Energy Saving by Power Factor Improvement and Harmonic Reduction

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***Abstract**:* This paper discusses the improve power factor and reduce the harmonics distortion of system. Poor power factor costs our community in increased electricity charges and unnecessary effect in the system and poor power quality. In electrical plants the loads draw from the network electric power (active) as power supply source (e.g. personal computers, printers, etc.) or convert it into another form of energy (e.g. electrical lamps or stoves) or into mechanical output (e.g. electrical motors) or rectifier. To smooth such negative effect, the power factor correction of the electrical plants is carried out. The power factor correction obtained by using power factor correction switches banks to generate locally the reactive energy necessary for the transfer of electrical useful power, allows a better and more rational technical-economical management of the plants. The system is capable of correcting power factor up to unity or adjusting it according to user desire. The proposed system is characterized by, no generation of harmonics, and reduction of transmission losses

Keywords: *Harmonics Filter, power factor correction, microcontroller, Capacitor bank*

I. INTRODUCTION

In this paper, an implementation of hardware is described which helps in reduction of power loss in various industries through power factor compensation using number of shunt capacitors. This results in reduction in amount of electrical bill for industries and commercial establishments. Power factor is defined as the ratio of real power to apparent power. This definition is often mathematically represented as KW/KVA, where the numerator is the active (real) power and the denominator is the (active + reactive) or apparent power. Reactive power is the non-working power generated by the magnetic and inductive loads, to generate magnetic flux. The increase in reactive power increases the apparent power, so the power factor also decreases. Having low power factor, the industry needs more energy to meet its demand, so the efficiency decreases. In this proposed system, the time lag between the zero voltage pulse and zero current pulse duly generated by suitable operational amplifier circuits in comparator mode are fed to two interrupt pins of the microcontroller. Microcontroller displays the power loss due to the inductive load on the LCD. The program takes over to actuate appropriate number of relays at its output to bring shunt capacitors into the load circuit to get zero power loss. The 8bit microcontroller used in the project belongs to 8051 family which results in power saving. Generally it is useful for the industry and the commercial purpose because they are use heavy or high electricity consumption machine by which they also requirement of more power comparison than of others by which not enough power supply in the rural areas at all time so they feel difficulties but by the use of this project we reduced the power by mean of increase the value of power factor by use of capacitor in series.

II. LITERATURE REVIEW

This paper covers issues related to energy management at plant level utilities, energy management practices adopted by the industries, barriers to energy efficiency in industries. In order to get the complete understanding of energy management, literature has been reviewed and the gaps in the previous studies were identified. A lot of research work has been done on the dynamic power reduction with the use of DVFS techniques [2]. However, as technology continues to shrink, leakage power will become a dominant factor. Power gating is a commonly used circuit technique to remove leakage by turning off the supply voltage of unused circuits. Power gating incurs energy overhead; therefore, unused circuits need to remain idle long enough to compensate this overheads. A novel micro-architectural technique for run-time power- gating caches of GPUs saves leakage energy. Based on experiments on 16 different GPU workloads, the average energy savings achieved by the proposed technique is 54%. Shaders are the most power hungry component of a GPU, a predictive shader shut down power gating technique achieves up to 46% leakage reduction on shader processors. The Predictive Shader Shutdown technique exploits workload variation across frames to eliminate leakage in shader clusters. Another technique called Deferred Geometry Pipeline seeks to minimize leakage in fixed function generator unit by utilizing an imbalance between geometry and fragment computation across batches which removes up to 57% of the leakage in the fixed-function geometry units. A simple time-out power gating method can be applied to non-shader execution units which eliminates 83.3%

of the leakage in non-shader execution units on average. All the three techniques stated above incur negligible performance degradation, less than1%. The Home Energy Saver energy assessment tool allows consumers to conduct a do-it-yourself home energy audit and provides specific recommendation help lower house hold emergency consumption and utility costs [3] . By entering a zip code, users get estimates for typical and efficient homes in their area.

III. CHALLENGES IN POWER QUALITY IMPROVEMENT

One of the major challenges in power quality enhancement is the increasing rate of non-linear loads and the power electronic devices. The other devices like load switching equipments, addition of capacitor bank energies. The increase of such equipments is responsible for reduction in power quality. One of such issue is the presence of transients, which are undesirable but decay with time and hence not a steady state problem. It is the part of the change in a variable that disappears during transition from one steady state operating condition to the other. Another synonymous term is surge. Transients are classified into two categories *viz.* impulsive and oscillatory. An issue which relates to the power frequency fluctuation is waveform distortion and harmonic distortion. This is defined as a steady-state deviation from an ideal sine wave of power frequency. There are five types of waveform distortion *viz.* DC offset, Harmonics, Inter harmonics, Notching, and Noise. Harmonic distortion causes increase in the losses and thus, heating in rotating machines and capacitors. Also, it results in the over voltages due to resonance and thus causing interference with ripple control systems used in Demand Side Management (DSM). There is huge disturbance caused not only in power system but with the communication system as well.

IV. MITIGATION TECHNIQUES

A. ***Using Capacitor Bank:*** There are many fluctuations, raise and falls, and surges/Spikes in the incoming current. Saving energy by power factor improvement is easier using capacitor bank. Power savers use capacitors for this purpose. When there is a surge of current in the circuit, the capacitor saves the power by storing the excess charges and releases it when there is sudden drop. Thus only smooth output current comes out of the device.

B. ***Microcontroller Automatically P.F Correction:*** The whole processing of the device is done by microcontroller. The micro-controller89s51 is a small but powerful micro-controller from Microchip.

In the work presented in this paper, we are using Microcontroller 8051. A microcontroller (sometimes abbreviated µC, uC or MUC) is a small computer on a single integrated circuit containing a processor core, memory, and programmable input/output peripherals. Program memory in the form of Ferroelectric RAM, NOR flash or OTP ROM is also often included on chip, as well as a typically small amount of RAM. Microcontrollers are designed for embedded applications, in contrast to the microprocessors used in personal computers or other general purpose applications.

EEPROM (also written E^2PROM and pronounced “e-e-prom”, “double-e prom”, “e-squared”, or simply “e-prom”) stands for Electrically Erasable Programmable Read Only Memory and is a type of non-volatile memory used in computers and other electronic devices to store small amounts of data that must be saved when power is removed, e.g., calibration tables or device configuration. When larger amounts of static data are to be stored (such as in USB flash drives) a specific type of EEPROM such as flash memory is more economical than traditional EEPROM devices.

ULN2003 is a high voltage and high current Darlington array IC. It contains seven open collector Darlington pairs with common emitters. Darlington pair is an arrangement of two bipolar transistors. ULN2003 belongs to the family of ULN200X series of ICs. Different versions of this family interface to different logic families. ULN2003 is for 5V TTL, CMOS logic devices. These ICs are used when driving a wide range of loads and are used as relay drivers, display drivers, line drivers etc.

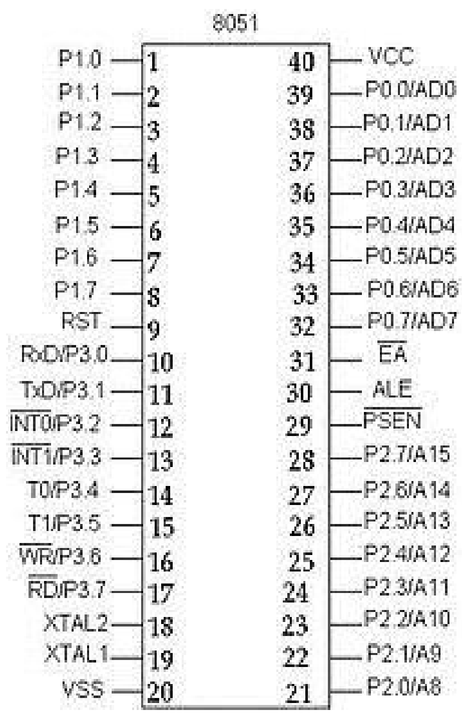

Fig.3. Pin diagram of µC 8051

ULN2003 is also commonly used while driving stepper motor. Refer Stepper Motor interfacing using ULN2003. Each channel or Darlington pair in **ULN2003** is rated at 500mA and can withstand peak current of 600mA. The inputs and outputs are provided opposite to each other in the pin layout. Each driver also contains a suppression diode to dissipate voltage spikes while driving inductive loads.

In hardware implementation of the project for an automatic power factor controller, current transformer is used to get current wave form from of load current and current transformer also step down ac current. LM358 is used as a comparator in this circuit. Similarly, voltage transformer is used to get current wave form and fed this wave to LM358 comparator. LM358 is used as zero crossing detector in this project. After LM358 both current and voltage waveforms are fed to PIC16F877A microcontroller. PIC16F877A microcontroller measures zero crossing detection and power factor by measuring time difference between current and voltage wave form. Time difference between current and voltage waveform is used to measure power factor using pic- microcontroller.

V. CONCLUSION

The Automatic Power Factor Detection and Correction provides an efficient technique to improve the power factor of a power system by an economical way. Static capacitors are invariably used for power factor improvement in factories or distribution line. However, this system makes use of capacitors only when power factor is low otherwise they are cut off from line. Thus, it not only improves the power factor but also increases the life time of static capacitors. The power factor of any distribution line can also be improved easily by low cost small rating capacitor.

VI. REFERENCES

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