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IOT Based Power Factor Correction

Grace Dias[1], Rosmy Johnson[2], Sajay Saju[3], Sreelakshmi K.V[4], Sunil V. Chandran[5]
[1,2,3,4,5] *APJ Abdul Kalam Technological University*

Abstract- **In this era of technology power consumption and depleting resources for energy production is a major concern. It is important to eliminate losses, deliver quality power at the least possible tariff rates. Majority of the loads in industries are inductive in nature and they include transformers, motors, induction motors, stamping machines, machine tools and presses etc. These loads are said to consume extra power to maintain the magnetic field. That further results in increased bills and higher consumption rates. This condition can be identified by a lagging power factor. These losses in power factor have much importance in the industries as well as in the domestic units. The idea is to upgrade the power factor correction using IoT so as to operate it automatically in the power system and also to help understand the variation of power with respect to various load types. This would further enable efficient power management, power analysis and careful future designs for further expansions. Thus online power monitoring is enabled along with conventional power factor metering.**

Index Terms- Power factor, Arduino, Relay, Reactive Power, IoT

I. INTRODUCTION

The aim of the project is to design a system to minimize penalties for industrial and residential units by power factor correction using IoT. Parameters such as voltage and current measurements are taken with the help of instrumentation transformers and opto-couplers. Depending on the measured phase difference, capacitors are added to compensate the reactive power. This calculation is done using Arduino and it further gives signal to the relay for addition of capacitances.

This would further enable efficient power management, power analysis and careful future designs for further expansions. Thus online power monitoring is enabled along with conventional power factor metering.

II. METHODOLOGY

The current transformer enables measurement of current and a opto-coupler is used to measure voltage value. The voltage, current measurements are stepped down to a suitable value for the computation in Arduino. After step down of current and voltage, rectifiers are enabled for converting AC to DC. Current measured is given to Op Amp so that the output is a square wave. The current and voltage square waveforms are given to EXOR gate to understand pulse width difference. The output of EXOR gate is given to Aurdino. Aurdino is coded to identify this pulse width and further calculate the variation of power factor. Aurdino would then provide activation to the required number of capacitors as per the calculated values. Capacitors will provide the required compensation in the system. The whole process is depicted in a webpage and in the mobile application. The current value is also amplified and given to Aurdino along with voltage value and phase difference in order to calculate the power consumed in real time. Fig.1 shows the proposed system

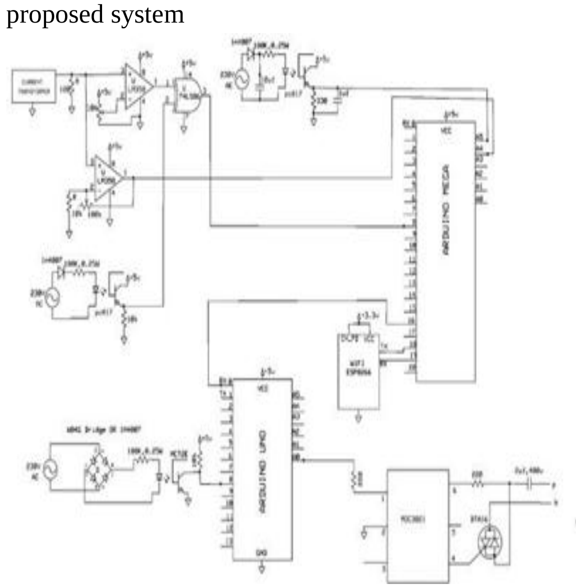

Fig 1.Proposed System

III. HARDWARE

The loads used in the system are two 100W bulbs and an induction motor. The current and voltage measurements are taken using current transformer and with the help of opto-coupler. From the current transformer the current value is given to LM350 Op Amp through a parallel resistor. These values are given to the EXOR gate. The voltage measurement is taken to the opto-coupler through a half wave rectifier and a resistor which limits the current to the opto-coupler.

The opto-coupler consists of a LED and a photo transistor. It is followed by a pull down resistor from where the output is taken. Fig. 2 shows the circuit hardware.

To calculate the power consumed current is amplified and given to Aurdino, voltage is rectified with the help of a diode and is given to opto-coupler. For amplifying the current Op Amp is used. The voltage, current and power factor is now considered to find the energy consumed as a multiple of time.A ZCD circuit is used to find the zero crossing points in the waveform. This identification of zero crossing points help in determining the triggering point of TRIAC in the relay. TRIAC is formed by connecting two thyristors in anti-parallel. The difference between zero crossing points detected will help in adding the required capacitance for the circuit.

With the help of another Aurdino communication is made possible to the relay. Now an adapter supplies 12V to the circuit which is stepped down to 5V so as to operate the Aurdino. For the integration of the circuit using mobile application and web page a Wi-Fi module is used. This module operates at 3.3V which is given through the regulator. The webpage displays current, voltage and power factor. It also displays the energy consumed as a multiple of time. The time of day values are visible in the mobile application. Load clipping is added to the circuit. A 100W bulb is cutoff from the supply at peak loads.

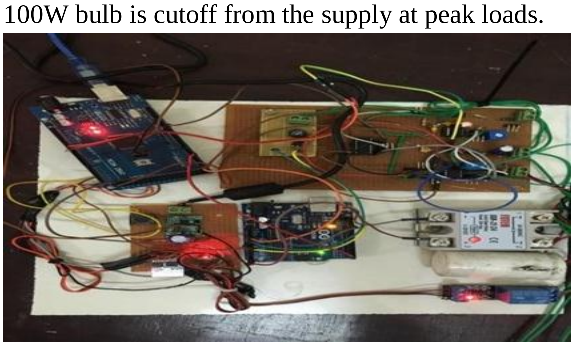

Fig 2.Circuit Hardware

IV. SOFTWARE

The programming is done using C language and this makes the program development cycle short and enables the use of modular programming.

The algorithm can be written as follows:

- Measure voltage and current for the connected loads
- Measure phase shift of current and voltage
- Display the power factor in the webpage
- Calculate the required compensation
- Triggering of TRIAC in the relay as per the capacitor requirement
- After compensation the power factor is corrected

The output obtained by the user in the mobile application is shown in Fig. 3.

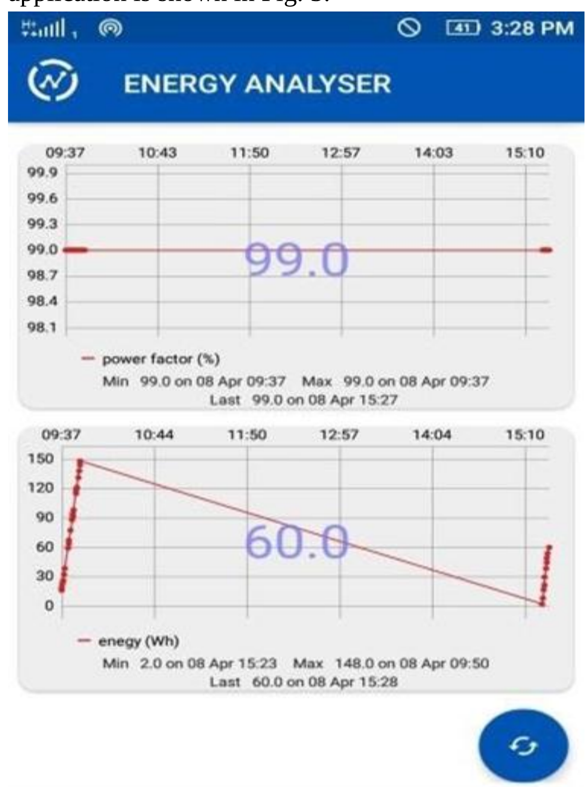

Fig 3.Output displayed in mobile application

V. CONCLUSION

The project provides one of the techniques used to fix power losses due to low power factor associated in industrial units. In this era of high electrical energy consumption and industrialization it is required to provide quality power an uninterrupted supply. At the same time it is necessary to make judicious use of resources. It is very important to prevent unwanted losses in the power system. IoT is enabled so that the variation in power factor can be controlled and analyzed in real time. This also provides easiness to the user and the utility. This would further enable efficient power management, power analysis and careful future designs for further expansions. Thus online power monitoring is enabled along with conventional power factor metering. The complete circuit and its output is shown in Fig 4.

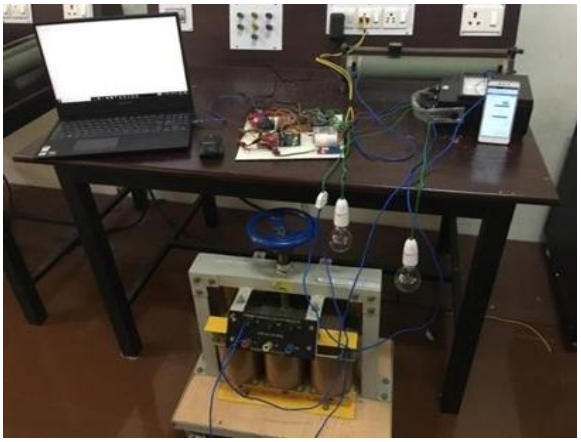

Fig 4.Final project hardware

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