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Case Study on Automatic Power Factor Compensation for Industrial Power

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Abstract: ***In an electrical power grid, for an equal amount of usable power transmitted, a load with a coffee power factor draws more current than a load with a small power factor. The higher currents increase the loss of energy in the distribution network and require larger wires and other equipment. Due to the costs of larger equipment and waste energy, electrical utilities will usually charge a much higher cost to industrial or commercial customers where a low power factor is present. Low-power factor linear loads (such as induction motors) are often corrected with a passive condenser or inductor network. The present drawn from the system is distorted by non-linear loads, like rectifiers. In such cases, the correction of the active or passive power factor may also counteract the distortion and lift the factor of the facility. The facility factor correction devices may also be installed at a central substation, opened over a distribution grid, or built into power-consuming equipment.***
Keywords: Power Factor, Microcontroller, Voltage Regulator, Quad Voltage Comparator and transformer.

I. INTRODUCTION

A. *Existing System*

All current will cause losses within the availability and distribution system. A load with an influence factor of 1.0 finishes up within the foremost efficient loading of the supply and a load with a PF of 0.5 will cause much higher losses within the availability system. A poor power factor are often the results of either a significant phase difference between the voltage and current at the load terminals, or it are actually because of a high harmonic content or distorted/ discontinuous current waveform. Poor load current phase is typically the results of an inductive load like an induction motor, power transformer, lighting ballasts, welder or induction furnace. A distorted current waveform are often the results of a rectifier, variable speed drive, switched mode power supply, discharge lighting or other electronic load. The PF correction presently done by three methods

1) Displacement Bulk Correction (Bulk Compensation)
2) Displacement Static Correction (Static Compensation).
3) Capacitor selection.

B. *Proposed System*

An AC electrical power system's power factor is defined as the ratio of the significant power flowing to the load to the apparent power inside the circuit is a dimensionless number between 0 and 1 (often expressed as a percentage, e.g. 0.5 pf = 50 percent pf). Real power is that it adds aparticular time to the circuit's capacity to operate.

Apparent power is that the circuit's present product, and voltage. Because of the energy stored within the load and returned to the source, or thanks to a nonlinear load that distorts the present wave form drawn from the source, the apparent power will be greater than the significant power.

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II. BLOCK DIAGRAMS OF PROPOSED SYSTEM

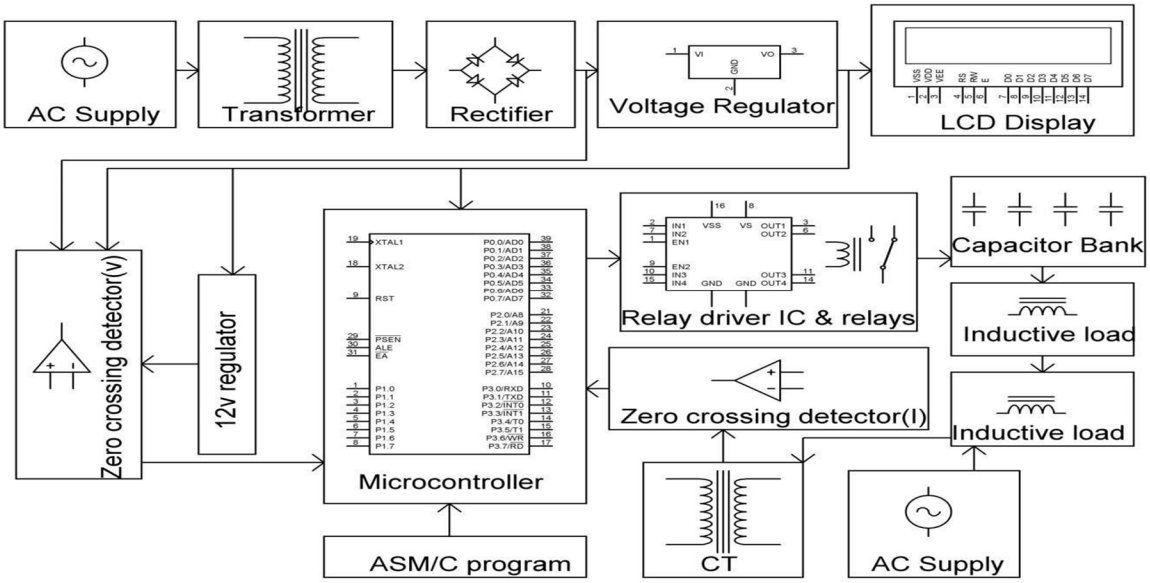

Figure-1: Block Diagram of Proposed System

There are following modes on this device.

A. Automatic Mode

Measurement cost is indicated with digital range. The size values and capacity (of capacitors) are displayed in this Mode.

B. Manual Mode:

Set-up of segment/twine kind, primary voltage, and primary cutting-edge are possible. Set important items for operation. In addition, it is able to carry out operation tests for connecting/disconnecting.

C. Compensating Mode

Set-up of goal electricity factor, control approach, and capacity are feasible.

D. Lagging Mode

In this mode the power factor tends to lag since pure inductor load is been loaded up using the choke or blast.

Table-1: checking the Loading of the circuit

	No capacitor	First capacitor	Second capacitor	Third capacitor
I lags	3.03	1.36	0.00	2.23 Leads
Pf	0.58	0.91	1.00	0.76
Improved Pf	0	0.33	0.42	0.19

The above shown details is for the Automatic power factor monitoring circuit values as per the designed values of the resistive inductive and capacitive loads that are been imposed in the circuit in the power factor terms. All the measurements want to be done for the 3 different styles of load designed; one after the other with and without the correction gadget. The portions like deliver voltage, frequency, cutting-edge drawn by means of the load, electricity consumed, strength factor are important to be measured for every instances. The strength utilized is also important to monitor for a specific duration of time to verify for the consequent strength savings within the circuit.

E. Analysis Of Load Without Correction

The evaluation of the natural restive load (R Load), collection resistive-inductive loads (Series R-L Load) and parallel resistive-inductive (Parallel R-L Load) was accomplished with-out the usage of the correction equipment.

The designed loads were related through the electricity defend and the readings for exceptional electrical parameters is been recorded.

F. Analysis Of Load With Correction

As there is a need for energy component improvement for Series R-L load and Parallel R-L load, they have been related to the deliver along with the correction system designed to affirm the predicted correction. The correction device is plugged in to the electricity shield and the masses are linked to the output factor of the system. All the 3 loads designed had been attempted and the located values is been recorded.

G. Monitoring

Monitoring normally approach to be aware of the state of a system and can consult with study a situation for any adjustments which might also arise over time, the usage of a reveal or measuring device. To measure the electricity fed on, it's miles vital to monitor the burden for a selected time frame. The electricity protect may be used to display the time in addition to measure the strength of consumption for each form of load. The loads are connected constantly for the specific time and continuous tracking changed into finished with excessive care.

H. Monitoring Of Load With Correction

Because there may be a scope for power component development for Series R-L load and Parallel RL load, they were related to the supply alongside the correction equipment designed to affirm the expected correction. The correction device is plugged in to the energy defend and the hundreds are connected to the output factor of the equipment. All the 3 masses designed were monitored over a period of time and the discovered values had been recorded.

III. PRACTICAL IMPLEMENTATION

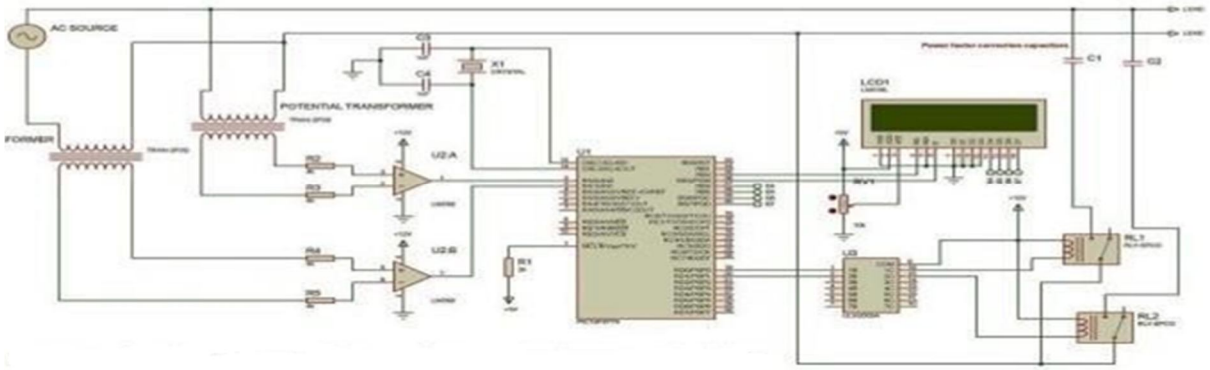

Figure-2: Power factor correction using Microcontroller

A. Working Principle

The input enter deliver i.E., 230V AC is given to the number one of the transformer (Transformer is an electromechanical static tool which remodel one coil to the every other without changing its frequency) due to the magnetic effect of the coil the flux is brought on within the primary is transfer to the secondary coil. The output of the secondary coil is given to the diodes. Here the diodes are connected in bridge kind. Diodes are used for rectification purposes. The out placed of the bridge circuit isn't always natural dc, a few what rippled ac is likewise gift. For that capacitor is hooked up at the output of the diodes to get rid of the undesirable ac, capacitor also are used for filtering purpose. The each (-ve) terminal of the diode (D2 & D3) is attached to the (+ve) terminal of the capacitor and accordingly the enter of the IC Regulator (7805 & 7812). Here we're the usage of Voltage regulators to get the constant voltage of the circuit with needed voltages can be obtained up for our desired value as per the IC standards" The Voltage regulator is a CKT that has a constant voltage within not altering a change in load currents.

These IC's are designed as fixed voltage regulators and with good enough heat sinking can deliver o/p currents in extra of 1A. The o/p of the IC regulator is given to the LED via resistors, When the o/p of the IC i.E , the voltage is given to the LED, it makes its ahead bias and thus LED gloves on kingdom and as a consequence the +ve voltage is acquired. Similarly for –ve voltage ,right here the each +ve terminals of the diodes(D1 & D4) is connected to the –ve terminals of the capacitors and as a consequence to the I/p of the IC regulator with admire to ground. The o/p of the IC regulator(7912) that is a –ve voltage is given to the terminal of LED, thru resistor, which makes it ahead bias, LED conducts and for this reason LED gloves in ON country and for that reason the –ve voltage is received. The mathematical relation for ac enter and dc output is Vdc=Vm⁄3.141 (earlier than capacitor) Vd=Vm (after capacitor). After the regulation of the supply in the voltage regulator circuitry as per the circuitry we will get the detailed overview of what voltage we are getting and the output voltage details of the circuit. The circuit of one above said respective voltage is been tapped up to the microcontroller IC and the others to the relay driver unit ULN2003 and a comparator which is of QUAD voltage comparator LM339 and a zero crossing detector unit 741 IC which consist of the anode cathode and N/C and main terminal and NO units respectively to compare the study of the flow over the circuit. This circuit has a major propose of comparing the voltage and current in a circuit with required power factor to be calculated using the formulas has been micro processed to the programmable microcontroller ie: 89051.

The compared voltage and current values of the circuit gives the angle of the values in the kit as per the loaded components ie: resistive inductive and capacitive loads.

IV. CONCLUSION AND FUTURE SCOPE

The Hardware can be enhanced by:

A. By adding other parameter sensors the circuit can control various unites
B. Fault detection unit can be added
C. GSM for wireless control can be added
D. Each industry can have this circuit

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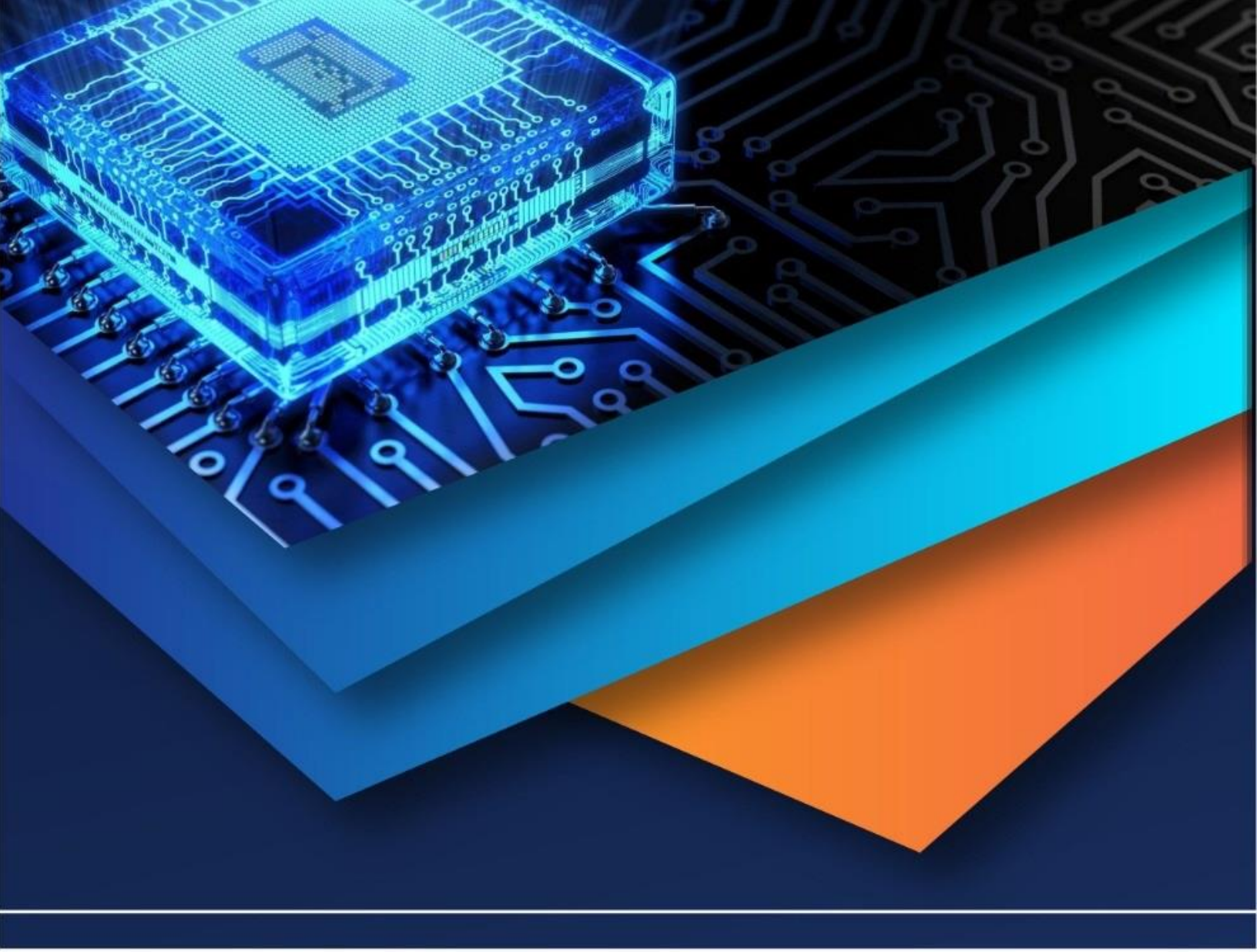

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