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Abstract- In present days Technological advancement and its incorporation is becoming a significant role in human life. Now Electrical power is very precious but due to the addition of Inductive load the reactive power is increasing rapidly as a result the industrialization has been affecting the efficiency of the electric power system. To minimize the reactive power consumption the power factor detection system is became a serious issue. The developed module will be an ideal possibility in the upcoming future with minimal cost and flexibility. In this project we have used atmega16 microcontroller, LCD, current sensor, voltage sensor, Bluetooth Module and Android Application. The microcontroller is used to measure the phase voltage and current by using ADC as well as it detect the power factor by measuring the phase difference between voltage and current using delay. The current sensor is used to measure the current respectively voltage sensor for voltage. The LCD is used to show the measured data and the Bluetooth module is to send the data. The android application is used to show the data in smart phone which is specially developed for it. This is a part of smart grid. The ultimate objective of the project is to monitor the consumer end status continuously with minimum cost.

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Power Factor Detection using Android Application via Bluetooth

Md. Faysal Chowdhury ^α, Sayeedul Mursalin ^σ, Mohammad Jubair Hossain ^ρ & Omor Ahmed Dhali ^ω

Abstract- In present days Technological advancement and its incorporation is becoming a significant role in human life. Now Electrical power is very precious but due to the addition of Inductive load the reactive power is increasing rapidly as a result the industrialization has been affecting the efficiency of the electric power system. To minimize the reactive power consumption the power factor detection system is became a serious issue. The developed module will be an ideal possibility in the upcoming future with minimal cost and flexibility. In this project we have used atmega16 microcontroller, LCD, current sensor, voltage sensor, Bluetooth Module and Android Application. The microcontroller is used to measure the phase voltage and current by using ADC as well as it detect the power factor by measuring the phase difference between voltage and current using delay. The current sensor is used to measure the current respectively voltage sensor for voltage. The LCD is used to show the measured data and the Bluetooth module is to send the data. The android application is used to show the data in smart phone which is specially developed for it. This is a part of smart grid. The ultimate objective of the project is to monitor the consumer end status continuously with minimum cost.

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I. INTRODUCTION

Power factor is the ratio between the kW and the kVA drawn by an electrical load where the kW is the actual load power and the kVA is the apparent load power. Simply, it is a measure of how efficiently the load current is being converted into useful work output and more particularly is a good indicator of the effect of the load current on the efficiency of the supply system. The value for the power factor can theoretically vary between 0/% and 100%, where a value of 100% also called unity power factor – delivers all of the power as active power. A value of 0% would mean all the power is supplied as reactive power; no motors would turn and no useful work could be accomplished. A high power factor is important. But if the power factor is low the Current will be increased, and this high current will cause to the following disadvantages.

- Large Line Losses (Copper Losses) will occurs.
- Large kVA rating and Size of Electrical Equipment's will be required.
- Greater Conductor Size and Cost will be needed
- Poor Voltage Regulation and Large Voltage Drop.
- Low Efficiency.
- Penalty from Electric Power Supply Company on Low Power factor.

This Project focuses on the design and implementation of power factor Detection using Atmega16 microcontroller chip, determine the power factor of the loaded power system, and generate proper action to calculate Capacitor. Also we would be using concepts of Bluetooth Module and Android Application.

II. PROPOSED SYSTEM

Microcontroller base automatic Detection of power factor with load monitoring is shown in fig.1

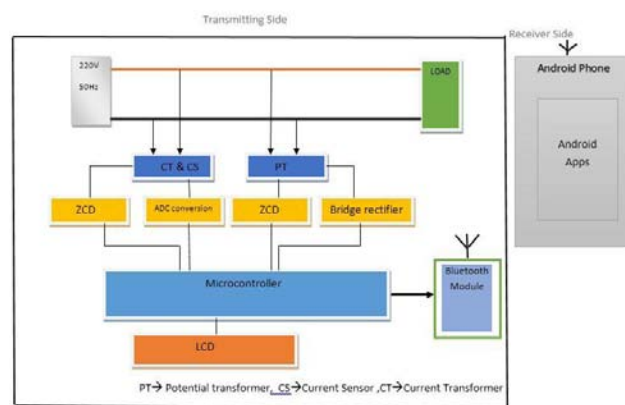


Figure 1 : Block diagram arrangement of the project

The principal element in the circuit is Atmega16 microcontroller. The current and voltage are measured from the main AC line (L) by using Hall Effect current sensor and Potential Transformer. The potential transformer and current transformer are used to measure the phase difference between voltage and current. The signals from potential transformer and current transformer are pass in to the zero crossing detector IC (ZCD I & ZCD V) individually that transposed square-wave of current and voltage and connect it to the Microcontroller to observe the zero crossing of current and voltage at the same time instant. Bridge Rectifier is used to convert the AC voltage to DC voltage. Voltage divider applied to convert the dc voltage to 5v. Hall

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Effect current sensor gives the digital signal of current. Microcontroller read the value for both of voltage and current. The microcontroller internal timer read the time difference between voltage and current and convert it to phase angle and measures the power factor. The load monitoring status are shown in LCD and send it via Bluetooth module through UART for android application.

III. CIRCUIT DESIGN ARRANGEMENT

In figure 1, the basic arrangement of the implemented project can be found.

Among the major components required to establish the project, few of them are the power transformers (step down), microcontroller ATMEGA 16 and Bluetooth module, Bridge rectifier, Zero crossing detector.

a) Transformer

Transformer is an electrical device which transfer energy from one circuit to another circuit without change its frequency but in different voltage level. In this project we have 230v to 12v step down transformer. Step down transformers convert electrical voltage from one level usually down to a lower level. A step down transformer has less turns on the secondary coil than the primary coil. The induced voltage across the secondary coil is less than the applied voltage across the primary coil or in other words the voltage is "stepped-down". Step down transformers are made from two or more coils of insulated wire wound around a core made of iron. When voltage is applied to one coil (frequently called the primary or input) it magnetizes the iron core, which induces a voltage in the other coil, (frequently called the secondary or output). The turn's ratio of the two sets of windings determines the amount of voltage transformation.



Figure 2 : 220v/12v transformer

b) Microcontroller ATMEGA 16

ATmega16 is an 8-bit high performance microcontroller of Atmel's Mega AVR family with low power consumption. Atmega16 is based on enhanced RISC (Reduced Instruction Set Computing, Know more

about RISC and CISC Architecture) architecture with 131 powerful instructions. Most of the instructions execute in one machine cycle. Atmega16 can work on a maximum frequency of 16MHz. ATmega16 has 16 KB programmable flash memory, static RAM of 1 KB and EEPROM of 512 Bytes. The endurance cycle of flash memory and EEPROM is 10,000 and 100,000, respectively. ATmega16 is a 40 pin microcontroller. There are 32 I/O (input/output) lines which are divided into four 8-bit ports designated as PORTA, PORTB, PORTC and PORTD. ATmega16 has various in-built peripherals like USART, ADC, Analog Comparator, SPI, JTAG etc. Each I/O pin has an alternative task related to in-built peripherals [3].

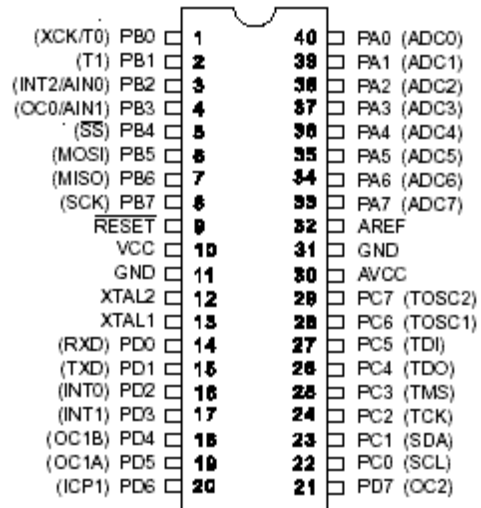


Figure 3 : Atmega16 microcontroller

c) Bluetooth module

HC-06 has been used as Bluetooth module. The Baud rate is 9600. Master and slave mode can't be switched in this Module. HC-06 module have paired memory to remember last slave device. The working voltage is 3.3V, but it can work at 3.00-4.2v. The Current pairing 20~30mA, connected 8mA [4][8].

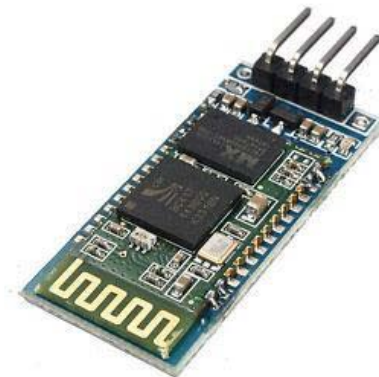


Figure 4 : Bluetooth module HC-06

d) Bridge rectifier

A bridge rectifier is an arrangement of four or more diodes in a bridge circuit configuration which provides the same output polarity for either input polarity. It is used for converting an alternating current (AC) input into a direct current (DC) output. A simple rectifier circuit described in this project converts the input from AC source to DC voltage. Firstly, the step down transformer converts the AC mains supply of 230V to 12V AC. This 12V AC is applied to the bridge rectifier arrangement such that the alternate diodes conduct for each half cycle producing a pulsating DC voltage consisting of AC ripples. A capacitor connected across the output allows the AC signal to pass through it and blocks the DC signal, thus acting as a high pass filter. The output across the capacitor is a smooth DC signal [8].

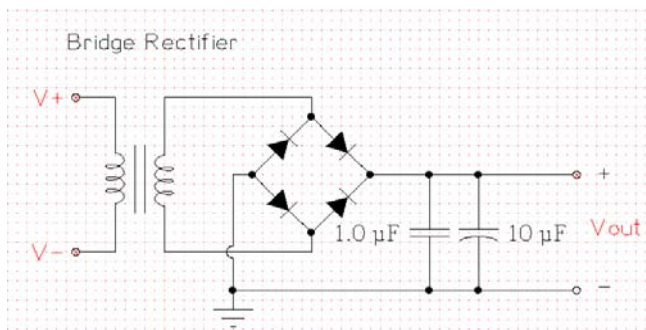


Figure 5 : Bridge rectifier

e) Zero crossing Detector

The zero crossing detector is a device that is used to detect the point where the voltage and current crosses zero in either direction. The reference voltage in this case is set to zero. The output voltage waveform shows when and in what direction an input signal crosses zero volt. If input voltage is a low frequency signal, then output voltage will be less quick to switch from one saturation point to another. And if there is noise in between the two input nodes, the output may fluctuate between positive and negative saturation voltage V_{sat} . Here IC LM358n is used as a zero crossing detector.

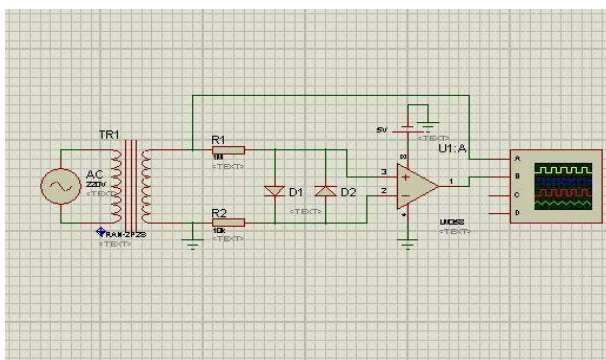


Figure 6 : zero crossing detector

The output of the zero crossing detector circuit is shown in Fig 7.

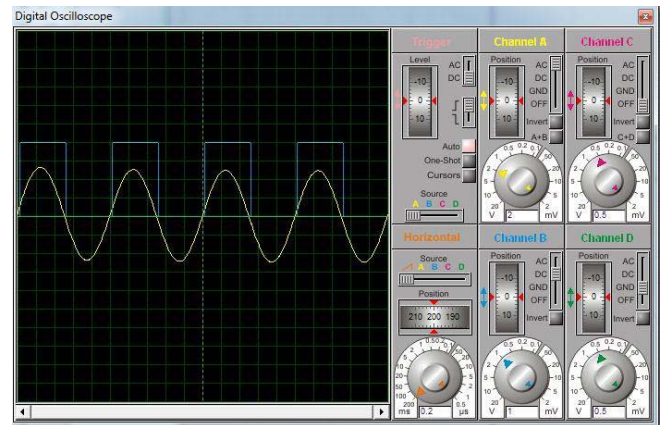


Figure 7 : Zero crossing detector circuit output

IV. SIMULATION & FLOW CHART

The initial stage, the circuits have been designed and simulated in PROTEUS. The circuit have been utilized to detect the power factor using Android application via Bluetooth module. The circuit diagram can be found in figure 8.

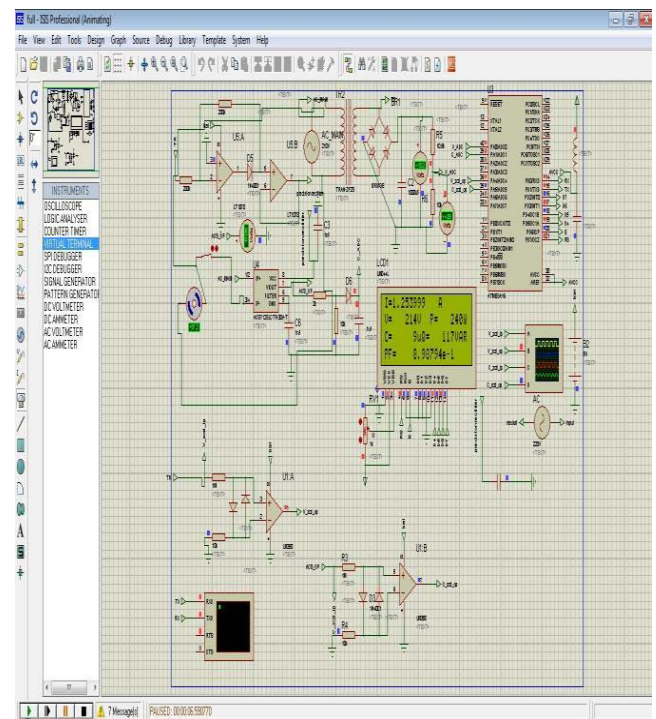


Figure 8 : Circuit Simulation

The output of the Bluetooth Module (Via UART) is shown in Fig 9.

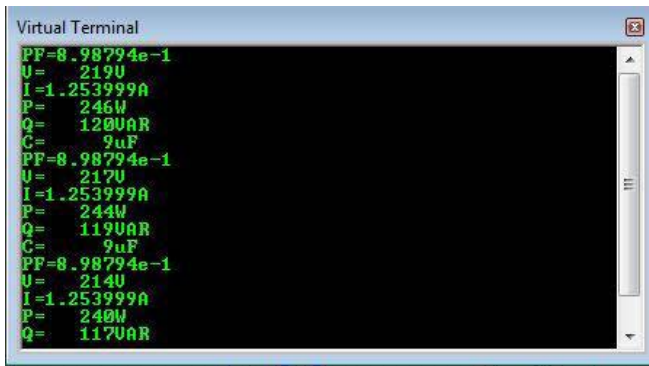


Figure 9 : Bluetooth Module output (Via UART)

The flow chart of the proposed automatic power factor Detection using Android application via Bluetooth module is shown in Fig 10.

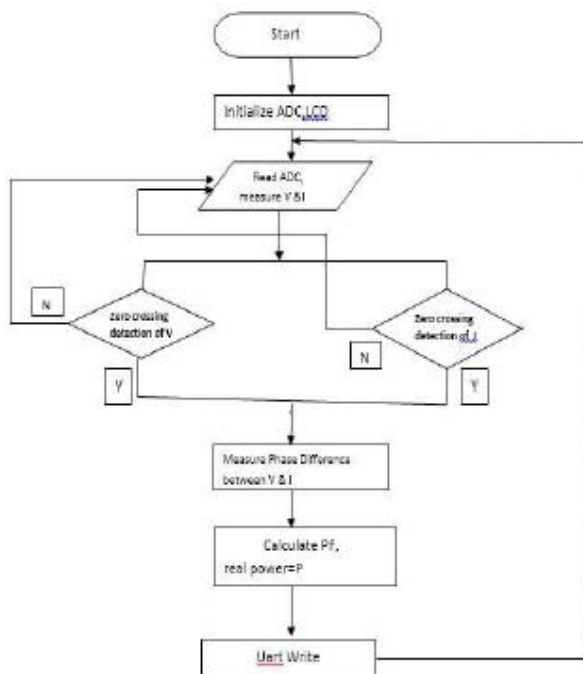


Figure 10 : Flow Chart of the Project

As can be seen from the flow chart, the sequence of operation depicted clearly. The process runs continuously in accordance with obtained logic. Vrms and Irms are read by the Microcontroller using ADC ports. After the zero crossing of voltage and current Signals, which are converted to square-waves, are provided to Microcontroller. Power Factor is measured by the Microcontroller from manipulating of capture module for V and I signals. After measuring the Power factor then microcontroller calculate the real power, reactive power, apparent power and value of capacitor. All the measured value are transmitted via UART.

V. HARDWARE IMPLEMENTATION

In reference to figure 1, the transmitting and receiving side can be described as follows:

a) Transmitting side

Heart of the project is the microcontroller ATMEGA 16. For measuring the line Voltage in this project we have used a step down transformer (220/12V) to converting the line voltage from 220V to 12V. Then, a bridge rectifier has been used to converting the 12 V ac to 12 V dc; after that, voltage divider have been applied to converts the 12 V to 5 V because the microcontroller works at maximum 5 V after that we connect it into a microcontroller pins. For current here we used a Hall Effect current sensor and connect the sensor output to another microcontroller pin. From this two pin the microcontroller measures the line voltage and current through ADC. For measuring zero crossing of voltage and current here we used a current transformer and potential transformer and the output ZCD are connected with microcontroller pins and microcontroller measures the phase angle between voltage and current. the Bluetooth module power is given from external power source (4V battery). Bluetooth module communicates with atmega16 through UART. RXD of Bluetooth module is connected with TXD of atmega16 and TXD of Bluetooth module is connected to RXD of atmega16.

b) Receiving side

In receiver Side an Android Phone is available which is connected with transmitting side via Bluetooth Module CI Android Apps [6]. The apps can communicate with Bluetooth Module HC-06. The password of the module is 1234. The communication protocol is UART and baud rate is 9600[4].

In view of the descriptions above, the implemented hardware can be found in figure 10.



Figure 11 : Implemented Hardware model

As viewed from figure 11, Automatic Power factor detection system to be found. In figure 12, the corresponding representation appears in the LCD display with the Voltage, Current, Power factor, real power, reactive power and the value of Capacitor. The view from Android Phone is also shown in figure 12.



Figure 12 : Android Phone output

VI. FUTURE PROSPECTS

In The view of a wide and short range of possibilities on the basis of Bluetooth based power factor Detection system, a few has been depicted below:

- Improvements to human-machine interface.
- Load controlling.
- Load status checking and fault detection.
- Capacitor Switching etc.

Also this project work has not been tested on synchronous motor because of the requirement of considerable expense. It needs the further enhancement of the system. Finance is a critical issue for further enhancement.

VII. CONCLUSION

This Project has proposed the advanced method of the power factor Detection by using the Atmega16 and Android application via Bluetooth module which has the many advantages over the various conventional methods of the Power factor compensation. The microcontroller always monitor power factor, voltage and current and it always send the current status of the load via Bluetooth module. This project gives more reliable and user friendly power factor detection. Thus we have presented the Possible advanced method for the detection of the power factor.

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