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Automatic Power Factor Compensation (APFC) for Industrial Power Use to Minimize Penalty

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Abstract: ***In this proposed system, two zero crossing detectors are used for detecting zero crossing of voltage and current. The project is designed to minimize penalty for industrial units using automatic power factor correction unit. The microcontroller used in this project belongs to 8051 family.***
The time lag between the zero-voltage pulse and zero-current pulse is duly generated by suitable operational amplifier circuits in comparator mode is fed to two interrupt pins of a microcontroller.
The program takes over to actuate appropriate number of relays from its output to bring shunt capacitors into load circuit to get the power factor till it reaches near unity. The capacitor bank and relays are interfaced to the microcontroller using a relay driver. It displays time lag between the current and voltage on an LCD. Furthermore, the project can be enhanced by using thyristor control switches instead of relay control to avoid contact pitting often encountered by switching of capacitors due to high in rush current.
The Methodology is divided into 3parts:

1) ***Assessment of Power Factor: Understand the current power factor situation of your system. Measure the power factor using appropriate instruments. Power companies usually provide guidelines regarding acceptable power factor limits.***
2) ***Identify Reactive Power: Reactive power is the component of electricity that does not perform any useful work but still flows in the system due to inductive or capacitive loads. Identify the equipment and processes in your system that contribute to reactive power.***
3) ***Design Reactive Power Compensation System: Based on the assessment, design an automatic power factor correction system. This typically involves the installation of capacitors that can provide reactive power on demand. The capacitors are switched on and off automatically by a controller based on the real-time measurement of power factor.***

I. INTRODUCTION

Power factor is the ratio between real power and the apparent power of the equipment. In the present trend, Automatic Power Factor Controller design can be achieved by using programmable device. As we think about programmable device embedded system comes forefront. Embedded system nowadays is very popular and microcontroller proves to be advantageous with the reduction of cost, extra hardware use such as timer, RAM, ADC are avoided. Only the relays used are disadvantageous as they are too bulky and need regular maintenance. Now the embedded technology has become cheaper with the help of technical revolution so as to apply it in all the fields.

Automatic Power Factor Correction device is very useful to improve the transmission of active power efficiently. Power factor must be maintained within a limit. As inductive load is connected, Power factor lags and when Power factor goes below the lagging Power factor, then a penalty is charged by the supplying company. Therefore, it is necessary to maintain Power factor within limit. APFC techniques can be applicable to industries, power systems and also to households to make them stable and also help in improving the efficiency of the system.

Poor Power factor can be improved by addition of Power factor correction, but a poor Power factor which is caused due to distortion in current waveform needs to have a change in the design of the equipment APFC is to be developed based on microcontroller (AT89S52\C51) Poor Power factor can be improved by addition of Power factor correction, but a poor Power factor which is caused due to distortion in current waveform needs to have a change in the design of the equipment APFC is to be developed based on microcontroller(AT89S52\C51) .

Lesser reactive power flows from the line. They decrease the phase difference in the voltage and current. When capacitors are used Losses are low and also requires very less maintenance. Installation of capacitors is easy because of lighter weight and do not require foundation.

II. LITERATURE SURVEY

By the literature survey we have found the due to modern day development in the industrial sector the demand of the power has been increased extremely. There are more power demand arises due to the loads in industries. An electrical load can be classified in three types and they are resistive load like filament lamp, capacitive load like motor starter

III. PROBLEM STATEMENT

1) In this proposed system, two zero crossing detectors are used for detecting zero crossing of voltage and current.
2) The project is designed to minimize penalty for industrial units using automatic power factor correction unit.
3) The microcontroller used in this project belongs to 8051 family. The time lag between the zero-voltage pulse and zero-current pulse is duly generated by suitable operational amplifier circuits in comparator mode is fed to two interrupt pins of a microcontroller.
4) The program takes over to actuate appropriate number of relays from its output to bring shunt capacitors into load circuit to get the power factor till it reaches near unity
5) The capacitor bank and relays are Research Article Volume 10 Issue No.7 IJESC, July 2020 26778 http:// ijesc.org/ interfaced to the microcontroller using a relay driver. It displays time lag between the current and voltage on an LCD.

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IV. PROPOSED SYSTEM

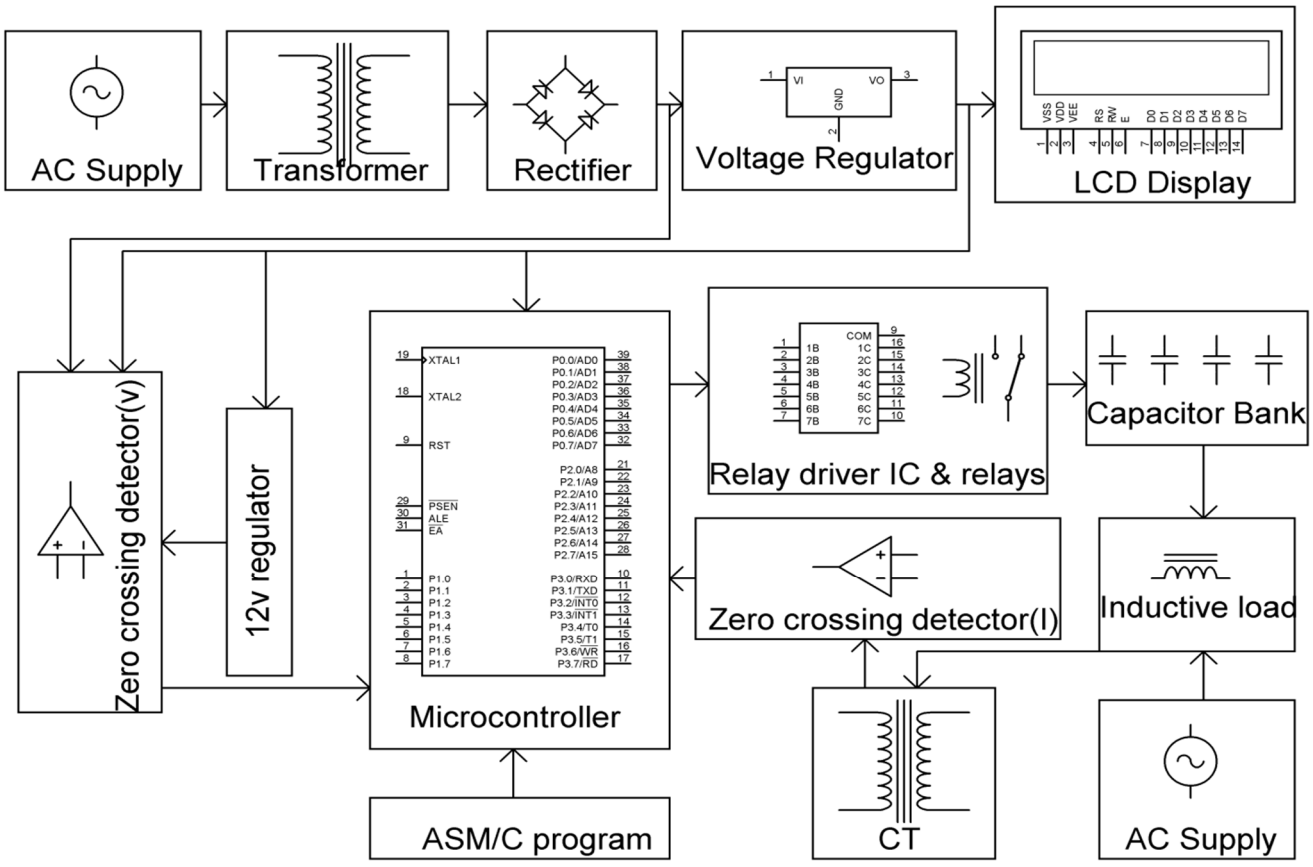


Fig 1: Proposed system architecture

230V AC supply is given to the step down transformer
The basic building blocks of a regulated DC power supply are as follows:
A step down transformer
A rectifier
A DC filter
A regulator

A. Step Down Transformer

A step down transformer will step down the voltage from the ac mains to the required voltage level. The turn's ratio of the transformer is so adjusted such as to obtain the required voltage value. The output of the transformer is given as an input to the rectifier circuit.

B. Rectification

Rectifier is an electronic circuit consisting of diodes which carries out the rectification process. Rectification is the process of converting an alternating voltage or current into corresponding direct (DC) quantity. The input to a rectifier is ac whereas its output is unidirectional pulsating DC. Usually a full wave rectifier or a bridge rectifier is used to rectify both the half cycles of the ac supply (full wave rectification)..'

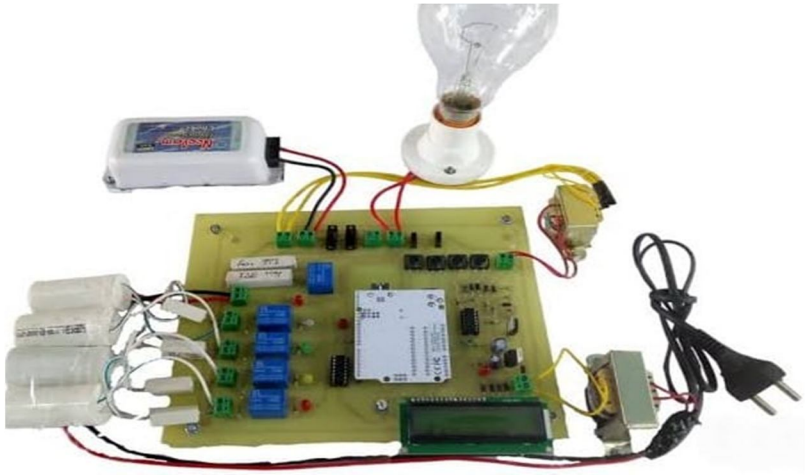
C. DC Filtration'

The rectified voltage from the rectifier is a pulsating DC voltage having very high ripple content. But this is not we want, we want a pure ripple free DC voltage.Hence a filter is used. Different types of filters are used such as capacitor filter, LC filter, Choke input filter, π type filter.

D. Regulation

This is the last block in a regulated DC power supply. The output voltage or current will change or fluctuate when there is change in the input from ac mains or due to change in load current at the output of the regulated power supply or due to other factors like temperature changes. This problem can be eliminated by using a regulator. A regulator will maintain the output constant even when changes at the input or any other changes occur. Transistor series regulator, Fixed and variable IC regulators or a zener diode operated in the zener region can be used depending on their applications. IC's like 78XX and 79XX are used to obtained fixed values of voltages at the output. Waveform.7812 ic gives constant 12v dc and 7805 gives constant 5v dc.Output of 7805 is given to the arduinolcd and all sensors where required power.

V. RESULT & DISCUSSION



A. Discussion

Cables help power distribution. These cables have so many defects that it is difficult to find the defects in these cables. The system uses Arduino Uno to fix an error. Turn up cable. Nowadays in many non-rural areas, the generally, underground cables are used instead of overhead lines. The system uses the Arduino Uno board. The fault is caused by multiple turnouts, and the track fault is displayed on the LCD screen and website the paper IOT based underground fault detector is used for detecting any flaws in an underground cable system. This system can clearly choose the region where the fault has occurred and can send the co-ordinates to the user as well as displays in the LCD display screen. Henceforth the strategy used in this paper works in a consecutive way and ends up being helpful in discovery and area of deficiencies in underground cables. Through this project we simplified the actual problem of the detecting the fault in the underground area.

We discover the position or location where the fault will be occurred and also find the accurate distance of breaker point. The line to line, single line, line to ground fault in the underground cable is located to rectify the fault efficiently using simple concepts of Ohms law. The work automatically displays the phase, distance and time of occurrence of fault with the help of ATMEGA16 and ESP8266 Wi - Fi module in a webpage. The benefits of accurate location of fault are fast repair to revive back the power system, it improves the system performance, it reduces the operating expense and the time to locate the faults in the field.The open circuit fault can be detected using a capacitor in ac circuit which measures the change in impedance and calculate the distance of fault.

VI. ADVANTAGES

1) Reactive power decreases
2) Efficiency of supply system and apparatus increases.
3) The electrical consumption tariffs depend on power factor.
4) Avoid poor voltage regulation
5) Overloading is avoided
6) Copper loss decreases
7) Transmission loss decreases
8) Improved voltage control
9) Efficiency of supply system and apparatus increases

VII. CONCLUSIONS & FUTURE SCOPE

The automatic power factor correction 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 ,Man power is not required and this Automated Power Factor Correction using capacitive load banks can be used for the industries purpose in the future.

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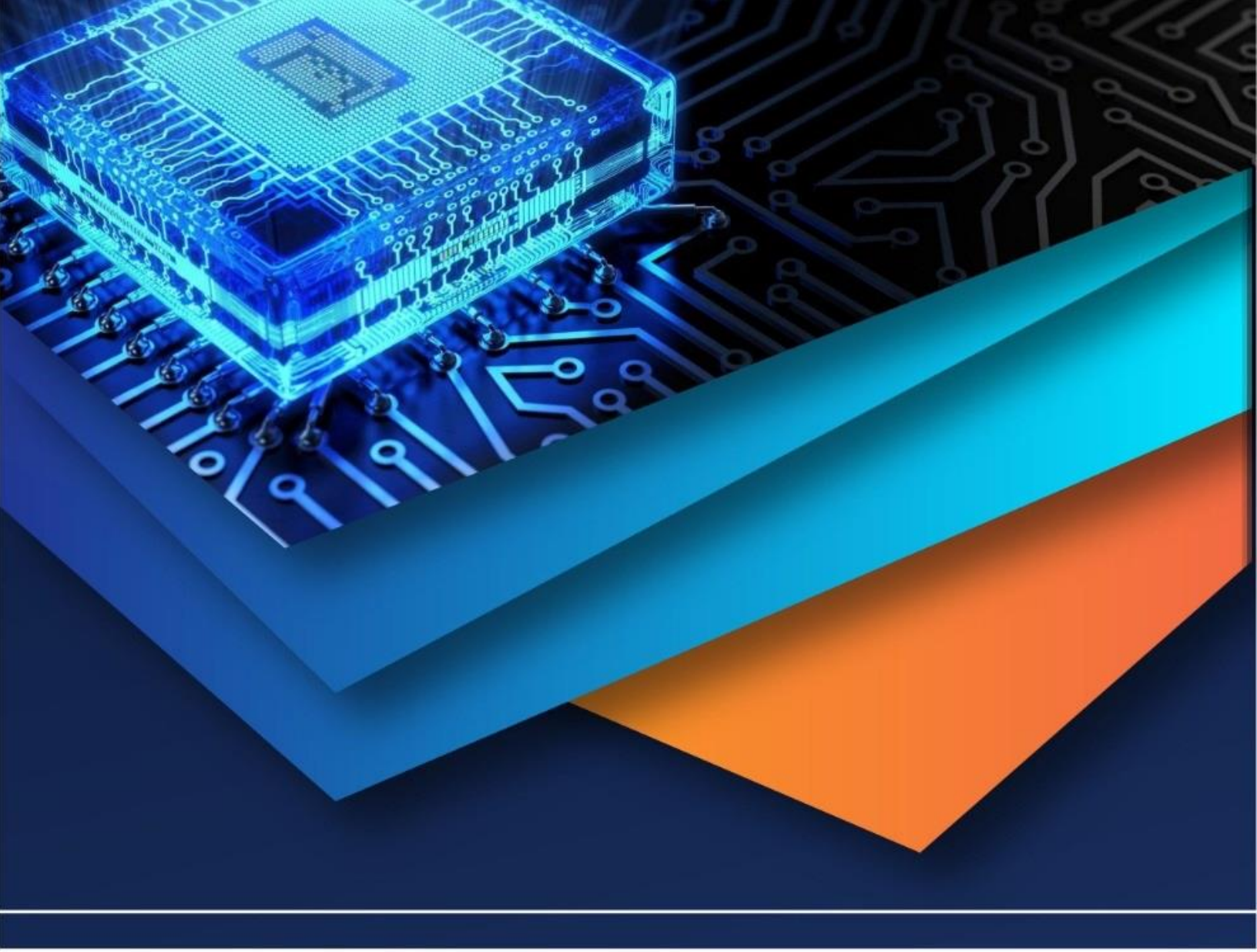

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