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Real time monitoring of power consumption and load demand control

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Abstract: *India is a developing country where major portion of the electric power is generated by using non renewable energy sources and the power demand increases day by day. The generated power is sufficient in normal conditions. But in abnormal conditions i.e peak load demand the generated is not sufficient to meet the load. This variation in load demand is due to variation in utilization of load. In order to make the load constant we introduced the new tariff system i.e time based variable tariff. Therefore the tariff rate is high at the time of peak demand and it is low at the time of low load demand. Therefore the consumer try to escape from high tariff hence try to shifts his load utilization to another time slot where there is no peak demand. This project also helps the consumer to know his electricity bill at the instant itself. It can be done by using opto coupler circuit which counts the number of blinks of LED in the energy meter. The count of the blinks is given to the micro controller. The micro controller counts the corresponding tariff and it will display the tariff at the instant and this calculated tariff is sent as notification to the consumer.*

Key Words: *load demand, variable tariff, power consumption.*

1. INTRODUCTION:

The Electrical metering instrument technology has come a long way from what it was more than 100 years ago. From the original bulky meters with heavy magnets and coils, there have been many innovations that have resulted in size & weight reduction in addition to improvement in features and specifications. Resolution and accuracy of the meter have seen substantial improvements over the years. Starting with Voltmeters and Ammeters, the digital meter has conquered the entire spectrum of measuring instruments due to their advantages like ease of reading, better resolution and rugged construction. Now a days, the energy consumption and energy distribution has become a major problem because of huge difference in energy production and consumption. Due to increased demand, there is need to generate more power. Need of generating power is directly proportional to load demand. If demand is increased then more power is required to generate. As the load increases day to day. so obviously power generation is also increased day to day. In India most of the power is generated by using thermal power plants and the fuel used in thermal power plants is coal which is a non renewable energy source. Because of rapid increment in the generation, the level of coal is also reduced very fastly i.e:coal consumption increases. Generally we can't reduce demand of load but we can reduce utilization level so that energy consumption is reduced. So the need to generate more power is indirectly reduced. By using this project we will bring awareness to the consumer by giving alerts that he is consuming more power in terms of money. So the consumer will alert and tries to reduce his utilization.

1.1. LITERATURE REVIEW:

The total load demand of a particular area can be calculated by summing all the individual loads.This total load demand is called as peak load demand. This peak load demand is not constant at all times because variation in usage of load. India is developing country where the supply is always less than the demand required. Therefore frequent power cuts were happened because of the occurrence peak demand. The frequency of occurring peak demand can be reduced in two ways i.e reducing the consumption of load or shifting the load to another time where there is no peak demand. Shifting of load can be by the consumer only. In order do that the proposed system contains variable tariff system. It also includes monitoring of power consumption.

2. DISCUSSION AND RESULT:

2.1. Load shifting:

One of the techniques of load shape change in load curve of a particular area is load shifting which moves peak loads to off peak time periods without necessarily changing overall consumption. Load shifting combines the benefits of peak clipping and valley filling by moving loads that are already existed from on peak hours to off peak hours as in figure.

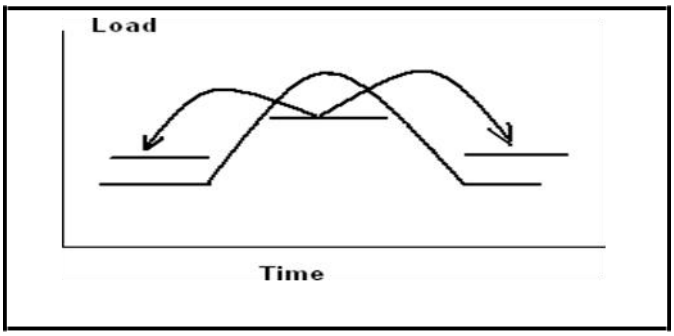


Figure 1 load shifting

This technique best suits utilities and customers when incremental cost of electricity is less than the average cost of electricity. Adding load at the right price can reduce the average cost of electricity to all consumers and improve system load factors. One of the most promising methods of valley filling is off-peak industrial production, which displaces loads served by fossil fuels with electricity. By using this method the frequency of occurring peak load demand can be reduced so that power cuts can be reduced in rural areas.

2.2. Variable tariff :

Now a days blocked rate tariff system is used to charge the consumer for the utilization of electric power. It means tariff rate per unit power is based on number of units consumed. The tariff rates of domestic loads are: Up to 50 units consumption Rs 1.45/unit, 50 to 100 units consumption RS 2.60/unit, 100-200 units consumption Rs 3.60/unit, Above 200 units consumption Rs 6.90/unit. The present system introducing the new tariff system called "Time of day tariff". This means the tariff is based upon the time i.e the tariff rate is different at different timings.

2.3. Problem statement:

The main problem that was faced in villages is frequent power cuts.The power cuts are occurred due to various reasons. In that majorly due to lack of resources, system failures etc. 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. India is an developing country in which major part of the electricity is generated by using coal. The coal that we have in India is less in quantity and which is non renewable one. Due to this lack of resource the power cut will happen. The second reason for power cuts is system failures. When we are growing up, failures of local transformers were very common. Power cuts used to happen because the systems we had were not up to the mark. Although with use of latest technologies, this problem has been mitigated to quite an extent, but still there are lot of places in the country. Where the work is still pending just like bad roads, bad power systems still exist in many places in the country, resulting in failures leading to power cuts. By the continuity of supply to industrial areas and urban areas which makes the village people to suffer from power cuts.

2.4. Solution with the proposed system:

Here in this system we are proposing a solution that will help the consumer in knowing the electricity consumption at every instant and also helps the consumer in reducing his utilization levels. In the digital energy meters there is blinking LED. The number of blinks of LED is depends upon the type of load and amount of load. Based on the blinking count, number of units consumed is calculated. For domestic loads 3200 blinks are considered as one unit of electric power consumption.. A ULN2003 circuit is connected to the blinking LED circuit of the energy meter. Now the blinks are recorded in the ULN circuit. Based on the blinking count number of units consumed is calculated. In the proposed system the total day is divided into number of parts by using past data of the existed system. The tariffs rates for regions are different for each region. The tariff rates fixed based on the load curves for particular time. Actually the existing system is an open loop control system by means the supply is directly given to the load. Now the system that we are proposing is closed loop in which the alerts are taken as the feedback to the consumer. For every region there is limit of electric consumption. The LCD displays number of units consumed up to that instant and alerts the consumer whenever he is reaching limit. Whenever the limit is crossed for a particular region, the tariff rate is changed. The tariff rate may be twice or thrice, depending upon the consumption of the consumer. In this way the consumer shifts utilization of the loads to another region where there is no problem of peak demand. So that in this way the problem of peak demand can be solved. This calculated information was sent as notification to the consumer to his mobile number that is saved in the program. The program for blinking count and for the LCD display is written by using the embedded 'c' language.

3. Advantages of the proposed system:

3.1. Load Demand Control: By using the proposed system we can control our load in home appliances as well as in industries. The load control can be achieved by fixing number of units for a particular time period of time. Up to a particular limit the tariff rate is same as mentioned in the earlier. Whenever the limit was crossed then the consumer will charged at higher tariff rate. So the consumer will avoid the waste usage of his daily consumption. Therefore whenever the wastage is avoided somewhat of power demand is reduced. So the load demand control can be achieved.

3.2. To Know The Number Of Units Consumed At The Instant: Generally we don't know how much electric bill will come at the end of the month. By using this system we can calculate how much amount of power consumed up to that instant. This can be done by calculating number of blinks of the blinking LED on the energy meter. An opto coupler circuit connected to the LED of energy meter then it will senses and counts the number of blinks of LED. The calculation is done by ULN circuit.

3.3. Minimization Of Power Consumption: Based on the number of on and off states of LED the number of units consumed is calculated. And the corresponding fare is calculated bt the micro controller simultaneously. The alerts are given to the consumer by seeing his fare of electric consumption at that instant. So that he will alert and try to reduce his utilization levels to escape from high electric bill.

4. Results:

4.1. Load demand control:

In general, the tariff is charged based up on the number of units consumed. The charging of the tariff is different from meters to meters i.e category 1 is different from category 2 type meter. We can say that tariff is based upon the number of units we consumed. It is called as block rate tariff system i.e the tariff is different from block to block. Actually the consumer doesn't know how much tariff he will get up to the end of the month. The tariff rapidly increases with increase of the number of units consumed. To bring more awareness to the consumer we are placing a opto coupler circuit to count the number of blinks in the energy meter. The blinks are needed to calculate number of units consumed. In general 3200 blinks are equal to one unit of energy consumed. The number of blinking of energy meter is calculated by using opto coupler. The opto coupler is internally connected to the energy meter to count the blinks of LED. This opto coupler is connected to the micro controller. In this project we are introducing the variable tariff system i.e tariff will be charged according to the demand. Here the tariff will be high, whenever there is peak demand. The tariff will be low where the demand is low. To escape from high Tariffs, the consumer will change his load to time another time slot where there is no peak demand. Now, the peak of the daily load curve is removed then the daily load curve will change. The changed daily load curve has almost constant load demand with some alteration. This constant load demand curve is also useful to the consumer in knowing peak demand of a particular area.

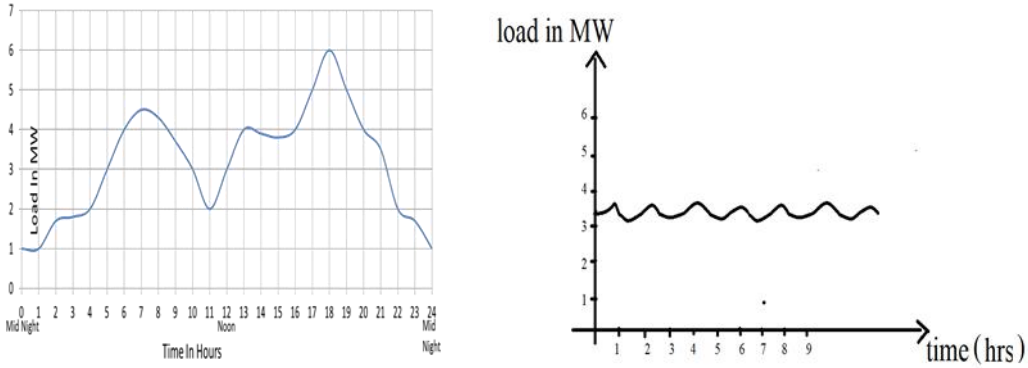
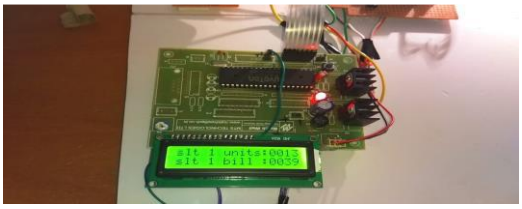


Figure 2 comparison between existing system and proposed system

4.2. Power consumption monitoring:

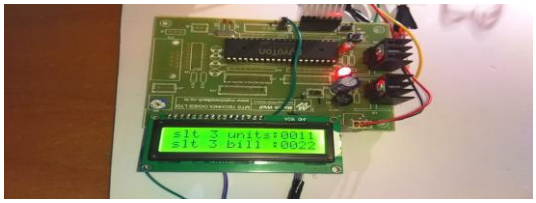
When the load curves of a particular area is observed there is peak demand on a particular time and there is low demand in a particular time. India is developing country where supply is less than the demand of power. Therefore frequent power cuts were happened whenever the peak demand occurred. The power cuts can be reduced in two ways. First one generating more power or the second thing is using the loads according to power supply i.e utilizing the loads equally in all times. Generating more power will leads to more investment of cost and it also leads to more consumption of non renewable energy sources. The other alternative source for removing of peak load demand is shifting of load to other time where there is no peak load demand. The load shift is in the hands of consumer. In order to do that variable tariff is introduced in the proposed system. In this the tariff is charged according

to the time. Therefore the total time of the day is divided into number of slots. For each slot tariff rate is fixed. Consider the total time is divided into three slots. If the consumer consumed 13, 5 & 4 units in slot 1, slot 2 & slot 3 respectively. Then the tariff calculation was done as shown in below.



Slot 1

Slot 2



Slot 3

Total bill

Figure 3 calculated tariff in micro controller

This calculated information is passed from micro controller to GSM. The GSM will send notification to the consumer about his consumption and the corresponding tariff. The notification is shown in the figure.

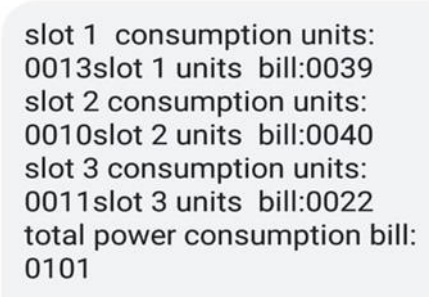


Figure 4 result of mobile notification

5. CONCLUSION:

Therefore we conclude that, by using this proposed system the consumer will know his electric power consumption at the instant itself and the consumer gets the notification daily. We can also control the peak load demand by introducing variable tariff is also called as "Time of day tariff" system in which shifting of the load takes place from one time slot to another time slot where there is no peak demand. This system also helps the supplier in knowing the average load demand of a particular area.

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