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Power Optimization and Theft Detection

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ABSTRACT: Electric energy is very essential and important for everyday life and plays an important role in every possible way. Electrical energy plays an important role in our day-to-day life and it acts as backbone for the industries and hence increasing the need of electricity and corresponding theft of electricity is also increasing. Wastage of electricity and theft of power increasing day by day because of the unnecessary actions taken by human beings. Hence proper actions against power theft are need to be taken care. If proper actions are not taken to save electricity, future generations have no scope of living their life in light, peace and harmony. So, this project deals with power optimization and theft detection. It will give a clear picture of electricity consumption of each load, hence helping in optimization of electricity by monitoring and controlling the power usage of each device. Power theft is normally done by two methods that is bypassing or hooking. So, to detect power theft, a system is proposed in which Current division rule has been used to detect the power theft. According to this rule, a parallel circuit is used as a current divider, here the current divides in all the branches in a parallel circuit, and the voltage remains same across them. The current across the circuit impedance is determined using the current division rule determines.

KEYWORDS: Power Optimization; Power Theft; Energy Meter; Liquid Crystal Display; Opto coupler

I. INTRODUCTION

Power theft or the electricity theft is the major and very common problem, especially in our country in recent years. which leads to huge loss to electricity boards and to country's economy. As the population increases access to electricity also increases. Since it is a social evil, it is very important to take this issue in to consideration and hence to overcome these losses since prices are increased. So, by preventing this theft related to electricity we can save lot of power which will in turn be very beneficial for day-to-day life. The electric power generation are more than a century old technology but each element of the system contains high-tech solutions. There is a whole gamut of challenging areas in the power sector that India needs to address on priority in order to meet its growth targets. World over the economic growth is driven by energy, either in the form of finite resources such as coal, oil and gas or in renewable forms such as hydropower, wind, solar and biomass, or its converted form, electricity. This energy generation and consumption powers a nation's industries, vehicles, homes and offices. For growth to be sustainable, it must be both resource efficient and environmentally-safe. In India, the demand for electricity has always been more than the supply. The importance of electricity as a prime driver of growth is very well acknowledged and in order to boost the development of power system, the Indian government has participated in a big way through creation of various corporations such as, State Electricity Boards, NTPCL Limited etc. However, even after this the country is facing power shortage. The current power infrastructure in India is not capable of providing sufficient and reliable power supply. Some 400 million people have zero access to electricity since the grid does not reach their areas. Another problem is unstable power supply. There are frequency fluctuations caused by load generation imbalances in the system and this keeps happening because consumer load keeps changing. Poor power quality control has knock-on effects on equipment operation, including large scale generation capacity. The proposed system helps in monitoring the power usage through which the load performance can be analyzed. This helps in optimizing the usage of devices based on their power consumptions and also features the power theft detection in node junction. The following chart shows the number of power theft cases:

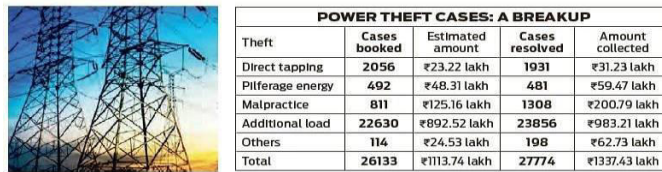


Figure 1. Power Theft cases

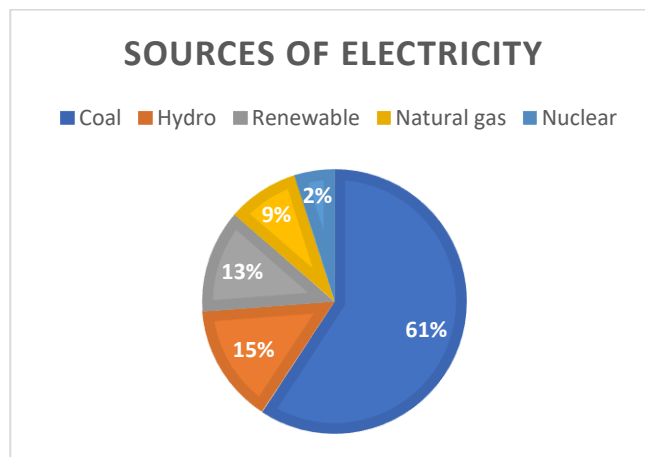


Figure 2. Sources of Electricity in India

II. LITERATURE SURVEY

Nitin K Mucheli, Umakanta Nanda, S.K. Das proposed a system in which the power theft is minimized by bypassing or by hooking this proposes a web based mobile application which will notify the operator about the theft of electricity that is happening in a particular area. It will detect the power theft automatically without engaging any man power by developing a cost effective and efficient system. It maintains the record of the total number of electric units consumed by users in the server database periodically and make online bill payment system. It uses a web based mobile app for the authorized officials of electricity board to keep track of all the thefts, area of theft and the direction to reach the area under theft. [1]

Rupali Shinde, Soniya Joshi, Vaibhav Rampure proposed an electricity theft detection system to detect the theft which is made by the most common way of doing the theft and that is bypassing the meter using a piece of wire, people simply bypass electricity meter which is counting the current unit by placing a wire before and after the meter reading unit. It will indicate exact zone and distribution line on which unauthorized tapping is done in real time. This system will provide a simple way to detect an electrical power theft without any human interface. This is time saving if distribution company personnel take reading by the wireless technique. [2]

Saurabh Singh, Krishna Yadav, Harjeet Matharu in their system a microcontroller is interfaced with an energy metering circuit current sensing circuit, RF communication and a contactor to make or break power line. During normal condition micro controller will read energy pulses and the current signals. If the energy pulses are normal and the current is drawing then there is no power theft. If energy pulses are not coming and current is drawing the it indicates power theft. Hence the output is tripped by the microcontroller using the relay. This information is sent to substation using wireless communication. [3]

III. OBJECTIVE AND BRIEF WORK FLOW

The objective of the designed device is expected to accomplish is to build a power optimization and theft detection system. Some of the objectives are:

- To detect the power theft automatically without involving any man powers by developing a cost effective and efficient system.

- To maintain the record of the total number of electric units consumed by users.
- To monitor the power consumption of each load connected to the power network, hence helping in optimization of power by controlling the usage of each device.
- To implement a remote monitoring and control system.

The hardware includes the customized electric meter and the distributor box and the software includes the development of coding and the Bluetooth module. For the hardware part to be developed first, study of basics components like digital electric meter, GSM module, Microcontroller, optocoupler and their workings has to be carried out. Then the brief circuit of both the distributor box and the electric meter have to be designed. After that the hardware design of the above components should be considered. Now the designs of all the components need to be integrated to a single design in accordance to our customization or circuit diagram. According to our customization the design of the distributor box will consist of a GSM module and one HC-05 Bluetooth module which should be connected to a microcontroller. The design of the customized electric meter will consist the circuits of the commercial electric meter at the input side and a GSM module such that all of them share the same microcontroller. The microcontroller will be programmed according to the desired functioning of the customized electric meter.

IV. METHODOLOGY

Even though there are so many methods existing, still there is a need of more simple and sophisticated equipment. Here proposed a system called power optimization and theft detection. The proposed system helps to monitor the power usage through which the load performance can be analyzed. This helps in optimizing the usage of devices based on their power consumptions and also features the power theft detection in node junction. The block diagram of this system is as shown below:

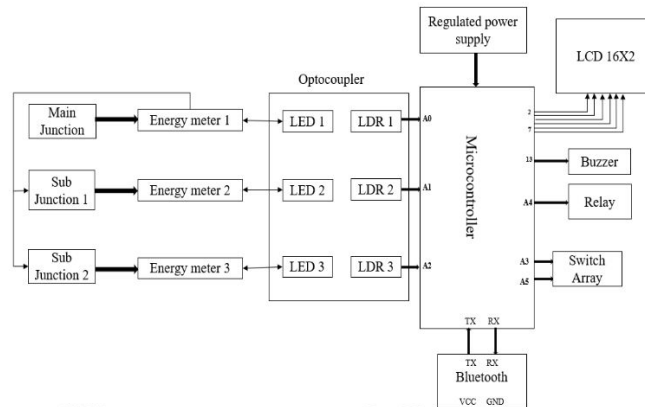


Figure3. Block diagram of Power optimization and Theft detection system

Power Optimization:

In this project, the proposed model will monitor the power consumption of each load connected to the power network. This is done by connecting a current sensor to each power socket which can measure the current as the load is connected. To keep a count and read the values, an optocoupler with voltage comparator circuit is used to provide digital pulse output which can be detected by a Microcontroller.

Arduino UNO is used as a Microcontroller board which can detect the pulses and the power consumption readings can be displayed on a 16X2 LCD. The data is also shared through a Bluetooth transceiver, so that any smart devices can also receive the data accordingly. This type of power monitoring system corresponding to the loads connected, will give a clear picture of power consumption of each load, hence helping in optimization of power by controlling the usage of each device.

Power Theft:

Current division rule has been used to detect the power theft. According to this rule, a parallel circuit acts as a current divider in this the current divides in all the branches in a parallel circuit, and the voltage remains the same across them. The current division rule determines the current across the circuit impedance. A current sensing current

transformer is connected in both the distribution box and the meter is installed in the house. The current from current transformer – optocoupler is fed into a micro-controller (Arduino Uno). The data of either side is then sent to the authorized smart device via Bluetooth. Hence the data are compared, if the difference is more than the provided threshold, power theft is detected.

IV. DETAILED SYSTEM STUDY

The hardware and software required for our solution is:

A. ARDUINO UNO

The Arduino Nano is a small, complete and breadboard friendly board based on the ATmega328P. It has more or less the same functionality of the Arduino Duemilanove, but in a different package. It lacks only a DC power jack, and works with a Mini-B-USB cable instead of a standard one. Each of the 14 digital pins on the Nano can be used as an input or output, they operate at 5 volts. The Arduino Nano has a number of facilities for communicating with a computer, another Arduino or other microcontrollers. The Arduino Nano can be programmed with the Arduino software.

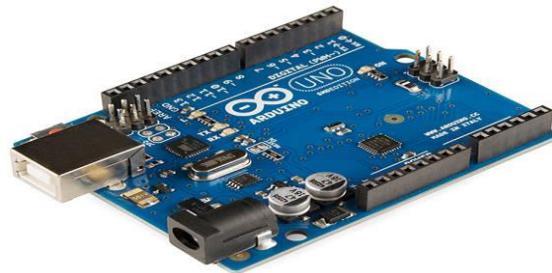


Figure 4: Arduino

B. OPTOCOUPLER

An optocoupler is a semiconductor device that separates DC from AC that it allows an electrical signal to be transmitted between two isolated circuits. It is the most sensitive for the environmental light intensity and it is generally used for detecting the ambient brightness and intensity of the environment. Two parts are used in an optocoupler, one is LED that emits infrared light and another is a photosensitive device that detects light from the LED. Both parts are contained within a black box with pins for connectivity. The input circuit takes the incoming signal, whether the signal is AC or DC, and uses the signal to turn on the LED. This is combined with voltage comparator circuit which is used to provide digital pulse output which can be detected by a microcontroller.

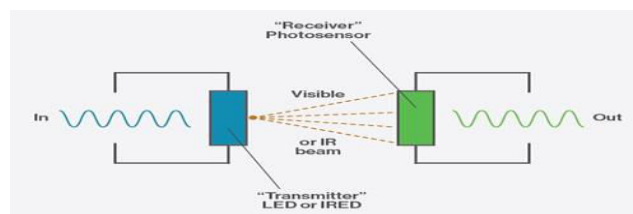


Figure.5 Optocoupler

C. LCD DISPLAY:

LCD screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special and even custom characters (unlike in seven segment), animation and so on.

A 16x2 LCD means it can display 16 character 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.



Figure6. LCD display (2x16 line)

D. POWER JUNCTION BOX

A junction box is an electrical enclosure that houses one or more wiring connections. The box protects the connections, which usually contain vulnerable points such as wire splices, from environmental conditions and accidental contact.



Figure7. Power junction box

E. BLUETOOTH TRANSCEIVER

Frequency hopping takes place between the transmission or reception of packets, so the packets that make up one transmission may be sent over different frequencies within the ISM band. The energy consumption data is shared through a Bluetooth transceiver, so that any smart device can receive the data accordingly.

F. SWITCH ARRAY

A switch array is a group of switches arranged closely together. It's often used with an assistive device that allows multiple switch inputs, for example a switch to tap and a second switch to scroll on a tablet.

V. RESULTS AND CONCLUSION

The proposed system is tested with a test object and is observed the performance of the system is quite satisfactory in Power Optimization and Theft Detection in very less time compared to traditional methods. The prototype has been designed keeping the possible practical issues in mind. The structure can be made strong enough to sustain all possible loads. This system detects the power theft automatically without engaging any man powers by developing a cost effective and efficient system. Maintain the record of the total number of electric units consumed by users. Monitor the power consumption of each load connected to the power network, hence helping in optimization of power by controlling the usage of each device.

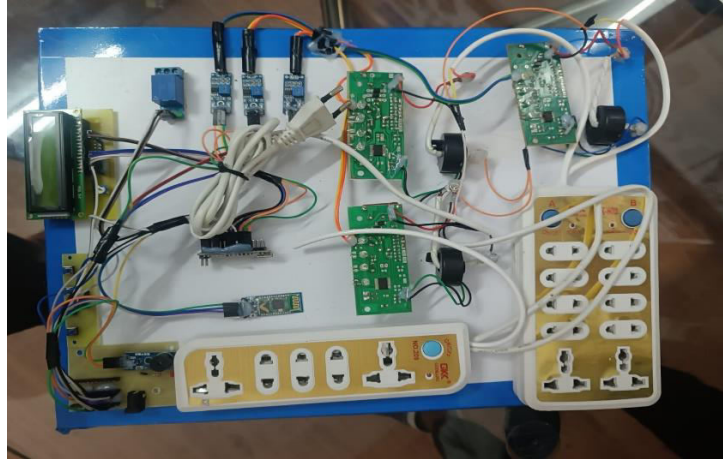


Figure 8. Final model of Power Optimization and Theft Detection

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