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IOT Cloud-Based PF Controller

Nikhil Dhamal[1],Tejaswini Jagtap[2],Aishwarya Londhe[3],Nikhil Jagtap[4]
Nikhil Shelke[5]

1(Student, E.E, N.B.N.Sinhgad school Of Engineering, Pune, INDIA, nikhildhamal8081@gmail.com)
2(Student, E.E, N.B.N. Sinhgad school Of Engineering, Pune, INDIA tejujagtap155@gmail.com,)
5(Asst. prof, E.E, N.B.N. Sinhgad school Of Engineering, Pune, INDIA, nikhilshelke27@gmailcom,)

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Abstract: *In recent years, the power quality of the ac system has become great concern due to the rapidly increased numbers of electronic equipment, power electronics and high voltage power system. Most of the commercial and industrial installation in the country has large electrical loads which are severally inductive in nature causing lagging power factor which gives heavy penalties to consumer by electricity board. This situation is taken care by Automatic power factor correction. APFC device reads power factor from line voltage and line current by determining the delay in the arrival of the current signal with respect to voltage signal from the function generator with high accuracy by using an internal timer. This time values are then calibrated as phase angle and corresponding power factor. Then the values are displayed in the 2X16 LCD modules. Then the motherboard calculates the compensation requirement and accordingly switches on different capacitor banks. The aim of this project is to make a system that will switch capacitor banks in and out of the circuit when the power factor drops below a certain point to avoid power company charges*

Key Word*: Power Factor, Automatic Power Factor Correction, Induction Motor, Capacitor Banks, Iot.*

I. Introduction

In olden days industries are used loads for more power utilization and the loads which are highly inductive in nature for example like induction motors, AC/DC drives, welding machines, electronic controls, and computers. There are very less industries which may have capacitive loads for like synchronous motors. Therefore, net industrial load is highly inductive that leads to a very bad lagging power factor where power factor is the ratio of real power to apparent power. So, it is represented as KW/KVA. The increase in the reactive power increases the apparent power, so that power factor also decreases. Having low power factor, the industry needs more energy to meet its demand, so the efficiency is decreases.

Automatic power factor correction focuses on the power flow (cosϕ) and the optimization of voltage stability by generating reactive power to improve voltage quality this technique can be applied to industrial units, power systems and also households to make them stable. As a result, the system becomes stable and efficiency of the system apparatus increases. Therefore, the use of microcontroller base power factor corrector results to reduced overall costs for both the consumers and the suppliers of electrical energy. The goal of this project is to obtain a power factor as close to one as possible and to control the system power factors within a range that will avoid any power company charges possible.

II. Objective Of The Work

1. The load power factor is continuously monitored it improves the power quality.
2. Design an Arduino based correction equipment to improve the power factor of the system to the desired value of greater than 0.95.

III. Software Implementation

A. Internet Of Things

The Internet of Things (IoT) is a new revolution for Data Transfer and Storage. Objects that make themselves recognizable and they obtain intelligence by making or enabling context related decisions to the situations. They can transfer information about themselves. They can access information that has been used by other things, or they can be components of other services. The three factors that makes IoT look forward are Sensing Nodes, Embedded Processing and Communication. This transformation is accompanied by the emergence of cloud computing capabilities supported by an increased storage capacity and high-end data processing and the Machine-to-Machine communication for data transport with complete security for data. By introducing cloud computing, we can make a full call to the storage resource pool and computing resource pool in the cloud computing architecture, and provide high reliability for IoT cloud storage service and efficient cloud computing services to users. This Machine-to-Machine service layer will provide the needed services like data transport, security, devices, management and device discovery in a harmonized manner across a vertical domain to the application layer.

B. Arduino Software (IDE)

The Arduino Integrated Development Environment (IDE) contains message area, the text console, and text editor for writing code, a toolbar with buttons for common functions and a series of menus. It connects to Arduino and genuine hardware upload programs written using the Arduino software (IDE) are called sketches. The programs are written in the text editor and are saved with the file extension of‘. ino’. The editor has features for cutting/pasting and for saving/replacing text. The message area gives feedback and displays errors. The console displays text output by the Arduino software (IDE), including complete error message and other information. The configured board and serial port are displayed in the right hand corner of the window. The toolbar buttons permit to verify and upload programs, create, open, and save sketches, and open the serial monitor.

IV.BLOCK DIAGRAM

Arduino is programmed to read the parameters of variable load. Real time voltage, current is uploaded to a webpage and checked whether these values are within the range or not. If the data are not within the specified range, then the corresponding action takes place. If the real time voltage or current is not in the specified range relay will be switched off and message will be sent to the concerned person using IoT module. If the power factor is not within the specified range, then capacitor banks are switched accordingly to correct it. When the power factor is increased or decreased it causes the penalty. so the power factor monitoring and control using IoT. It is used to avoid this problem. By using IoT things that connected to the internet can be accessed from anywhere. The data monitored can be used to store in a cloud environment and view the details when needed. The capacitor can be connected to the system for compensating the power factor whether power factor lags or leads.

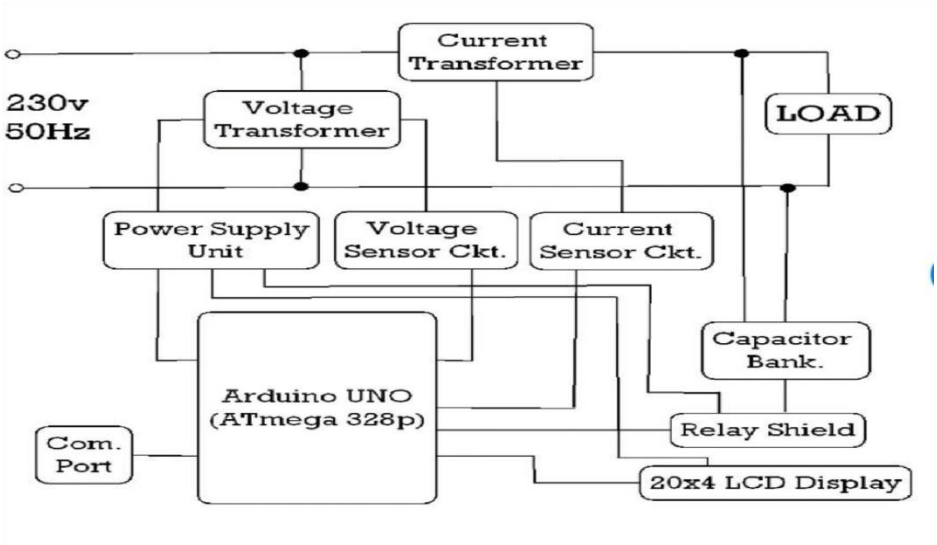

Figure no III Block Dig of IOT Cloud based power factor controller is shown in below fig.

A. Potential Transformer

Potential Transformer is used to step down the input voltage because the maximum rating of Arduino is very less compared to the input voltage. So, the PT is used to step down the voltage. The rating of PT used to step down the supply voltage of 230 Volts to 12 Volts as required by the circuit to operate. The ratio of the number of turns on each coil, called the turn's ratio, determines the ratio of the voltages. A step down transformer has a large number of turns on its primary (input) coil which is connected to the high voltage mains supply, and a small number of turns on its secondary (output) coil to give a low output voltage.

B. Current Transformer

Current Transformer is used to step down the input current because the maximum rating of Arduino is very less compared to the input current. So, the CT is used to step down the current. The CT is used to step down the supply current of 2A to 40mA as required by the circuit to operate. When current in a circuit is very high it directly applies the measuring instruments, a current transformer produces a condensed current perfectly proportional to the current in the circuit, which can be appropriately connected to recording and measuring instruments. It also isolates the measuring instruments from what may be very high voltage in the monitored circuit. They are frequently used in metering and protective relays in the electrical power industry.

C. Arduino Uno

Arduino is an open-source platform. It is easy-to-use hardware and software. Arduino boards are able to read input from light on a sensor, a finger on a button, or a Twitter message and turn it into an output activating a motor, turning an LED on. You can tell your board what to be done by sending a set of instructions to the microcontroller on the board. There are many other microcontrollers and microcontroller platforms are available for computing. Parallax Basic Stamp, Netmedia's BX-24, Phidgets, MIT's Handy board, and many others offer similar functionality as the same. Arduino looks simple process of working than with microcontroller, but it offers some advantage for students and interested amateurs over other systems. It will fetch input from source module and process them and decide the required action for them. Arduino is programmed to read the parameters the load. Real time voltage, current and power are uploaded to a webpage and checked whether these values are within the range. If the values are not within the specified range, then corresponding actions to be taken place. Arduino boards are inexpensive compared to the other microcontroller.

D. NODEMCU

NODEMCU is an open source development board and firmware based on the widely used ESP8266 -12E Wi-Fi module. It agrees to program the ESP8266 Wi-Fi section with the simple and powerful LUA programming language or Arduino IDE. NODEMCU is a combination of Wi-Fi access point and microcontroller. These features make the NODEMCU very powerful device for Wi-Fi networking. It can be used as an access point and station, host a web server, connect to the internet to fetch or upload data. Which is used to send and receive the data to the cloud?

E. LCD

LCD (Liquid Crystal Display) is an electronic display module. A 16x2 LCD display is a very basic module and is frequently used in various devices and circuits. These modules are chosen over seven segments and other multi segment LEDs. The advantages are: LCDs are very economical, easy to program, have no limitation of displaying special& even custom characters, animations and so on. The image of 16*2 LCD display is used here. A 16*2 means display 16 characters per line and there are 2 such lines. On this 16*2 LCD display each character is displayed in 5*7-

Pixel matrix. This LCD has two registers that are Command and Data registers.LCD display is a most common device to attach the microcontroller. Some of the most common LCDs connected to the microcontroller are 16x2 and 20x4 displays. In this project a 16x2 LCD, model JHD 162A which shows the power factor and the phase lag between voltage and current in milliseconds.

F. Relay

The Relay is an electrically operated switch. Relays are used to control a circuit by a low-power signal (with complete electrical isolation between control and controlled circuits), or where several circuits need to be controlled by single signal. Current flowing through the coil of the relay creates a magnetic field which attracts a lever and changes the contact of the switch. The rating of relay is 12V/5A.

V. RESULT & ANALYSIS

The hardware setup shows the value of Current, Voltage, Real Power, Reactive power and Power Factor. This is a real time power factor monitoring and correction. The Liquid Crystal Display shows the result of the power factor, Voltage and Current before and after the power factor correction in all occasions. The values will be updated for every 2 minutes.

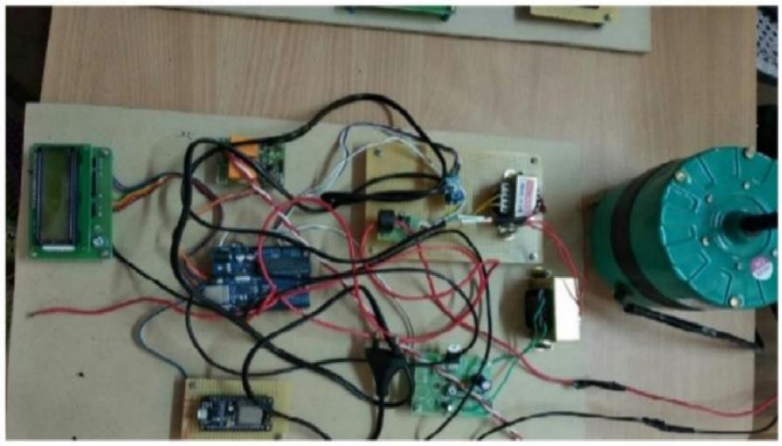

Figure no IV Block

VI. Conclusion

The Power Factor is improved and the value becomes nearer to 0.9 to 0.95 by installing suitably sized power capacitors into the circuit thus line losses are improved and the efficiency of a plant increases. By using this system, the efficiency of the system is highly improved. Precautions should be taken for over correction otherwise the voltage and current increases due to which the power system or machine will not remain stable and the life of capacitor bank decreases. The automatic power factor correction by using capacitive load banks is very efficient as it decreases the cost by reducing the power drawn from the supply. As it operates automatically, no manpower is required and this Automated Power factor Correction by using capacitive load banks can be used for the industries purpose in the future. Further, the project can be intensified by using thyristor control switches in place of relay control so that contact pitting is avoided which is often resulted by switching of capacitors due to flow of high inrush current

VII. Future Scope

In future this method will be implemented in most of the organization and industry. It can be implemented even in the small-scale industries because energy conservation and paying penalty cause a major issue in all scale industry and this method rectifies the entire problem and so this will be a compulsion to minimize their expenses. This will be the best solution in future because man power will be eradicated completely and will be automated. This will play a major role in it.

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