Implementation of Energy Saving Algorithm in Smart Home

Mrinmay Saha, Rima Halder, Anamitra Baruah , Ashish Kumar Sharma and S.Senthilmurugan

Abstract: ***In India, due to the increasing population, there is always a shortage of energy. The more we consume energy the more we require energy. There is mass production of electrical energy at present but there is no full utilization of the energy which is produced. So, there is always a necessity that the power which is produced is utilized wisely and efficiently. The most upcoming technique which can be implemented to save energy is the smart grid. This has many advantages which not only helps us to manage energy but also helps us in dealing with the power theft and smart utilization of power. This paper deals with the very basic but the most important part of the smart grid. Before going to any aspect of the smart grid we are bound to know the basic building block of the smart grid, i.e., we need an energy algorithm which will allow us to proceed further for the smart grid. Energy algorithm is basically the backbone of smart grid system which allows us to manage as well as helps to reduce the total power consumed by the consumers. This paper mainly deals with the energy algorithm and a simpler way to reduce power consumption by the consumers.***

Index Terms: Smart Grid, Energy Algorithm, Power Consumption Levels.

I. INTRODUCTION

The metering business is under the change nowadays. India has most of the age, transmission and appropriation organize in the world. The plan of the smart meter with robbery recognition has been proposed [1]. The impact of cross breed electric vehicles on the smart network has a colossal impact [2].

The rate of modernization is increasing immensely with the passage of time. Modernization has led to the automation of everything reducing the workload. As everyone knows electricity plays enormous role automation of every aspect of life, be it be charging of the battery to powering of large industries. Electricity fulfills basic needs of day to day life. But with advantages comes the disadvantage. In India, there is an enormous generation of power every day. These powers are utilized daily to fulfill the consumer's needs. But there are many problems which are faced. Problems like power theft, power loss, and excessive powers, which are almost impossible to avoid if the whole system is controlled manually. There will always remain of scope for all this problem to occur. Imagine an apartment containing three rooms having high power consuming appliances like the air conditioner, washing machine, etc. and due to some negligence of human the appliance is kept ON, then the amount of power consumed will be exceptionally high and as a result, the amount of bill paid will be more. So, there will be no proper management of power consumption and more wastage of money and energy. The only solution for all this problem is to change to a smart grid, it unlocks many aspects of power management may it be in the field of distribution or at the consumer level.

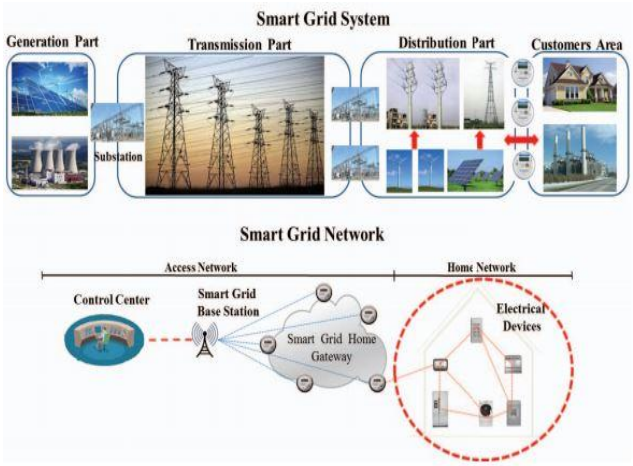

Fig 1. Smart Grid Architecture

In this paper, we will basically deal with proper management in the consumer level, where the main aspect is to control all the appliances in an apartment using Smart Grid Home Gateway(SGHG) [3]. This is one of the upcoming technology which manages the state of all the appliances which are available in an apartment. The main advantage [3] of SGHG system is mentioned as below:

1. They continuously manage the appliances.
2. They continuously collect data.
3. They continuously note reading comprising to real time.
4. It is self-adjusting and continuously manages the time w.r.t time.

So let us explore more about the SGHG system. This system is basically segregated into two parts and the main mode of communication is sensor-based wireless communication. Here SGHG system controls all the appliances in the home, i.e., each and every appliance which is present in the home are controlled and managed through the SGHG system, it decides when the appliances are needed to be ON [2] and when the appliances are needed to be switched off. In this way, power consumption is managed and a huge amount of power is saved.

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The second part is the connection between the SGHG system with the central control system. The central control system sends the necessary data to the sensor [1], [3] and the information is sent to the SGHG which then analyses the data and the appliances are managed accordingly [4], [5]. If the appliances are running for a longer time and the power consumption is more, the SGHG receives data from the central control and then takes necessary steps which are needed to be taken to prevent overvoltage.

Fig.2. Energy Saving Algorithm Flowchart

This flowchart describes the sequential operation of the algorithm. After starting first, it will check if the system is a MANUAL or AUTOMATIC system. Then the system will check for load time schedule, which we have divided into three parts-

- 00:00 to 08:00
- 08:00 to 16:00
- 16:00 to 24:00

The first slot (00:00 to 08:00) is considered as a normal hour, the second slot is considered as a moderate hour and the third slot is considered as rush or peak hour. After identifying load time, the system will check for power consumed. If the power devoured by the devices in that time period is low, then it is functioning normally and if the power consumed is high at that time period then the system will check for the high power consuming device. Now as the total consumed power is very high the system will compare the consumed power by different devices. To keep the consumed power in a normal range the system will automatically switch off the high power consuming device. Thus the total consumed power will be in a normal range. Now the description of the algorithm is given below.

II. DESCRIPTION OF THE IDEA

The algorithm which is been created is mainly done considering a simple room which is having an ac, a fan, a compact lamp, and an incandescent lamp. We know that all these electrical appliances have different power ratings and each of the appliances consumes a different amount of power. Some of the appliances consume more while others consume less power. But it can happen that sometimes due to some error, some of the appliances remain in the running condition. So, the energy consumed during this period of time will result in wastage of energy. So, to ensure the proper usage of energy and to reduce the wastage, this algorithm is created. So, the different appliances that are used have been differentiated into three levels. Level 1 has the appliance that consumes maximum power, level 2 has appliances that consume a moderate amount of power and level 3 appliances consume the lowest of the three. Hence, our main motive is to identify the appliance which consumes maximum power and switch it off.

Table 1- COMPONENT DETAILS

Name	Level	Quantity	Time	Power
COMPACT LIGHT	3	1	14	2
INCANDESCENT LAMP	2	1	6	200
FAN	2	1	15	80
AC	1	1	3	10500

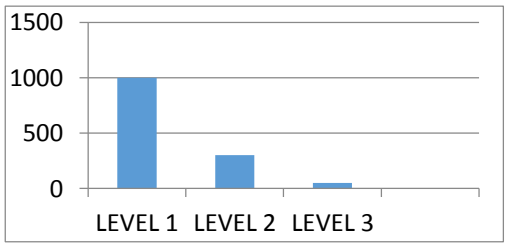
III. ALGORITHM

To overcome the problem of wastage of energy, many algorithms have been created with different solutions. This algorithm allows us to reach a proper solution to our problems. It is the basic step before we start with the smart grid. We too came with an algorithm which is described below:

The main motto of this algorithm is to diminish the power utilization and to manage the electrical appliances which are taken into consideration. The main concept used here is ‘sorting'.

So, let's try to explore the concept used in this algorithm. The algorithm which we have adapted to sort the electrical appliances is descending order. In this algorithm, we have divided a day into three equivalent parts having equal time intervals. The first part is from 12 a.m. to 8 a.m. which is considered a normal period of the day, i.e., during this period of time energy compared will be less. The second part is from 8 a.m. to 4 p.m. which is the moderate period of the day, i.e., the energy consumed during this period will be moderate. The last part is from 4 p.m. to 12 a.m. which is regarded as the rush hour and the energy consumed during this period of time will be maximum.

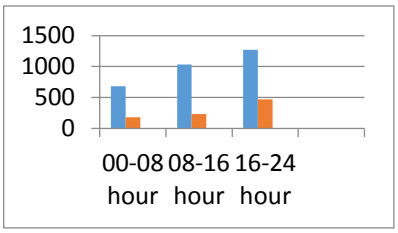
LEVEL VS WATT



X axis-LEVELS Y axis-WATTS
LEVEL 1-above 500
LEVEL 2-above 50 but less than 500
LEVEL 3-BELOW 50

This algorithm helps in recording the power utilized by the appliances at every instance of time. After recording it checks for the total power consumed. If the total power consumed during a specific timeframe is more than that of predefined power, it then switches off the appliance which is responsible for maximum power consumption. The recording of power is done with the help of the electricity sensor. The recording is done at every instance of time and the appliance which consumes more power will be turned off without any delay. Hence, the wastage of power will be reduced.

TIME VS WATT

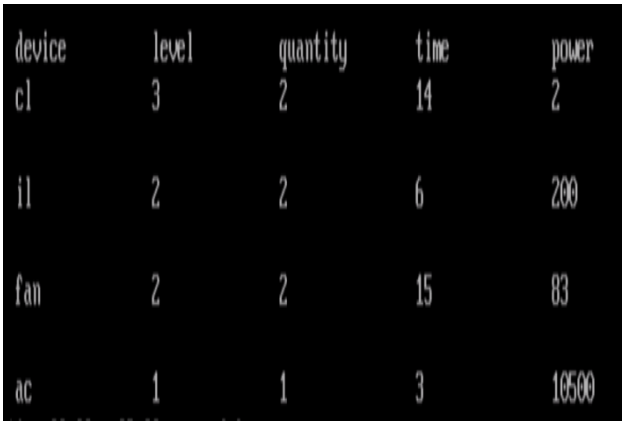


X axis-time
Y-axis- watts

-before using an algorithm -after using an algorithm

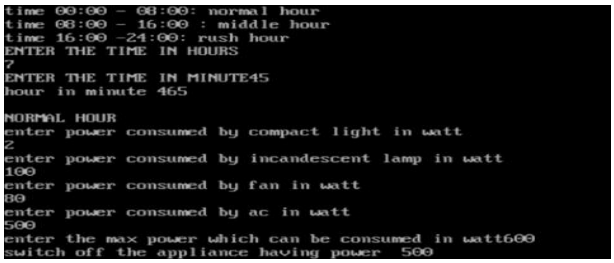
IV. RESULTS

IMAGE 1



device	level	quantity	time	power
cl	3	2	14	2
il	2	2	6	200
fan	2	2	15	83
ac	1	1	3	10500

OUTPUT 1:

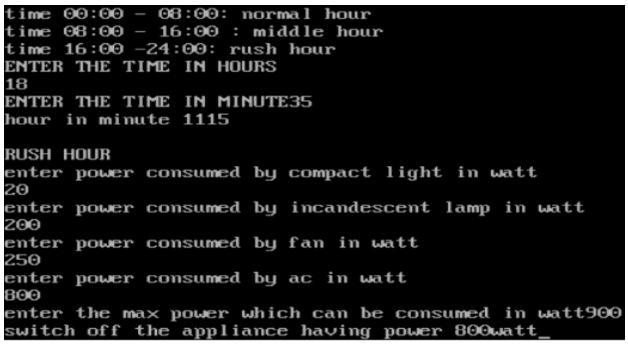


```
time 00:00 - 08:00: normal hour
time 08:00 - 16:00 : middle hour
time 16:00 -24:00: rush hour
ENTER THE TIME IN HOURS
7
ENTER THE TIME IN MINUTE45
hour in minute 465

NORMAL HOUR
enter power consumed by compact light in watt
2
enter power consumed by incandescent lamp in watt
100
enter power consumed by fan in watt
80
enter power consumed by ac in watt
500
enter the max power which can be consumed in watt600
switch off the appliance having power  500
```

OUTPUT 2:

```
time 00:00 - 08:00: normal hour
time 08:00 - 16:00 : middle hour
time 16:00 -24:00: rush hour
ENTER THE TIME IN HOURS
10
ENTER THE TIME IN MINUTE20
hour in minute 620

MIDDLE HOUR
enter power consumed by compact light in watt
2
enter power consumed by incandescent lamp in watt
80
enter power consumed by fan in watt
150
enter power consumed by ac in watt
800
enter the max power which can be consumed in watt1000
switch off the appliance having power 800
```

OUTPUT 3:



```
time 00:00 - 08:00: normal hour
time 08:00 - 16:00 : middle hour
time 16:00 -24:00: rush hour
ENTER THE TIME IN HOURS
18
ENTER THE TIME IN MINUTE35
hour in minute 1115

RUSH HOUR
enter power consumed by compact light in watt
20
enter power consumed by incandescent lamp in watt
200
enter power consumed by fan in watt
250
enter power consumed by ac in watt
800
enter the max power which can be consumed in watt900
switch off the appliance having power 800watt_
```

V.PRACTICAL IMPLEMENTATION

Implementation of this system will boost the consent of the power system to a great extent. Not only we will advance towards modernization but also we will be able to overcome certain major problems which we are facing at the present time. Problems like energy theft, overpower consumption, can be overcome easily. For implementing this algorithm, we need to have an electric sensor that senses the amount of energy utilized at a specific timeframe and then it checks with its predefined data and then it acts accordingly. To implement this technique first and foremost we will be needing an electricity meter, a smart grid home gateway system. So, let us tell what they are:

1. Electricity meter:

They are the modernized version of the meter which is available in our home. This type of meter records the power consumed and as well as displays the price. This type of meter uses real-time feedback and receives information legitimately from the control center.

2. Smart grid home gateway:

This is a system that is capable of tracking and monitoring appliances. It can receive data from central control and then analyze the data and then takes action accordingly.

Its main function is as follows:

- It receives data and analyses data after receiving from central control.
- It manages the appliances available in the room.
- It stores the data for future reference

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VI. FUTURE ASPECTS

With the upcoming technology, it is incredible that there will be more consumption and utilization of power. But the solution to all this problem is that we deal with the problem in a more versatile and flexible way. Thus introducing energy algorithm. This will allow us to enter into a new era, may it be industry or may it be home, it will be applicable everywhere both commercial and domestic. A total problem of power wastage or energy theft will be removed. thus allowing us to use energy efficiency and as well as it will be helpful economically by reducing the cost. This energy algorithm will be more efficient if it can be implemented with renewable energy and increase its production which will be beneficial to both industries and at the domestic level. Few countries like Sweden have already implemented this technology and are progressing enormously.

VII. CONCLUSION

In this paper, we have analyzed how smart grid works and as well suggested an algorithm which will be helpful in reducing power wastage. If the algorithm is implemented the automation of home will not only save energy but will manage the working of the appliances. By implementing this algorithm power wastage is expected to reduce by 10% to 12%. Thus enabling more flexible usage of energy. The smart grid home gateway not only manages data but also helps in storing and analyzing data and then the required steps are taken. Here we have considered some components and their power consumption is analyzed and then according to the result, the output is obtained. The algorithm helps in full automation and saving energy. The main motto of this algorithm is to reduce the wastage of energy and proper usage of energy. As a result of this algorithm, energy will become more economical and more assessable.

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