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AN EFFICIENT MONITORING OF SUBSTATIONS IN POWER TRANSMISSSION LINES USING ZIGBEE IN EMBEDDED SYSTEM

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ABSTRACT: This project proposes an innovative design to develop a system based on microcontroller that is used for monitoring power of a distribution transformer in a substation and to protect the system from the rise in above mentioned parameter. Protection to the distribution transformer from the main station is done with the aid of the ZIGBEE Communication. Moreover the system displays the same on a LCD at the main station that will lead to avoid the damage in substation.

The design generally consists of two units, one in the substation unit, called as transmitter unit, and another in the Main station called as controlling and receiver unit. The transmitter in the substation is where the power is monitored continuously by PIC microcontroller. A ZIGBEE is used for transmitting the signals that are obtained. The controlling unit in the main station receives the transmitted signals by means of ZIGBEE receiver and displays in LCD and LED and reacts in accordance to the received signal.

Keywords: PIC microcontroller, LCD, LED, ZIGBEE, Main-Substation.

I. INTRODUCTION

Electricity is a necessary and useful form of energy. It plays an ever growing role in our modern industrialized society. Maintenance of a transformer is one of the biggest problems in the Electricity Board (EB). The transformer may burn out due to the over load and short circuit in their winding. Power starts from the transmission grid at distribution substations where the voltage is stepped-down and carried by smaller distribution lines to supply commercial, residential, and industrial users.

Electric power systems can be divided into two stations, namely, Main station and Substation. Power to the substation is monitored using PIC Microcontroller and transmitted through ZIGBEE, then the main station receives the signal and compare with the reference voltage. Because of the microcontroller operation in the main station, if the increase in power rises higher than the desirable power, then that increased range is viewed by LCD and indicated using LED and BUZZER. And further damage can be avoided by shutting down the substation.

II. WORKING PRINCIPLE

The substation contains ZIGBEE transmitter and PIC microcontroller. The main station consists of PIC microcontroller, ZIGBEE receiver and LCD display. The power in the substation is continuously acquired by the PIC Microcontroller and transmits through the ZIGBEE transmitter to the main station. The ZIGBEE receiver in the mainstation receives the signal and compares it to the reference voltage. If the received signal is below the reference voltage it does not shows any variation or if it is above the reference voltage then that increased range is viewed by LCD and indicated using LED and further damage can be avoided by shutting down the substation using relay from the main station.

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III. HARDWARE DESCRIPTION

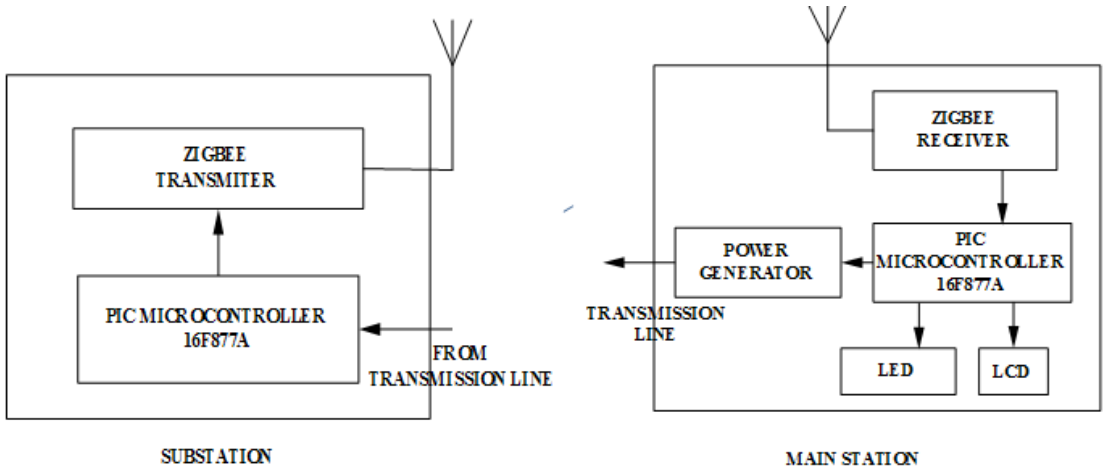

Figure.1 Block diagram

A. PIC MICROCONTROLLER: The controller PIC 16f877A is used in this project. It is 8-bit CMOS microcontroller with flash program it is RISC PROCESSOR with performance, fully static design it has 5 ports. Port A, Port B, Port C, Port D and Port E with 33 I/O lines. The Controller has 8kx14 words of flash memory, 368x8 bytes for data memory and 256x8 EPROM data memory. It is programmable code protection. The user code will be stored in the flash memory. The 5V supply is given to VDD and VSS of the controller. Microcontroller is used for monitoring power of a distribution transformer in a substation and to protect the system from the rise in that parameter.

B. ZIGBEE: ZIGBEE is based on an IEEE 802.15.4 personal area network. The technology defined by the ZIGBEE specification is intended to be simpler and less expensive than other WPANs, such as Bluetooth. ZIGBEE is targeted at Radio Frequency (RF) applications that require a low data rate, long battery life, and secure networking. ZIGBEE has a defined rate of 250 kbps. In substation unit the power is continuously monitored and it is transmitted through ZIGBEE transmitter and the transmitted signal is received by ZIGBEE receiver.

Figure.2 Zigbee module

C. TRANSMITTER SECTION: Each of the two transmitters is a CMOS inverter powered by + 10V internally generated supply. The input is TTL and CMOS compatible with a logic threshold of about 26% of Vcc. The input if an unused transmitter section can be left unconnected: an internal 400KΩ pull up resistor connected between the transistor input and Vcc will pull the input high forming the unused transistor output low. The open circuit output voltage swing is guaranteed to meet the RS232 specification + 5v output swing under the worst of both transmitters driving the 3KΩ. The slow rate at output is limited to less than 30V/μs and the powered done output impedance will be a minimum of

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300Ω with +2V applied to the output with Vcc =0V.The outputs are short circuit protected and can be short circuited to ground indefinitely.

D. RECIEVER SECTION: The two receivers fully conform to RS232 specifications. They're input impedance is between 3KΩ either with or without 5V power applied and their switching threshold is within the +3V of RS232 specification. To ensure compatibility with either RS232 IIP or TTl\CMOS input. The MAX232 receivers have VIL of 0.8V and VIH of 2.4V the receivers have 0.5V of hysteresis to improve noise rejection. The TTL\CMOS compatible output of receiver will be low whenever the RS232 input is greater than 2.4V. The receiver output will be high when input is floating or driven between +0.8V and –30V.

E. CIRCUIT DIAGRAM EXPLANATION: Figure.3 shows the circuit diagram. The reference voltage is fixed in the c program coding. A potentiometer is connected to the reference pin-2 in U2 PIC Microcontroller. The signal is transmitted from U2 controller TX pin-25 via ZIGBEE transmitter. The transmitted signal is received by ZIGBEE receiver and fed to U1 controller RX pin-26. The port C and port D is connected to LCD Display. The LED and Buzzer is connected to port B Pin 33 and 34.

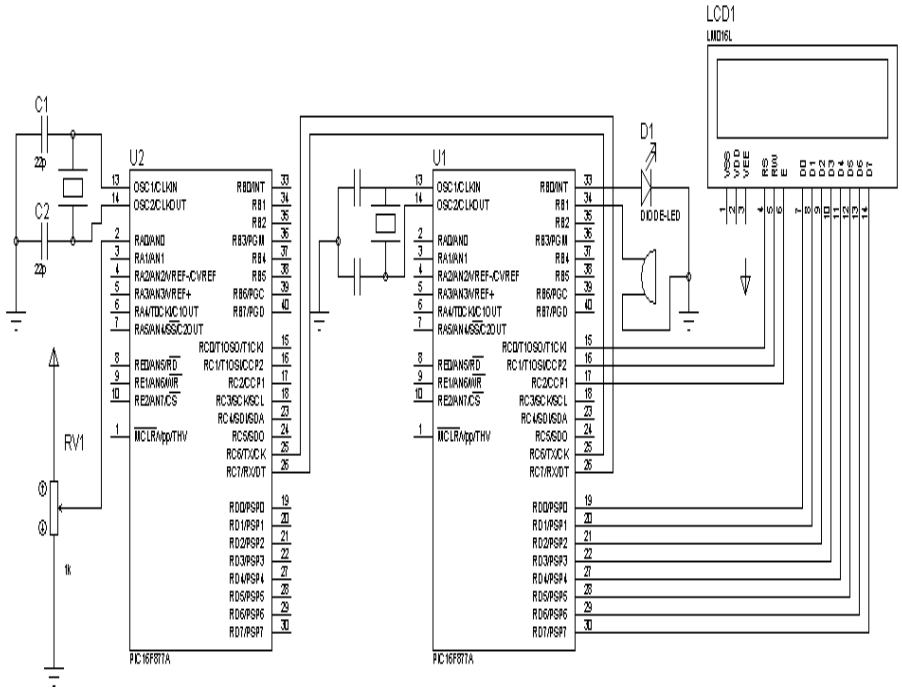

Figure.3 Circuit diagram

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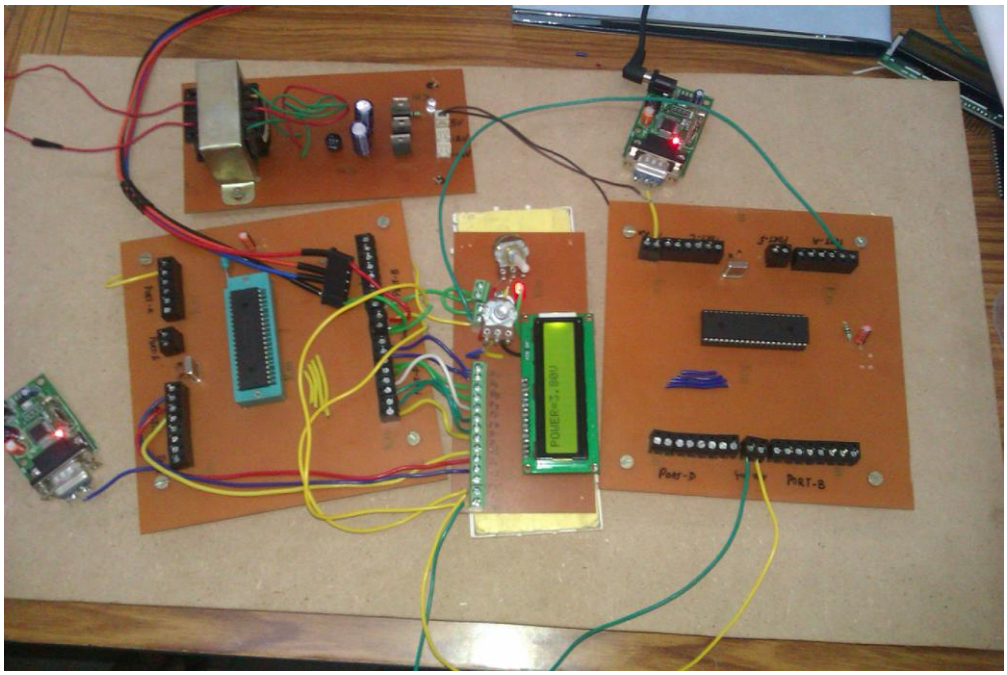

Figure.4 Final Hardware Arrangements

IV. SOFTWARE DESCRIPTION

A. MPLAB: MPLAB IDE is an integrated development environment that provides development engineers with the flexibility to develop and debug firmware for various Microchip devices. MPLAB IDE is a Windows-based Integrated Development Environment for the Microchip Technology Incorporated PIC microcontroller (MCU) and PIC digital signal controller (DSC) families. In the MPLAB IDE, you can:

- Create source code using the built-in editor.
- Assemble, compile and link source code using various language tools.

B. CCS C COMPILER: It offers the most optimized Microchip PIC MCU and dsPIC DSC C Compilers for Windows and Linux, and a powerful integrated development environment. Our compilers support the PIC10, PIC12, PIC14, PIC16, PIC18 microcontrollers and now support Microchip PIC24/dsPIC chips. The CCS C Compiler includes generous libraries of useful routines and ready-to-run example programs for hardware peripherals.
This compiler is used to compile the embedded c language program.

C. MPLAB SIMULATOR: PROTEUS is a discrete-event simulator for the running the hex code program. It's used to debug the software before going to hardware.

D. PCB DESIGN: PAD 2 PAD is used to prepare the PCB schematic. Tracks are made in insulating base. PCB's are used to route electrical signal through copper. The performance of an electronic circuit depends up on the layout and design of PCB.

E. PCB PREPARATION: Layout is printed on a butter paper. It is screen printed on copper clad, etched by using ferric chloride solution, drilled using PCB driller, cut the unwanted materials and soldered the components.

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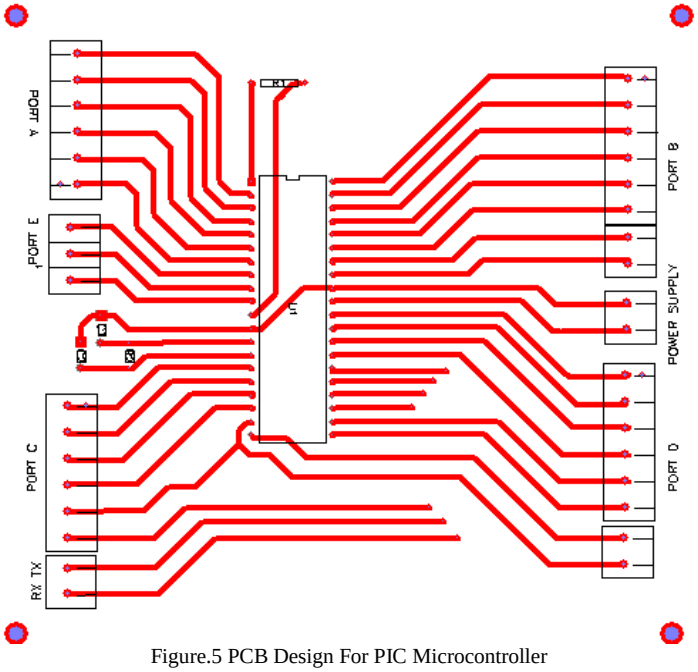

Figure.5 PCB Design For PIC Microcontroller

V. CONCLUSION

This design based on PIC microcontroller is used to monitor and control the power in the distribution transformer continuously throughout its operation. If the microcontroller recognizes any increase in the level of desired value, then the unit has been made shut down in order to prevent it from further damages and also indicates the values throughout the process in LED and Buzzer and displays the value in LCD. Hence the distribution is made more secure, reliable and efficient by means of the proposed system.

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