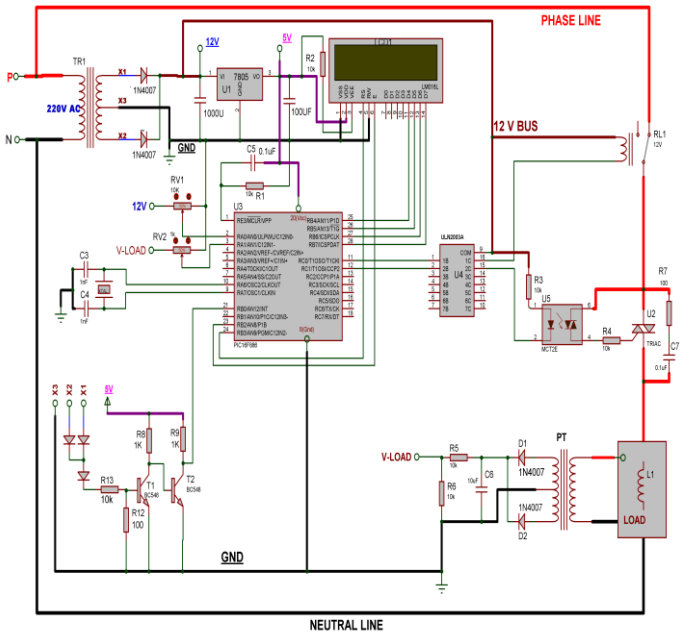


Fig.2 Smart Meter Circuit Diagram

V. WORKING OF SMART METER

In our project we used step down transformer of 220V/12V ac. Then through the rectifier and diode 12V ac converted to 12 V dc. And we used here filter capacitor for the purity of dc voltage. This 12 V dc gives to the input of regulator IC. And through this it converts in the 5 V dc. All components use this 5V dc. We use capacitor on 5Vdc as a storage capacitor. Microcontroller starts operating and to reset microcontroller we used one capacitor and resistance. Microcontroller measures the input and output voltage but in our project we measure only output voltage so that we used here potential transformer. Rating of potential transformer 220/6V. It measures the voltage across load. This PT has 6V ac output and to convert 6V ac into 6V dc we used filter and rectifier.

We cannot give 6V dc directly to the microcontroller because microcontroller operates only on 5V constant. For that one potential divider is used. This potential divider reduced the 6V into 5V.As controller identifies the output voltage, it generates the firing angle. Through this firing angle it turns ON the relay and gives signal to opto-coupler with the help of microcontroller. As optocoupler gets signal through the microcontroller it helps to TRIAC turn ON. And after turn ON the TRIAC it continues with the load. If a voltage goes suddenly increased or decreased the relay gets trip. This is nothing but an electromagnetic switch. [9]

VI. FUNCTION OF VARIOUS COMPONENTS OF SMART METER

Functions of inbuilt components of the smart meter are as follow:

A. The Full Wave Rectifier (12 V AC to 12 V DC):

A Full Wave Rectifier is a circuit, which converts an ac voltage into a pulsating dc voltage using both half cycles of the applied ac voltage. It uses two diodes of which one conducts during one half cycle while the other conducts during the other half cycle of the applied.

B. Voltage Regulator (12 V DC to 5 V DC):

A voltage regulator is designed to automatically maintain a constant voltage level, where they stabilize the DC voltages used by the processor and other elements.

ISSN: 2277-9655
Impact Factor: 5.164
CODEN: IJESS7

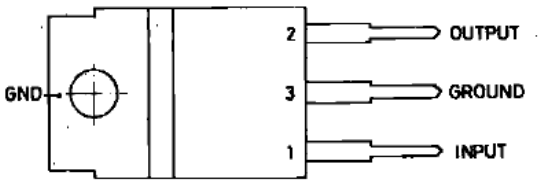
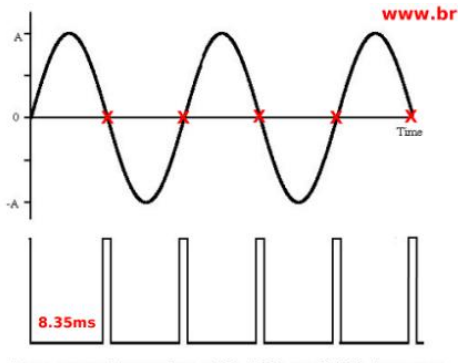


Fig.3.voltage Regulator

C. Sine wave cycle monitor (ZERO CROSSING DETECTORS):

A zero crossing detector is a one type of voltage comparator, used to detect a sine waveform transition from positive and negative, that coincides when the I/p crosses the zero voltage condition. In alternating current, the zero crossing is the instantaneous point at which there is no voltage present. In a sine wave or other simple waveform, this normally occurs twice during each cycle. The pulse occurs at 0, 180, and 360 degrees. Regulated 5V is also used as biasing voltage for both transistors (Q1 and Q2) and the control section. A pulsating DC voltage is applied to the base of transistor Q1 through diode D3 and resistors R4 and R5. When the pulsating voltage goes to zero, the collector of transistor Q1 goes high. This is used for detecting the pulse when the voltage is zero. Finally, the detected pulse from 'OUTPUT' is fed to the microcontroller of the control section.



Zero crossing pulse at 0, 180, and 360 degrees.

Fig.4. Zero Crossing Detector

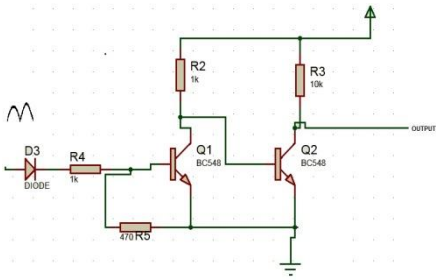


Fig. 5.

D. Driver:

A Microcontroller digital logic output pin supplies only 10mA of current. External devices such as high-power relays can require>100mA and they need more voltages. In order to control such devices which use high DC current, a transistor-based driver circuit is used to amplify current to the required levels. If the voltage and current levels are in perfect range, the transistor acts like a high-current switch controlled by the lower current digital logic signal

ISSN: 2277-9655
Impact Factor: 5.164
CODEN: IJESS7

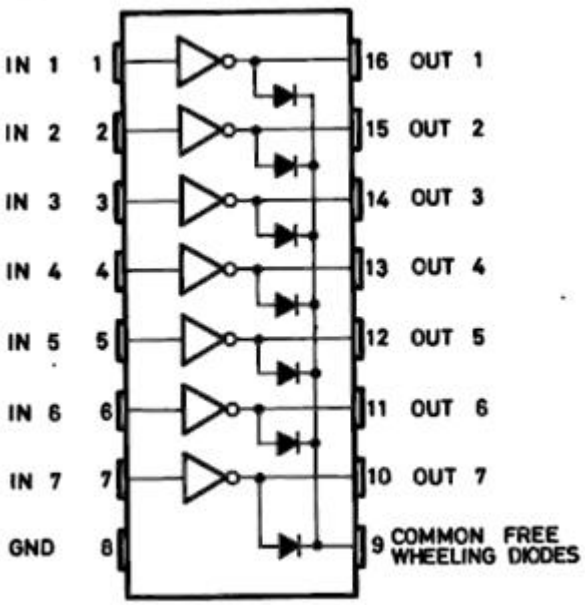


Fig 6

The ULN2001A, ULN2002A, ULN2003 and ULN2004A are high voltage, high current Darlington arrays each containing seven open collector Darlington pairs with common emitters. Each channel rated at 500mA and can withstand peak currents of 600mA. Suppression diodes are included for inductive load driving and the inputs are pinned opposite the outputs to simplify board layout. These versatile devices are useful for driving a wide range of loads including solenoids, relays DC motors; LED displays filament lamps, thermal print-heads and high power buffers.

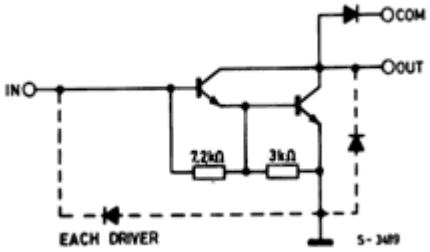


Fig 7

E. Opto-coupler:

An opto-coupler are designed to provide complete electrical isolation between an input low voltage side(controller side) and output high voltage side (SCR/TRIAC side) circuits.

F. LCD:

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data. The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the LCD. [10]

ISSN: 2277-9655
Impact Factor: 5.164
CODEN: IJESS7

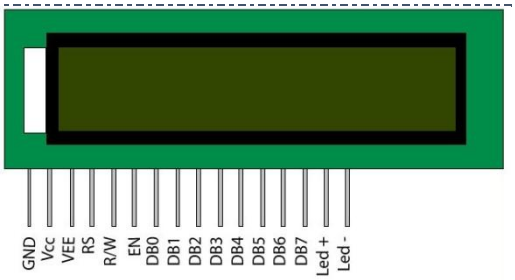


Fig.8.LCD

Fig.9. Table. Of LCD pins with functions

Pin no.	Function	Name
1.	Ground (0v)	Ground
2.	Supply voltage:5V (4.7V-5.3V)	Vcc
3.	Contrast adjustment: Through variable resistor	V_{EE}
4.	Selects command resistor when low ; and data resistor when high	Resistor select
5.	Low to write to the resistor ; High to read from the resistor	Read/Write
6.	Send data to data pins when high to low pulse is given	Enable
7 to 14	8 Bit Data Pins	DB0 to DB7
15.	Backlight V_{cc} (5V)	Led +
16.	Backlight ground (0V)	Led-

G. THYRISTOR/TRIAC:

These are Static devices used to switch. Static device is a kind of device which converts one type of energy or energy level in to another type of energy or energy level respectively without physical movement.

H. MICROCONTROLLER:

In our project we are using a PIC (16F886) microcontroller which has RISC (restricted Instruction Set Codes) architecture due to which controller requires only One Clock Cycle to complete a single execution. In our project we are using a 28 pin microcontroller having 16K/b of FLASH ROM, 1.2K/b of RAM, and 256 bytes of EEPROM. This controller having an inbuilt 10 Bit ADC which requires measuring input and outputting analog voltages. The operating cycle of PIC is of 200n/s. The output port capability is off to deliver 5v/40mA on each port pins.

VII. POWER SUPPLY CIRCUIT

The entire electronics component such transistor, integrated circuits, etc generally requires DC for their operation. So AC supply is then stepped down. Now this stepped down AC is converted to DC supply by rectification process .there may be some ripples coming out of Power supply circuit the entire electronics component such transistor, integrated circuits, etc generally requires DC for their operation. So AC supply is then stepped down. Now this stepped down AC is converted to DC supply by rectification process .there may be some ripples coming out of rectifying unit is bypassed by connecting the capacitor in parallel. Then 12v supply given to the LM7805 regulator. Now as microcontroller, LCD module, relays and other certain ICs requires 5V DC supply for their operation

ISSN: 2277-9655
Impact Factor: 5.164
CODEN: IJESS7

We need a regulated uninterrupted 5V DC supply. This block involves production of 5V DC supply for Whole circuit.

Every circuit requires power for its operation. Here we require +5v dc to operate Micro-controller, Relays, and certain ICs. The supply voltage of 230v ac is step downed to 12v by using the step-down Transformers. As the circuit requires only the dc supply the in fed ac is converted to dc by using the rectifying unit. The rectifying unit consists of bridge rectifiers comprising diodes for rectification Purpose. Any of the ripples coming out of the rectifying unit is bye passed by connecting the Capacitor in parallel. As the microcontroller circuit requires only +5v dc supply, the outputs is further diminished by the regulator (LM7805) for accurate +5v to the micro-controller circuit. The capacitor is connected in parallel for suppressing the ripples.

VIII. METER TEMPERING PREVENTION METHOD

We have provided the facility called meter temper; this facility prevents ill minded peoples from interfering with smart meter normal working.

In meter temper feature if anyone is tried to interfere with the meter , the smart meter immediately gives tripping signal to the relay and relay then tripped to the smart meter to off condition and also send a message about it to the electricity power service provider through GSM based service and the meter could reset only by the professional person who is sent by the electricity power service provider Thus this way electricity service provider comes to know that someone has interfered with the smart meter.

IX. GSM FACILITY

GSM Facility in a smart meter is a facility that provides information about smart meter related to power uses and meter interfering by someone.
In this facility a GSM Sim is inbuilt by ma
nufacturer registered with user mobile number and electricity service provider number and thus provide information about meter to them during set time schedule.

X. CONCLUSION

Power theft is prevent in the society but we by using and developing a power theft prevention devices like smart meter we can reduce it to far lower level. In our project device called smart meter has designed to meet these required of preventing power theft by hooking and by meter tempering and GSM facility has made smart meter a user friendly.

XI. REFERENCES

[1] R. Jiang, H. Tagaris, A. Lachsz, and M.Jeffrey, “Wavelet Based Feature Extraction and Multiple Classifiers for Electricity Fraud Detection” in Proc. Of IEEE/PES T&D Conference and Exhibition 2002: Asia Pacific, Vol. 3, pp. 2251-2256.
[2] C. R. Paul, “System loss in a Metropolitan utility network” IEEE Power Engineering Journal, pp. 305307, Sept. 1987.
[3] I. E. Davidson, A. Odubiyi, M. O.Kachienga and B. Manhire, “Technical Loss Computation and Economic Dispatch Model in T & amp; D Systems in a Deregulated ESI” IEEE Power Eng. Journal, Apr. 2002.
[4] A. H. Nizar, Z. Y. Dong and Y. Wang, “Power Utility Nontechnical Loss Analysis with Extreme Learning Machine Model” IEEE Trans. on Power Systems, Vol. 23, No. 3, pp.946-955, August 2008.
[5] J. W. Fourier and J. E. Calmeyer, “A statistical method to minimize electrical energy losses in a local electricity distribution network” in Proc. of the 7th IEEE AFRICON Conference Africa, Sept. 2004.
[6] A. H. Nizar, Z. Y. Dong, J. H. Zhao, P.Zhang, “A Data Mining Based NTL Analysis Method” IEEE PES General Meeting, pp. 18, 2007.
[7] T. B. Smith, “Electricity theft: A comparative analysis” Energy Policy, Vol. 32, pp. 2067-2076, 2004.
[8] A. Kumar and D. D. Saxena, “Decision priorities and scenarios for minimizing electrical power loss in an India power system network” Electrical Power Components and Systems, Vol. 31, pp. 717-727, 2003.
[9] M. S. Alam, E. Kabir, M. M. Rahman, and M. A. K. Chowdhury, “Power sector reform inBangladesh: Electricity distribution system “Energy, Vol. 29, pp. 1773-1783, 2004.
[10] Annual Report Tenaga National Berhad2004, TNB 2004.

ISSN: 2277-9655
Impact Factor: 5.164
CODEN: IJESS7