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Smart Meter for Power Factor Enhancement in Real Time

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ABSTRACT: The growing global population is driving a greater increase in the demand for electricity. Due to the increase in the emission of Green House Gases (GHG) by the present electrical grid, utilization of renewable energy sources in the power chain has become the need of the hour. Today, the legacy grids are under pressure to deliver the growing demand for power. This project report represents one of the most effective automatic power factor improvements by using static capacitors which will be controlled by a Microcontroller with very low cost although many existing systems are present which are expensive and difficult to manufacture. Smart meters provide real-time registration of electricity use, offers the possibility to read the meter locally and remotely and it is capable of limiting or cutting off the energy use. This paper attempts to create a system that helps industrial and residential consumers in identifying wasteful energy usage and thereby mitigating electricity use. The system measures all the power parameters like instantaneous voltages, instantaneous currents and power factor up to 0.9 and thereby distributes quality power to the end users.

KEYWORDS: Power factor, Microcontroller P18f4520.

I. INTRODUCTION

The traditional electricity distribution network has been designed essentially as a passive network that carries the energy one way: from a few big power stations to the consumption points of end users. The increased cost of energy production and the growing up of its demand require different management system, based on real-time measurements, which make more efficient its use. We are moving to an upgraded electricity network to which two-way digital communication between supplier and consumer, intelligent metering and monitoring systems have been added. These are known as smart grid paradigm. An essential requirement for the application of smart grid approach is the development of an advanced metering network. Basically, it consists in a set of electricity meters that records consumptions of electric energy and make this information available to the grid operator and energy supplier for monitoring and billing purposes. Typically, these meters are implemented with embedded microcontrollers designed for a specific application and capable to run stand alone. In addition these meters should include a communication front-end that allows them to exchange information within a network and to communicate with external devices. Then a new generation of meters is required: smart meters. In this way, the implementation of smart metering network is the first step towards the creation of a "smart grid" electricity network that can intelligently integrate the actions of all logged users: generators, consumers and presumes (those who simultaneously perform the dual role), in order to offer efficiency with a sustainable supply of electricity, cheapness and safety. An important feature of smart metering is the possibility to make available some basic information, such as current energy absorption, with stringent time constraints that reach the real time requirements. For a full functionality, another important feature that a smart meter should have is the ability of exchanging information or services, or any part of them, with other devices, also not homogeneous. This can be implemented.

The rest of the paper is organized as follows. Section II discusses literature survey. Section III describes our proposed system on the face image retrieval problem and the promising utilities of human attributes. Section IV introduces the algorithm used for image retrieval. Section V gives the experimental results, and section VI concludes this paper.

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II.LITERATURE SURVEY

Nowadays wireless [3] communication has become ubiquitous around the world and its application for gauging consumption of utilities by customers is rapidly gaining pace, not only in the developed world but also in the developing countries. To introduce this concept in the Sultanate of Oman, a model of Wireless Automatic Meter Reading System (WAMRS) has been developed, in which the wireless communication is based on IEEE 802.15.4 (ZigBee) standard and security is implemented by following the Direct Sequence Spread Spectrum (DSSS) protocol. Successful demonstration of WAMRS prototype has made it possible to be implemented in Oman on a larger scale for meter reading applications. Many countries have already noticed this power saving effect of the smart [4] metering system and made plans for demonstration and propagation. For instance, the Government of Australia has created a framework for the rollout of smart metering system. They estimate that 4~10% save in national wide power consumption as well as 1.4~3.5%reduction of greenhouse gas emission can be achieved. In the study of summer peak duration in 2007, 5.5~7.8% reduction was achieved through the combined usage of DPP (Dynamic Peak Pricing) and IHD (In-Home Display). Electricity [5] is the driving force behind the development of any country. With the rapid increase in residential, commercial, and industrial consumers of electricity throughout the world, it has now become imperative for utilities companies to devise better, non-intrusive, environmentally-safe techniques of gauging utilities' consumption so that correct bills can be generated and invoiced.

In this paper, [6] they present the design of the Bluetooth-Enabled Energy Meter and describe few possible commercial applications of this meter. They propose two methods of retrieving the data from the wireless energy meter. They are Automatic Meter Reading (AMR) and Automatic Polling Mechanism (APM). AMR is a mechanism whereby the Energy Meter sends the recorded power consumption of a household in the certain interval of time to a 'wirelessly' connected reader, which could be a personal computer (PC). Meanwhile, [7] APM is another method where an Energy Reader e.g., PC, will poll each and every individual Bluetooth Energy Meter automatically regularly in order to get the meter reading of the corresponding households. In this paper, they reviewed smart metering system of other countries and explained our development of smart metering system specialized for Korean residential environments. With this developed system, we have conducted a pilot demonstration for 2 months in the winter season Dec. 2008 to Feb. 2009. 77 various sized households in two different cities volunteered to participate in this demonstration.

III.PROPOSED SYSTEM

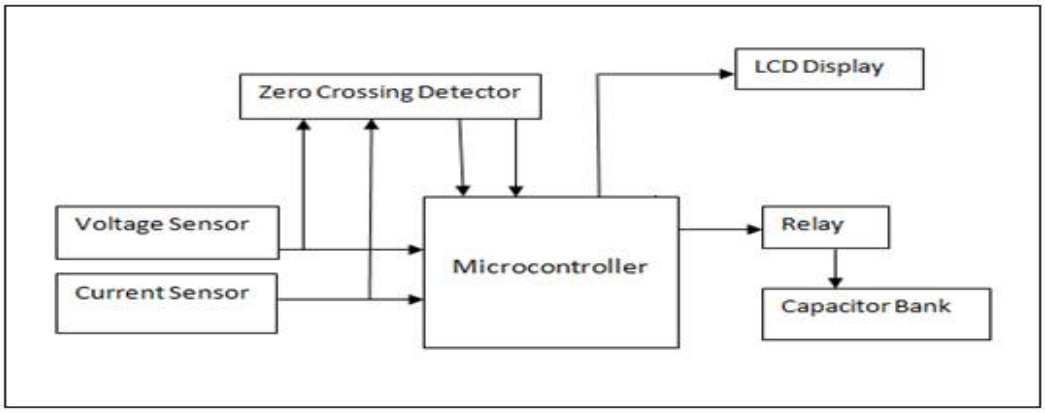

Fig 3.1: Block diagram of system

3.1Block diagram Description

The aim of this project is monitoring and controlling the power quality by keeping the power factor near unity. Also, it provides a low cost solution in providing the real-time registration of electricity use and helps the end-users in keeping a tab of energy usage. The Peripheral Interface Controller (PIC) acts as a Central Controller Unit. PIC processes the signals obtained from the Zero Crossing Detector (ZCD) and calculates the voltage, current, power consumed, energy and power factor.The values sensed by current sensor and voltage sensor are given to the analog channels of the central controller and also to the ZCDs which are realized using 741 op-amps. The peak voltages of

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voltage (Vp) and current (Ip) is processed by the controller from it. The instantaneous values of current and voltage are calculated by using the formula

$$Vrms=0.707*Vp \quad (1)$$

$$Irms=0.707*Ip \quad (2)$$

The power factor is calculated using ZCD algorithm. The current and voltage values are given as interrupts to central controller. Whenever the first interrupt occurs, the timer starts to determine the delay between the two consecutive interrupts which is the angle between voltage and current. The true power (Pt) is calculated using the formula

$$Pt=Vrms *Irms* \cos\phi \quad (3)$$

High pulses are produced whenever a voltage or current wave crosses a zero. Thus the angle is calculated by measuring the difference between zero crossings of voltage and current waveforms. If the power factor is below the 0.85 the capacitor banks are turned on using relays. The calculated values of power and energy are displayed on 16x2 LCD. The data usage can also be seen in the website that is updated in a server.The communication from server to PIC is accomplished using ZigBee protocol. The inductive loads induce lagging power factor that undermine power quality. The power quality is improved by correcting the power factor near unity. The power factor is maintained near unity by switching on the capacitor banks.

1) PIC Microcontroller (18F4520):-

PIC18xxxA series controller is an 8 bit controller; it has 40 pin and Consist of high Performance RISC CPU. It consists of Self-reprogrammable software. Only 35 single-word instructions to learn and 20MHz clock input is used, Up to 8K x 14 words of Flash Program Memory can be used. It is a very effective controller when compared to previous versions. It has an inbuilt 8-channel ADC. Port A and E are multi functionality ports which can be used for I/O. PIC8xxxA series controller is highly available and very cost efficient. Wide Operating Voltage Range (2.0V to 5.5V) and low power consumption.

High Performance RISC CPU:

- C compiler optimized architecture/instruction set
- Linear program memory addressing to 32 Kbytes
- DC - 40 MHz osc./clock input

2) ACS712 current sensor:

This is a breakout board for the fully integrated linear ACS712 current sensor. The sensor gives precise current measurement for both AC and DC signals. Thick copper conductor and signal traces allows for survival of the device up to 5 times over current conditions. The ACS712 outputs an analog voltage output signal that varies linearly with sensed current.ACS712 is based on Hall detection principle; please try to avoid the magnetic field, when using as it may impact the reading accuracy.

3) Zero crossing detector:

A zero crossing detector or ZCD is a one type of voltage comparator, used to detect a sine waveform transition from positive and negative that coincides when the i/p crosses the zero voltage condition.Zero crossing detectors is a voltage comparator that changes the o/p between +Vsat& –Vsat when the i/p crosses zero reference voltage. In simple words, the comparator is a basic operational amplifier used to compare two voltages simultaneously and changes the o/p according to the comparison. In the same way we can say ZCD is a comparator

4) Capacitor Bank

This ratio is alternatively known as electrical power factor, and fewer ratios indicates poor power factor of the system. If the power factor of the system is poor, the ampere burden of the transmission, distribution network, transformers, alternators and other equipments connected to the system, becomes high for required active power. And hence reactive power compensation becomes so important. This is commonly done by capacitor bank.

5) LCD Display:-

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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. 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.

V.FLOWCHART

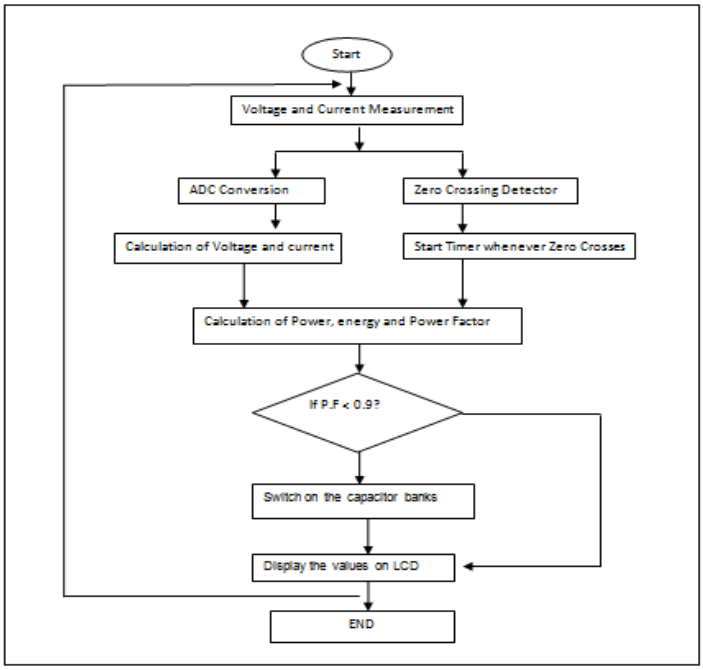

Fig. 5.1 Flowchart of system

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 ware's 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.

REFERENCES

[1] Anjana Shree M, Prasanna Vadana D, "*Smart Meter for Power Factor Enhancement in Real-Time*", International Conference on Embedded Systems (ICES) - 978-1-4799-5026-3/14/$31.00 ©2014 IEEE
[2] Abdul Khadar A, Javed Ahamed Khan, M S Nagaraj, " *Research Advancements Towards in Existing Smart Metering over Smart Grid*", (IJACSA) International Journal of Advanced Computer Science and Applications, Vol. 8, No. 5, 2017
[3] U.S. Department of Energy, the *Smart Grid: An Introduction* (Washington, DC: U.S. Department of Energy, 2008).http://www.oe.energy.gov/1165.htm.
[4] http://gettingsmarteraboutthesmartgrid.org/pdf/SmartGrid_Report_PDF- 2012-11-26-Final.pdf.
[5] F.Libano, I.paranhos, J.Melchiors, O. Mano, R.fehlberg, R.Braga and S.Muller, "Power energy meter in a low cost hardware/software", *inIEEE conference proceedings of ISIE*, Montreal, Quebec, Canada, 2006, pp.1-5.
[6] Shoeb S. Sheikh, "Design and implementation of wireless automatic meter reading system," *International Journal of Engineering Scienceand Technology (IJEST)*

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[7] Tae-Seop Choi, Kyung-Rok Ko, Seong-Chan Park, Young-Sik Jang, Yong-Tae Yoon, and Sang-Kug Im, "Analysis of energy savings using smart metering system and In-Home Display," in IEEE conference proceeding of T&D, Asia 2009.
[8] B. S. Koay, S. S. Cheah, Y. H. Sng, P. H. J. Chong, P. Shum, Y. C. Tong, X.Y. Wang, Y.X. Zuo and H. W. Kuek, "Design and implementation of Bluetooth energy meter," in conference proceedings of ICIC –PCM, Singapore 2003.
[9] Ling Zou, Sihong Chu and Biao Guo, "*The design of prepayment polyphase Smart Electricity Meter System*", in conference proceedings of ICIC –PCM, Singapore 2003.
[10] J.Zhu and R.Pecan, "*A novel Automatic Utility Data Collection System uses IEEE 802.15.4 Compliant Wireless Mesh Networks*", in Proc. Of the 2008 IAIC-IJME International Conference, Nov 17- 19, Nashville, Tennesse.
[11] Sabir Rustemli, Muhammet Ates, "*Measurement and Simulation of Power Factor using PIC16F877*," *PRZEGL□DELEKTROTECHNICZNY (Electrical Review), ISSN 0033-2097, R. 88NR June/2012*.