Minimization of Power Factor Penalty Charges for Non-Linear Domestic Loads with IOT Technology

A.Anton Amala Praveen¹,M.Muthu Kumaran ,Dr.A.Nazar ali³,Dr.K.Premkumar⁴

¹,²,³,⁴ Department of Electrical and Electronics Engineering

¹K.Ramakrishnan college of Technology,Trichy.

²Sree Sowdambika college of Engineering, Aruppukottai.

³,⁴Rajalakshmi Engineering College, Chennai

E.mail : praveenantoneee@gmail.com

Abstract: This Paper is dealt about the Power factor plays a major role for improving the quality of the power supply and also used to measure the system’s power efficiency. Existing solution is for automatic correction of power factor and it does not provide an information about load causing poor power factor. In proposed system, the status of domestic load are monitored and it intimate the power factor range of the concern load utilization. By using Microcontroller Arduino IDE, Developing a program for calculation action for the project is to dumped in it. The simulation results were obtained using the Proteus software and the penalty charge for the different power factor values was obtained using the program dumped in the Arduino Uno controller. The power factor range of the concern loads utilization was intimated to the consumer through IoT.

1.INTRODUCTION

The Ratio of valuable true power in terms of Kilowatts to reactive power in terms of Kilo Volt-ampere obtained from the electrical supply as Hardware otherwise forming of full step up of electrical supply in it. Resultant work is to be obtained from the electrical energy in better manner. The power factor is to be mandatory for the electrical circuit which is operated in the AC Supply. Extra Power is required to finish the things in better manner.

The path which produces and concentrate about the supply and circulation in it. Power factor with the unity brings about the productive stacking in the electrical supply. Power factor must be maintained in the Industries. If the Power factor didn’t maintain in the industries. Industries must pay the penalty according to their reduction in the power factor.

At the point when the force factor is short of what one. Inductive load which affects the power factor. To improve the power factor, capacitor bank is to be added in it. It will enhance the power factor in the load side. It will avoid the penalty which is paid by the industries. Reactive power can be useless power which added with the real power and it affects the efficiency of the equipment.

It will add the extra amount to the customer bill. A poor power factor will affects not only that equipment and also affects the line which connects to that equipment. Non linear loads, Apart from
the fundamental frequency, other order frequency will add in it. The waveform becomes non sinusoidal waveform. We have to maintain the unity power factor in the industries.

If the power factor is not maintained, penalty will be collected from the industries. When we use large inductive loads, it will draws more current in the non linear load. It will decrease the power factor in it. An equipment is added to the circuit which enhances the power factor in the circuit. Normally inverters are having the power factor in the range of 50% to 75%. But some type of inverters has the best power factor and the value is more than 95%. It make to act like resistive load type.

The power factor of the circuit is 0.95. The irregular waveform is to be obtained and along these lines adds to expand misfortunes. A similarly little better performance in power factor would realize a considerable decrement in misfortunes while misfortunes is proportional to the squares of the flow of electrons. The correction in the Power factor is to be the way toward repaying a main current with the slacking current, through the inventor interfacing with the capacitance.

Power factor produced in the circuit. It obtained with the help of angle between the current and voltage. Capacitors contained in most power factor revision framework draws current that drives voltage and produces a main power factor. Hypothetically, capacitors could give 100% of required reactive power, adjusting the power factor much closer to unity may bring about consonant bending.

A circuit which consists of capacitor which reduces the inductive nature and it will boosted the power factor range in the circuit. It will improve the efficiency and decrease the angle between the voltage and current in it. The magnetizing current is to be reduce with the help of Power factor amendment and useful to kill. It is to reduce misfortunes in the dispersion structure. It offers numerous advantages to the business electrical buyer, remembering diminished service charges by disposing of charges for reactive power, decreased misfortunes making more reactive power in the circuit.

Consequently it improves the strength effectiveness. IoT is new processing and correspondence worldview in which the objects of regular day to day existence have furnished with sensor, microcontroller and handset to detect the encompassing ecological parameters. What’s more, correspondence of the detected information with each other or client, turning into a basic piece of internet framework Spaces.

2. EXISTING MODEL

In the existing model, main drawbacks are to be that power factor is risen to 0.97 and it is difficult to determine the reactive power for the circuit. Another paper, the drawbacks are to be failed in triggering the switches for compensating the power factor. Normally, early days power factor will consider and also it affects the circuit.

It consists of Arduino Uno, power supply unit, voltage sensor unit, current sensor unit, current transformer, voltage transformer, LCD display, capacitor bank. It mainly used in the areas of industries to maintain the power factor with the satisfactory level.

With the help of sensing unit of current and voltage, current and voltage is to be sensed. It give to microcontroller input. The current, voltage is to be calculated with the help of Micro controller. The useful power, reactive power for the load also calculated with the help of Micro controller. By using if condition, range of the power factor are to be corrected with the help of program used in it.

If power factor range will not be greater than 0.9 no capacitive load will be added. The system will operate with an unity power factor does not cause any problem to the electrical system. If power factor range will be less than 0.9 an capacitive load will be added to maintain the range of the power factor as a unity. The power factor value is to corrected with the help of proposed system. The
drawbacks of this existing system is to be Power factor range cannot be displayed to consumer, No penalty charge reduction and Consumer cannot able to identify load causing poor power factor.

![Figure 1. Block Diagram of Automated Power Factor correction](image)

### 3. PROPOSED SYSTEM DESIGN

Power factor correction is proposes in the proposed system with the help of circuit which shown in the figure 2. Power factor is to be calculated and corrected. It will used to calculate the Penalty charge for the loads.

![Figure 2. Proposed model](image)

The proposed work is planned to intimate power factor range for concern utilization of the load. It builds penalty charge for the obtained power factor. To calculate power & power factor range of the individual non-linear loads, current and voltage which is flowing in the circuit measured with the help of sensing of current and voltage. The sensors are interfaced with the ARDUINO UNO.
controller thereby monitoring the power factor.

The controllers continuously update the measured power factor value in the IOT. The customer will receive information about the load causing poor power factor through IOT and they able to reduce the poor power factor causing electrical equipment. It will reduce the penalty amount for the respective poor power factor in their loads.
The Arduino UNO based on the ATmega 328 type. It is a Microcontroller. It consists of input/output pins of 14. 6 out of 14, used for output pin. Power factor is to be improved In increase the current carrying level.

By reducing the losses in the circuit, It obtain lower electric bills. The most straightforward method of improving the power factor by adding the capacitor to the electrical framework. Reactive current generators acted as a Power factor correction.

From above table 1, I mentioned the power factor range and penalty charges for not maintaining the power factor. Here, in my paper, I set a power factor range of .9 and more as a good P.F. For the power factor range goes down in the range of 0.9 to 0.85. If power factor will reduce 10% from unity power factor upto 15%, 1% charges will collected extra from normal current consumption charges.

Table1. POWER FACTOR SURCHARGE

| RANGE OF POWER FACTOR | PENALTY CHARGES |
|-----------------------|-----------------|
| < 0.75                | Reduce in 0.01 power factor from 90% , 2% charges for current consumption will collected along with normal payment. |
| 0.75 >= P.F > 0.85    | Reduce in 0.01 in power factor form 90%, 1.5% charges for current consumption will collected along with normal payment. |
| 0.85>= P.F > 0.90     | Reduce in 0.01 in power factor from 90%, 1% charges for current consumption will collected along with normal payment |

Power factor range goes between the range of 0.85 to 0.75, Additional 1.5% will collected extra along with normal consumption charges for reduction 1% from the power factor for this range. Power factor goes less than 0.75, Additional 2% will collected extra along with normal consumption charges for reduction of 1% from the power factor for this range. Power factor must be maintained in the Industries.

Dynamic Power factor correction, in some cases alluded to as ongoing power factor amendment, utilized for electrical adjustment in instances of quick burden changes. Dynamic power factor correction is valuable when standard power factor modification would cause over or under correction. Dynamic power factor correction utilizes semiconductor switches , regularly thyristors, to rapidly associate and separate capacitors or inductors to improve power factor.

From the figure 3, we noticed the power factor in the range of 0.9 in it. The current and voltage rating of the circuit displayed in the figure 3. The power factor will intimated to the customer. If the power factor obtained in the circuit below the nominal value, it will message to the customer
automatically. If the power factor is low, customer cut the circuit from the supply. Otherwise it will affects the circuit which connect to this equipment also.

Figure 3. Hardware model for Power factor Correction

4. SIMULATION

Figure 4. Proteus Model for proposed system
In this proposed paper, Model of proteus type in the proposed system are shown in the Figure 4. In this circuit, Power factor is to calculated with the help of Arduino. The customer will receive
information about the load causing poor power factor through IOT and they able to reduce the poor power factor causing electrical equipment. It will reduce the penalty amount for the respective poor power factor in their loads. By using current and voltage sensor, we can sensed the current and voltage in the circuit. Non-linear loads. Power and power factor calculated with the help of sensor mentioned above. Sensors are connected with the controller of ARDUINO UNO. It will update the power factor value through the IoT. Customer obtain the result of power factor causing electrical equipment.

Figure 5 Range of power factor between 0.85 and 0.9

Figure 6  Range of power factor between 0.8 and 0.85
5. CONCLUSION

Minimisation of power factor penalty charges for non-linear domestic loads using IOT technology has been presented in this project. With the help of microcontroller using Arduino IDE, calculations made for the project with help of programs developed in it. With the help of program, power factor is to be calculated here. Penalty charges of different power factor values are calculated. The simulation results were obtained using the PROTEUS software. The prototypes for minimisation of power factor correction are shown in it. The extracted result indicates that the poor power factor is to be identified for the load in the proposed method. Through IOT, loads utilization was intimated to the customer and also range of power factor also intimated to the customer.

6. REFERENCES

[1] A.Zuazua-Ros, J.C.Ramos and C.Mart in- G’omez, “System simulation of a linear concentration of energy meter Billing system” National Science and Technology Council, June 2015, last accessed: June 18, 2017.

[2] M.Chandrasekar, S.Suresh and T.Senthilkumar, “Energy balance model of billing system in real time”. International Journal of Research technology.

[3] R.Jai Ganesh, S.Koodeswaran, M.Kavitha, T.Ramkumar,” Performance analysis of piezoelectric harvesting system employing bridgeless power factor correction boost rectifier”

[4] A.Anton Amala Praveen, S.Murugesan,” Integration of Hybrid Energy sources for Grid connected AC Distribution System”, proceedings of the 4th International Conference on Advances in Electrical Electronics Information Communication and Bio-informatics 2018.

[5] S.Murugesan and M.V. Suganyadevi, “Hybrid renewable Energy parameters Monitoring and control of smart street Light using IoT”, International Journal of scientific and Technology Research, ISSN:2277-8616, volume 8, issue 10, pp.645-651, October 2019.
[6] Subramanian, A.T sankar, P. sabarish and A. Nazar Ali, “A Power factor correction based canonical switching cell converter for VSI fed BLDC motor by using voltage follower technique.” Electrical, Instrumentation and communication Engineering (ICEICE), 2017 IEEE International conference on IEEE, 2017.

[7] S.Vijayalakshmi, P. sabarish, S.R.Paveethra, Dr.P.R.Sivaraman, Dr. V.Venkatesh, “Exploration and application of Electronic Balance for High Power Discharge Lamps at High Frequency through power factor modification”, International Journal of Scientific & Technology Research volume 9, Issue 02, February 2020 ISSN 2277-8616.

[8] M.Kavitha, R.jai Ganesh & A.Rajkumar, “Facilities Navigation and Patient Monitoring system using IBEACON Technology”, International Journal of Mechanical and production Engineering Research and development ISSN(P): 2249-6890; ISSN(E): 2249-8001 Vol. 9, special Issue 1, Jan 2019, 562-570.