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Automatic Power Factor Compensation

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Abstract: *Paper present the project designed to correcting power factor for domestic, Commercial, Industrial. Which with hope to make the cost and energy usage efficient, because the energy source is depleting due to increase in population. Power factor is the ratio of real power and apparent power. This definition is mathematically represented as kW/kVA where kW is active power and kVA is apparent power (active + reactive). Reactive power is the non-working power generated by the magnetic and inductive load to generate magnetic flux. The increase in reactive power increase the apparent power so the power factor will decrease. Low pF will cause the industry to meet high demand thus making it less efficient. The main aim of this project is to increasing the current power factor of industries from 0.85 to 0.90. Power factor compensation contribute to reduction in current-dependent losses and increase energy efficiency while expanding the reliability of planning for future energy network. As technology develops, the gradual cost and efficiency penalty should reduce. Therefore, automatic power factor compensation device should become cost-effective and smaller device over time. That is the reason this project is using programmable device as it is a miniature architecture device.*

Keywords: Power Factor

I. INTRODUCTION

Electrical power has been proven to be one of the most important resource in India and due to its high demand and widely used, it has become a very expensive resource. The cause of its high cost is mainly because of the generation cost, transmission cost and distribution cost. Plus, the demand of commercial and industrial customers varies greatly throughout the day and for them (the industrial consumers) the maximum demand plays an important role in their overall electricity bills. Therefore, they need to ensure that their max demand is low as possible for their substantial savings. This is the main purpose of this project where it is to overcome the unwanted problem, power factor needs to be improved by installing Automatic Power Factor Compensation (by adding capacitor load to offset the inductive load present in the power system). The capacitors can be installed at the service entrance of the plant or on the load side of the metering equipment. These capacitors may supply part, or all of the reactive power required by the plant. There are many benefits by having Automatic Power Factor Compensation device. For the industrial usage, the equipment will have a longer life span and the maintenance costs remain low. Power factor improvement leads to a huge drop of apparent power drawn from the ac source which in turn protects energy and minimizes the transmission losses

II. HARDWARE IMPLEMENTATION

2.1 Arduino Nano

The **ArduinoNano** is a small, complete, and breadboard-friendly board based on the ATmega328P released in 2008. It offers the same connectivity and specs of the Arduino Uno board in a smaller form factor. The Arduino Nano is equipped with 30 male I/O headers, in a DIP-30-like configuration, which can be programmed using the Arduino Software integrated development environment (IDE), which is common to all Arduino boards and running both online and offline. The board can be powered through a type-B mini-USB cable or from a 9 V battery.

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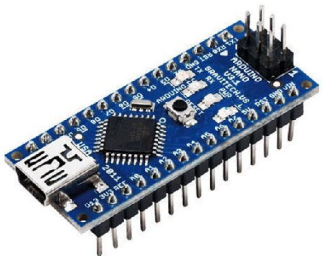

Fig. 1: Arduino Nano

2.2 Relay

Fig 2: Relay

Pin Number	Pin Name	Description
1	Coil End 1	Used to trigger (On/Off) the Relay, normally one end is connected to 5V and the other end to ground
2	Coil End 2	Used to trigger (On/Off) the Relay, normally one end is connected to 5V and the other end to ground
3	Common (COM)	Common is connected to one End of the Load that is to be controlled
4	Normally Close (NC)	The other end of the load is either connected to NO or NC. If connected to NC the load remains connected before trigger
5	Normally Open (NO)	The other end of the load is either connected to NO or NC. If connected to NO the load remains disconnected before trigger

2.3 Capacitor Bank

A capacitor bank is a physical group of several capacitors that are of the common specifications are connected in series or parallel with each other to form a capacitor bank that store electrical energy. The capacitor bank so formed is then used to correct a power factor lag or phase shift in(alternative current) power supply

Fig-3: Capacitor Bank

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2.4 LCD Display

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on.

A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data. The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the LCD. Click to learn more about internal structure of a LCD.

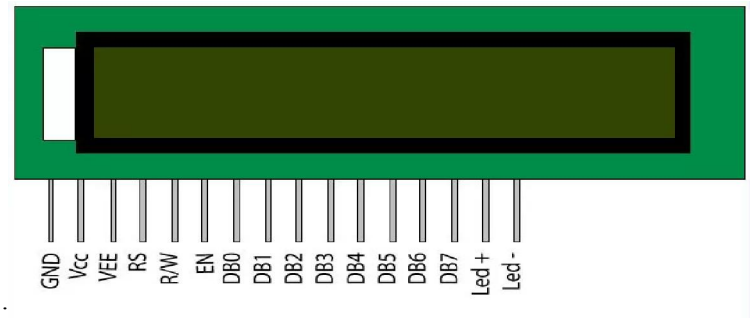

Fig 4: LCD Display

III. WORKING

Here Single-Phase Ac Supply is given to the Transformer with the help of power cable. Transformer then Convert 230v ac supply into the 12v ac supply by using the stepdown transformer (12-0-12). This 12v Ac supply is Given to the rectifier here rectifier convert 12v ac supply in to the 12v pulsating dc supply with the help of full wave rectifier. Capacitor of 35micro farad is used to convert the 12v pulsating dc supply into the Pure dc Supply for the functioning of the components.IC7805 is used to convert the 12v dc supply into the 5v dc for the functioning of the Arduino Nano, Display, IC & other component in the circuit. Arduino Nano is used for the Programming purpose in which system operation Programming as be done. The connection of Arduino Nano is given to the LCD display, Relays &Zero crossing.

LCD display of 16/2 is used to the show the power factor of the system when load is inductive, Capacitive, Resistive. IC ULN2003 is used to boost the value of current according to the relay requirement. Freewheeling diode across it connecting for the protection of the oppose current produce by the relay coil.

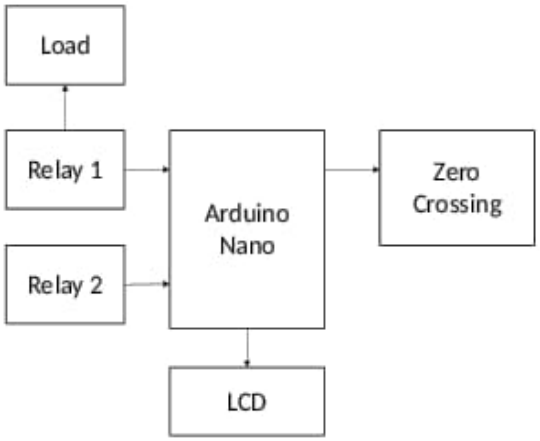

Fig: Block Diagram of Automatic Power Factor Compensation

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For the operation we connected three loads i.e. Inductive load as Transformer by short its secondary terminal to increase the current value. Two Capacitor of 2.50 microfarad is connected to increase the voltage value. Resistive as a Lamp Load.

Normal Condition When Load in on Pf is at the normal value

When Inductive Load is Connected in the system pf lag

When one capacitor is connected with inductive load pf start improving

When Second Capacitor is connected in the system Power Factor gets improves

IV. ADVANTAGES

- Reactive power decreases
- Efficiency of supply system and apparatus increases.
- The electrical consumption tariffs depend on power factor.
- Avoid poor voltage regulation
- Overloading is avoided
- Copper loss decreases
- Transmission loss decreases
- Improved voltage control
- Efficiency of supply system and apparatus increases

V. FUTURE SCOPE

The automatic power factor compensation using capacitive load banks is a very efficient as it reduces the cost by decreasing the power drawn from the supply. As it operates automatically, Manpower is not required and this Automated Power Factor Compensation using capacitive load banks can be used for the industries purpose in the future by using IOT based everything will be automated.

VI. CONCLUSION

It can be concluded that power factor correction techniques can be applied to the industries, power systems and also households to make them stable and due to that the system becomes stable and efficiency of the system as well as the apparatus increases. The use of microcontroller reduces the costs. Due to use of microcontroller multiple parameters can be controlled and the use of extra hard wares such as timer, RAM, ROM and input output ports reduces. Care should be taken for overcorrection otherwise the voltage and current becomes more due to which the power system or machine becomes unstable and the life of capacitor banks reduces.

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