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IoT Based Automatic Power Factor Correction & Monitoring System

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Abstract This paper is result paper base on the system like automatic power factor improvement and monitoring of energy. The day by day power quality issues increases like power factor. The system developed that improve power factor and update the data ON WEB P page continuously with help of IOT. During this process any If any defect occurs, the system sends alert messages to the authorize person and at same instant an relay activates which gives signals to mechanism. As the inductive load increased then there will be a decreased in power factor, the signal of the relay given to mechanism of capacitor bank connector switch that closed the switch and connect the capacitor bank to load. The power is improved by capacitor bank without manual operation. An Automatic Power Factor Correction (APFC) Unit, is built for variable load to monitor the energy consumption of an inductive load and automatically improve its power factor. It will help to reduce the penalty due to low power factor and improved power quality with the utilities in the protection of induction motor in addition the problems are identified before any failure.

Keywords —Alternating current, Power quality, Monitoring, Automatic Power Factor Correction, Capacitor Banks, Current transformer, Potential transformer, IOT .

I. INTRODUCTION

The power quality of AC systems is of great concern due to the rapidly increasing number of electronic components, high voltage power systems and power electronics. All commercial and industrial installations in India carry a large electrical load which is probably most inductive in nature. This causes lagging power factor which incurs high penalty to the consumers. high penalty The situation is dealt with by power factor control. Power factor control is a method of reducing the unbearable effect of the load by reducing the power factor to less than one. The ratio of the useful power that does work and the apparent power which is provided to the circuit is known as the power factor in ac circuits. Real power is well characterized as The ability of a circuit to perform a task in a specific amount of time. Also, apparent power is referred to as the current and voltage product of the circuit, see figure no. The power factor can achieve a value in the range of 0 to 1.

Power factor becomes zero when all the power present is only reactive power and this is commonly known as inductive load. Similarly, PF is when only real power is present, and is known as resistive load. Correcting the PF is nothing more than adjusting the electrical circuit so as to change the power factor closer to 1.

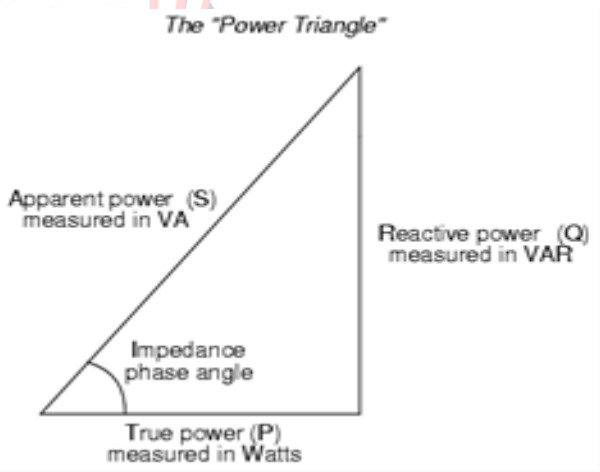

Fig.1 Power triangle

II. METHODS FOR POWER FACTOR IMPROVING

A. Phase Advancer:

To improve the PF of an induction motor this Ac exciter is mainly used. They are ascend on the shaft of the motor and are connected to the rotor circuit of the motor. To produce the required flux at the given slip frequency it is needed to prove exciting ampere turns. it improves the power factor. It can be operate at the leading power factor if ampere turn increases. Phase advancers use a isolated source of supply. That circuit inject a current in circuit, with

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a calculated phase difference, into the circuit, such that this current, added to current cancel or nullify the phase difference in voltage and current waveforms.

By doing so, current and voltage waveforms are brought in phase. This is an effective power factor correction system, but is used only for large loads.

B. Synchronous Condensers:

3 phase synchronous motors are Synchronous condensers with no load attached which is attached to their shaft. Under any power factor leading, lagging, or unity depending upon the excitation synchronous motor has the characteristic of operating. A synchronous motor is connected to the load side for inductive load, and is overexcited. Like capacitor synchronous condenser make behave it. Lagging current draws from the supply or supplies the reactive power. Main benefit of using synchronous motor is that the improvement of power factor is smooth. At the time when a synchronous motor rotate with over-excitation, it takes leading current from the source. We utilize this property of a synchronous motor for the purpose.

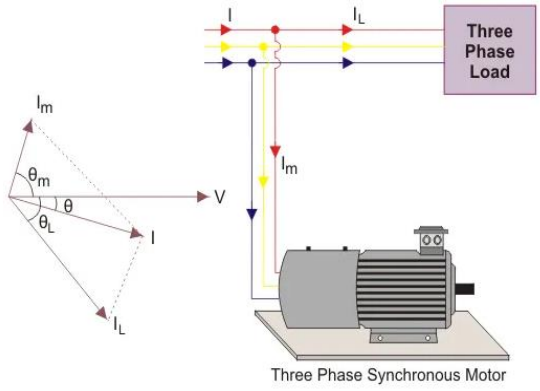

Fig.1. Synchronous Condensers Method

C. Capacitor bank :

Reducing phase difference between voltage and current is the process of improving power factor. For the function of majority of inductive nature loads some amount of reactive power is required. This reactive power provides by connecting capacitor bank parallel to the load. Less reactive power flows through the line when they act as a local reactive source. Phase difference between voltage and current reduce by capacitor bank. In many industries, a system of capacitors controlled by a power factor correction controller is installed for purpose reactive power compensation. When designing a power factor correction system, it is important to avoid adding extra capacitance to in network. Depending on the requirement of a particular substation or facility, fixed or automatically switched capacitor banks can be installed.

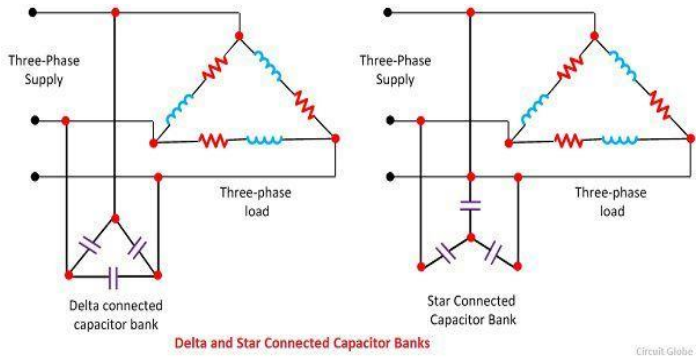

Fig.2. Capacitor bank method

III. PROPOSED SYSTEM DEVELOPEMENT

D. Internet of things:

The Internet of Things (IoT) is a new revolution in data transfer and storage. Objects that make themselves recognizable and gain wisdom by making or empowering decisions regarding the context of situations.They can transfer information about themselves. They may have access to information used by other people, or they may be part of other services. The three factors that look forward to IoT are sensing nodes, embedded Processing and communication. With this change comes the rise of cloud computing capabilities supported by an increased storage capacity and machine-to-machine communication for data transport with high-end data processing and complete data security. With the introduction of cloud computing, we can fully address the storage resource pool and computing resource pool in the cloud computing architecture, and provide users with an outdoor cloud storage service and efficient Can provide high reliability for cloud computing services. This machine-to-machine service layer will provide essential services such as data transport, security, equipment, management and equipment search in a seamless manner in the application layer in a vertical domain.

B. Power supply:

Most of the time the embedded system circuit uses 12 volts. 5-volt DC is used as its operating voltage. The 230 volt AC supply must be converted to a mandatory DC supply. The first 12 volt AC supply is obtained by reducing the 230 volt supply to 12 volts using a step down transformer. Potential Transformer (PT) in this project The outputs can be used in place of any other step-down transformer. Through the rectification process, the 12 volt AC is converted to a 12 volt pulsing dc voltage. The plastering DC is then sent to a capacitive filter for flattening and a standard 12 volt DC is obtained as the output.

C. Potential transformer:

They convert AC from one level to another voltage level and also cause some power loss. PT uses a step-down transformer to reduce the dangerously high voltage to the

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safer low voltage in any substation. The automatic power factor reduces the supply voltage from 230 V to 12 V as required to work through the potential transformer circuit used in the correction project. Potential transformer output is commonly used for measuring and various monitoring purposes.

D.Current transformer:

In an electrical circuit, currents are measured using a CT when the current at the point is extremely high then applied directly to measuring instruments, CT generates a reduced current, which is measured and measured by instruments connected can be added. CTs used in circuits also protect measuring instruments from a very high voltage. CT is used in most metering devices. And also, in the security relay.

E. Capacitor bank:

Shunt capacitor banks are basically used to improve the PF in the power network. Capacitor banks are also used to improve voltage stability and reduce network losses. Shunt capacitor banks are not expensive. Shunt capacitors can be easily installed anywhere on the network. Depending on the power requirement, the capacitor bank which includes the shunt capacitor is turned on or off. Switching can be done manually or manually using the relay. Capacitor bank of 6 MFD, 8 MFD connected in circuit.

F. Relay unit:

The relay unit consists of a relay driver and some relays. The relay unit controls the low-power circuit to the high-power circuit because the output of the microcontroller cannot control the direct switching of the capacitors. The switch which is operated electrically is known as relay Relays are used in such cases when a circuit needs to be controlled by a low power signal. The current passing through the coil of the relay Generates a magnetic field that is attracted to the lever and then the switch contacts change. The connections of the relay switches are normal, normally open (NO), normally closed (NC). The relay coil is not driven by the current supplied by the output of the microcontroller because the current is insufficient. ULN2003 relay driver is use to operate the relay. Relay operate on 12 V DC.

G. Microcontroller:

Atmel 328p use in this project. An embedded system is ineffective without logical processing. Microcontrollers are responsible for logical processing so it can be seen as the heat of an embedded system. They do most of the work, from taking the data or instructions, processing it according to the written program, and finally providing the output to complete the required work. Another positive of the embedded system Features such as chip memory are worth mentioning. This allows the system to store some variables temporarily during the processing process to make the process smoother. One of the most popular microcontroller is PIC Atmega 328p microcontroller. This microcontroller is very suitable for use. The main advantage is that it can be written or deleted as often as possible because it uses flash memory technology.

H.Display unit:

An embedded system communicates directly with humans through the use of input and output devices. It should be noted that in an embedded system, the interactions are triggered by the microcontroller. The system uses input and output devices that produce direct communication with humans. The LCD display is considered to be the most common device connected to a microcontroller. Determine the types of LCD displays However, 16x2 and 20x4 microcontrollers are the most common. These numbers represent the number of characters and the number of lines. For example, a 16x2 LCD display has 16 characters and 2 lines available for use. Similarly, the 20x4 LCD display makes it accessible to use 20 characters and 4 lines. A 16x2 LCD display is considered in this project.

I. Wifi module

Wifi mofule is ultilize to transmit data. Having specification of ESP8266 ,ISM 2.4GH, PA =25dBm

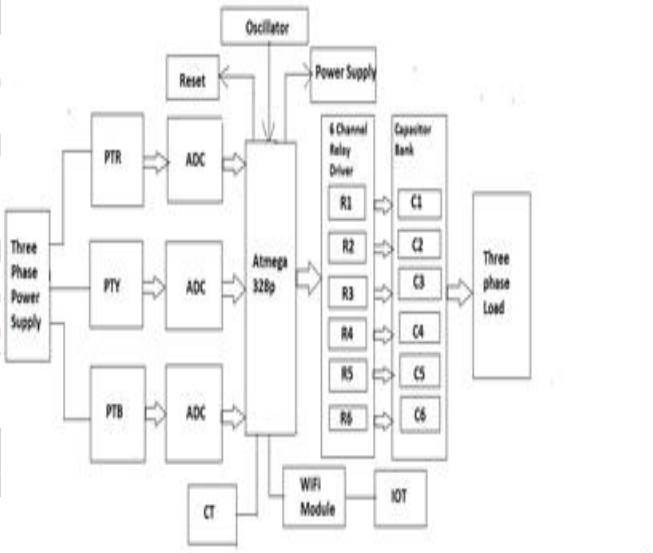

Fig.3 Block Diagram of Automatic Power Factor Correction unit.

IV. RESULT

The whole hardware of Automatic Power Factor Control Unit used for improving power factor. One of the results is discussed below.

Sr.No	V (V)	I (A)	Existing PF	Corrected pf	C (MFd)	Quantity of C
1	440	2	0.5	0.7	14	2
2	440	2.5	0.6	0.7	20	3
3	440	3	0.7	0.9	28	4

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4	440	3.5	0.75	0.9	34	5
5	440	4	0.79	0.9	43	6

Table No.1 Proposed system result details

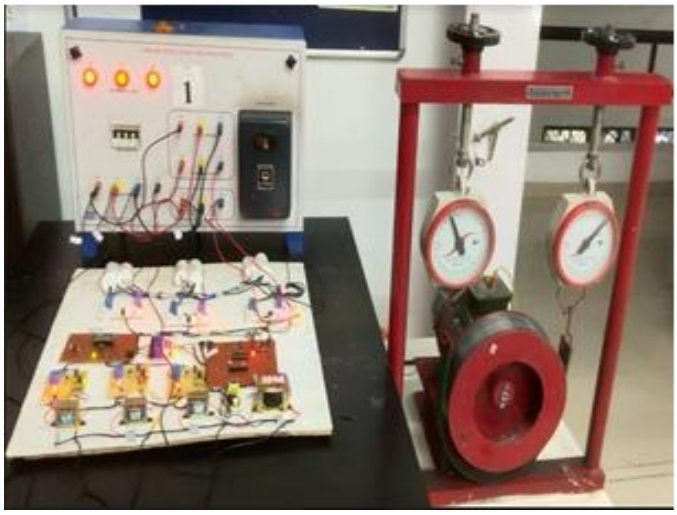

Fig.4 Proposed system hardware images

Fig.5 Proposed system hardware images

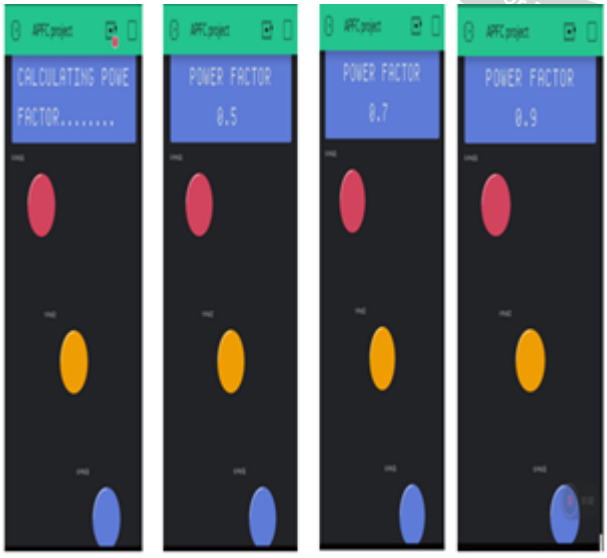

Fig.6 Power factor improvement result

There is Change in percentage of Power Factor penalty and incentive as follows: Power factor penalty for lead and lag power factor:

Power factor	Old %	New %
0.9	0	0
0.89	2	1
0.88	3	1.5
0.87	5	2
0.86	6	2.5
0.85	7	3

Table No. 2 Power Factor Penalty (For Lead as well as Lag)

V. CONCLUSION

The contents of IJREAM TRANSACTIONS and JOURNALS are peer-reviewed and archival. The TRANSACTIONS publishes scholarly articles of archival value as well as tutorial expositions and critical reviews of classical subjects and topics of current interest.

REFERENCES

[1]"Power Factor Correction: A Guide for the Plant Engineer."www.eaton.com/. Eaton Corporation, Aug. 2014. Web. 14 July 2016. Available at [www.eaton.com/ecm/groups/public/@pub/.../sa0260 7001e.pdf]

[2]"POWERFACTORCORRECTION."www.nhp.com.au. NHP Catalogue - PFCSFC, Nov. 2007. Web. 14 July 2016. Availableat[https://portal.nhp.com.au/power-quality]

[3]Muhammad Bilal Khan, Muhammad Owais, “Automatic Power Factor Correction Unit”, IEEE,2017.

[4]Grace Dias1, Rosmy Johnson2, Sajay Saju3,Sreelakshmi K.V4, Sunil V. Chandran “IOTBased Power Factor Correction” © June 2019 | IJIRT | Volume 6 Issue 1 | ISSN: 2349-6002

[5] The 8051 Microcontroller and Embedded Systems” by Muhammad Ali Mazidi and Janice Gillispie Mazidi.

[6] Lilavati Pujari “IoT based smart energy meter monitoring and controlling system” International Journal of Advance Research, Ideas and Innovations in Technology,Volume 4, Issue 2018

 DOI : 10.35291/2454-9150.2021.0575