

The Real Time Hardware Design to Automatically Monitor and Control Light and Temperature

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Abstract: A smart, integrated temperature and light controlling and monitoring system has been implemented with the use of open standard technology, commercial and household items which actively monitor the environmental conditions. A main target for this system is to have it designed and implemented as cost efficient as possible. The system allows for a user to input the desired conditions regarding the surrounding atmosphere's temperature and lighting requirements. This paper incorporates design and development of temperature & light monitoring and controlling system. The project consists of two modules. One is the parameter monitoring and the other one is the parameter controlling. Monitoring and controlling physical parameters like temperature and light are of outmost importance. A temperature sensor LM35 will be used for the purpose of measuring temperature and a LDR will be used for measuring light intensity. A microcontroller then compares the environmental conditions against the user's input requirements, and actuators change the settings until the desired conditions have been obtained. The controller is responsible for sensing from ADC, detection and polling of the peripherals status. A display unit will show the values of parameters like Temperature and Light. This will be helpful for the person to know the values, for this purpose use various sensors will be used, which will be connected to ADC. The device can be used for various purposes like weather forecast, industrial monitoring and green house monitoring etc.

Keywords: Microcontroller, Sensor, ADC, LDR, LM35

I. INTRODUCTION

The proposed temperature and lighting monitoring and control system is an integrated device that is intended to allow users to input specific requirements for a environment .It is very much essential in case of some industrial as well as experimental setup to monitor as well as control temperature and light continuously. Monitoring and controlling physical parameters by embedded systems using microcontrollers are very much effective in industrial and research oriented requirements. The purpose of this project is to explore the possibility to continuously monitor temperature & light intensity. This Project consists of temperature & light monitoring and controlling. This unit or system can be installed in a room or in any industry where we need to monitor and control light and temperature. This project consists of two basic modules. First is "Parameters monitoring" second is "Parameters controlling". In the first module, various sensors are used to acquire the atmospheric data or the values of light and temperature, which are connected to ADC and microcontroller. For this project work only two types of sensors are used. One is the temperature sensor and the other on is the light sensor. The other module is named as parameter controlling. It can be used to control the values of temperature. Four relays are used for this purpose. Two relays are connected to a Fan or Heater and another two are connected to Lighting device. The display in LCD is programmed in such a fashion so that temperature value and light intensity are displayed one by one at a fix interval of time. System is also equipped with necessary hardware to initiate control action for temperature & light intensity as soon as they reach higher than some particular set values. Temperature and lightning control is a process to maintain the temperature and light at certain level. Automatic temperature and lightning control referred as the best method in any application by controlling the temperature and light automatically. The result obtain from the project shows that the temperature and lightning are controlled effectively and more accurately. In addition, this finding makes human works become easy and system that automatically controls and functions will be developed.

II. HARDWARE DEVELOPMENT

- A. **Power supply modules**-This module is basically designed to achieved 5V, 500mA.This consists of a transformer which is used to step down the AC voltage, IN4007 diodes used to form a bridge rectifier to convert AC to DC, capacitor 1000uF which used as a filter circuit, 7805 regulator to obtain a 5V at the output of the regulator, 330 ohm resistance, LED as indicator.

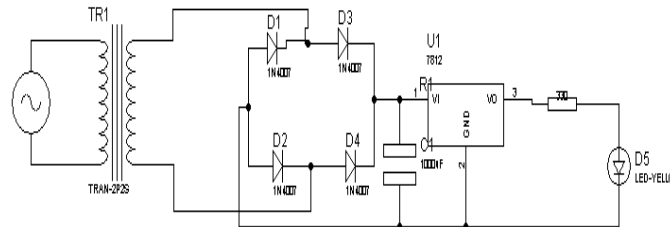


Fig 1: Diagram of power supply section

- B. **PIC Microcontroller**- The PIC microcontroller was originally designed around 1980 by General Instrument as a small, fast, inexpensive embedded microcontroller with strong I/O capabilities.. PIC stands for "Peripheral Interface Controller". General Instrument recognized the potential for the PIC and eventually spun off Microchip, headquartered in Chandler, AZ to fabricate and market the PIC microcontroller .A microcontroller is an integrated chip that is often part of an embedded system. The microcontroller includes a CPU, RAM, ROM, I/O ports, and timers like a standard computer, but because they are designed to execute only a single specific task to control a single system, they are much smaller and simplified so that they can include all the functions required on a single chip.PIC 16F877 is one of the most advanced microcontroller from Microchip. This controller is widely used for experimental and modern applications because of its low price, wide range of applications, high quality, and ease of availability.
- C. **Analog to digital conversion section**- Since we have to sense analog parameters i.e. temperature and light hence we have to use any analog to digital converter. We have opted for ADC 0809 as it has 8 channels and is microprocessor compatible ADC which is easily available. It will convert the analog signal of the transducer to digital value with respect to the reference voltage which in our case is 2.5V. This reference voltage is obtained using TL431, which is a programmable shunt voltage reference with output voltage range of 2.5V to 36V and works like zener diode. For the conversion ADC requires a reference frequency which is supplied from 555 IC in the form of astable oscillator. The conversion frequency is kept around 150 kHz. Sensor used for temperature measurement is LM 35 and for light intensity is LDR. LM 35 is calibrated in °C and is linear in +10 mV/ °C scale factor with 0.5°C accuracy . The calibration curve given here with will make the scenario clear.
- D. **LCD Display** - LCD technology has advanced very rapidly since its initial inception over a decade ago for use in lap top computers. Technical achievements has resulted in brighter displace, higher resolutions, reduce response times and cheaper manufacturing process. The liquid crystals can be manipulated through an applied electric voltage so that light is allowed to pass or is blocked. By carefully controlling where and what wavelength (color) of light is allowed to pass, the LCD monitor is able to display images. A backlight provides LCD monitor's brightness. Over the years many improvements have been made to LCD to help enhance resolution, image, sharpness and response times. One of the latest such advancement is applied to glass during acts as switch allowing control of light at the pixel level, greatly improving LCD's ability to display small-sized fonts and image clearly. Most of the LCD modules conform to a standard interface specification. A 14-pin access is provided having eight data lines, three control lines and three power lines

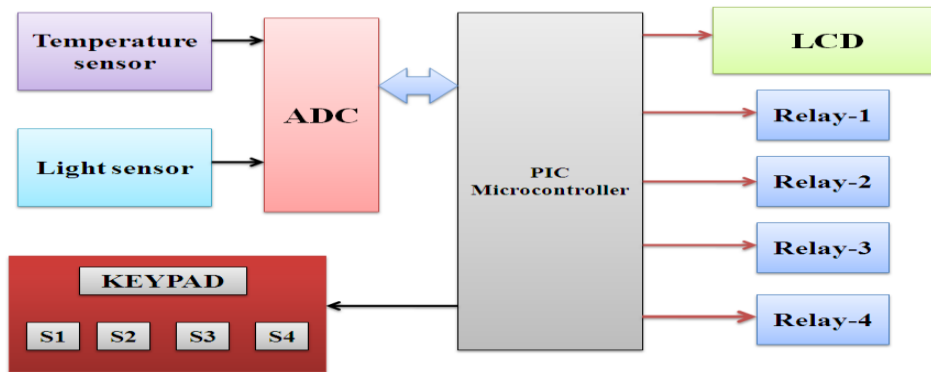


Fig 2 Block diagram of the system

E. **Temperature Sensor** - A temperature sensor is a device that gathers data concerning the temperature from a source and converts it to a form that can be understood either by an observer or another device. Temperature sensors come in many different forms and are used for a wide variety of purposes, from simple home use to extremely accurate and precise scientific use. The LM35 thus has an advantage over linear temperature sensors calibrated in° Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Centigrade scaling. It also does not require any additional calibration or trimming in order to get typical accuracy. Low cost is assured by trimming and Calibration at the wafer level. The LM35's low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy. It can be used with single power supplies, or with plus and minus supplies. As it draws only 60µA from its supply, it has very low self-heating, less than 0.1°C in still air. The LM35 is rated to operate over a -55°to+150°C temperature range, while the LM35C is rated for a -40°to+110°C range(-10° with improved accuracy).

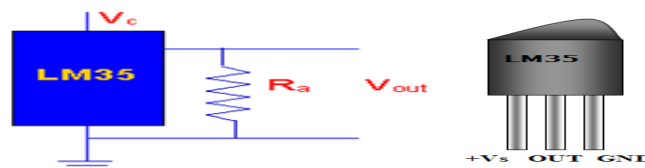


Fig 3: Temperature Sensor (LM35)

F. **Light Sensor**- A light sensor, as its name suggests, is a device that is used to detect light. There are many different types of light sensors, each of which works in a slightly different way. LDRs or Light Dependent Resistors are very useful especially in light/dark sensor circuits. Normally the resistance of an LDR is very high, sometimes as high as 1000 000 ohms, but when they are illuminated with light resistance drops dramatically. LDR are made by depositing a film of cadmium sulphide or cadmium selenide on a substrate of ceramic containing no or very few free electrons when not illuminated. The film is deposited in a zigzag fashion in the form of a strip. The longer is the strip the more the value of resistance. When light falls on the strip, the resistance decreases. In the absence of light the resistance can be in the order of 10K ohm to 15K ohm and is called the dark resistance.



Fig 4: Light Dependent Resistor (LDR)

III. SYSTEM PIN DIAGRAM

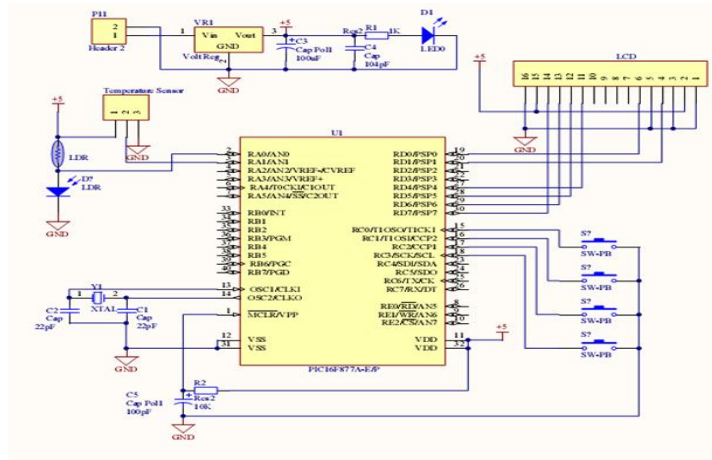


Fig 5: Schematic Pin Diagram of the system

IV. SOFTWARE DEVELOPMENT

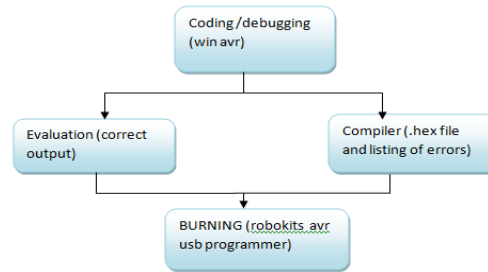


Fig 6: Steps for software development

1. Coding / Debugging-Coding or debugging is one in a high-level language (such as c or java). Compiler for a high level language helps to reduce production time. To program the microcontrollers WinAVR was used using C language. The source code has been commented to facilitate any occasional future improvement and maintenance. It includes the GNU GCC compiler for C and C++. WinAVR contains all the tools for developing on the AVR. This includes AVR-gcc (compiler), AVR-gdb (debugger) etc.

2. Compiling- After compiling the program, it is converted to machine level language in the form of o's and l's. This file is called as the Hex file and is saved with the extension (.Hex). The compiler also generates errors in the program which should be removed for proper execution of the program.

3. Burning-Burning the machine language (hex) file into the microcontroller's program memory is achieved with a dedicated programmer, which attaches to a PC's peripheral. PC's serial port has been used for the purpose. For this purpose Ponyprog programmer was used to burn the machine language file into the microcontroller's program memory. Ponyprog is serial device programmer software with a user-friendly GUI framework available for Windows95/98/ME/NT/2000/XP and Intel Linux. Its purpose is reading and writing every serial device. It supports I²C Bus, Micro wire, SPI EEPROM, and the Atmel AVR and Microchip PIC microcontroller. The microcontrollers were programmed in approximately two seconds with a high speed-programming mode. The program memory, which is of Flash type, has, just like the EEPROM, a limited lifespan.

4. Evaluation-If the system performs as desired by the user and performs all the tasks efficiently and effectively the software development phase is over and the project is ready to be installed in any of the industrial sites as a personal area network. If not, the entire process is repeated again to rectify the errors. One of the difficulties of programming microcontrollers is the limited amount of resources the programmer has to deal with. In PCs resources such as RAM and processing speed are basically limitless when compared to microcontrollers. In contrast to a PC, the code on

microcontrollers should be as low on resources as possible, but being cost effective and power efficient makes it a better option.

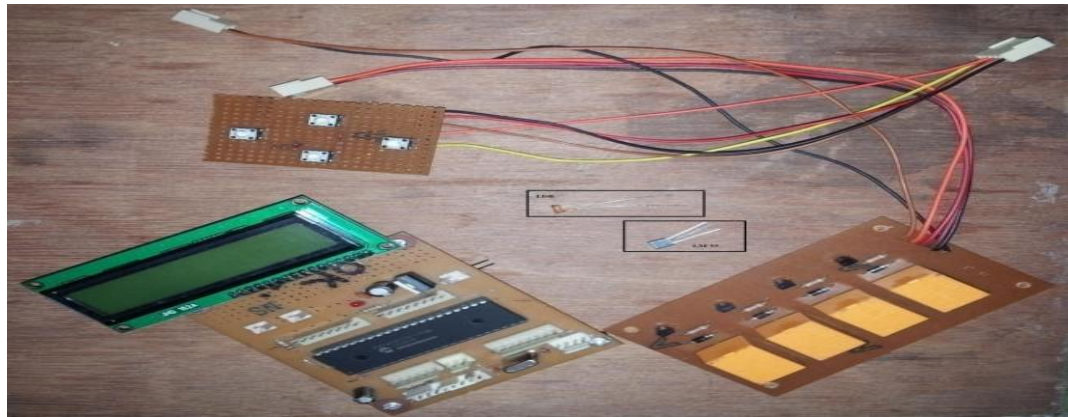


Fig 7: Hardware components connection

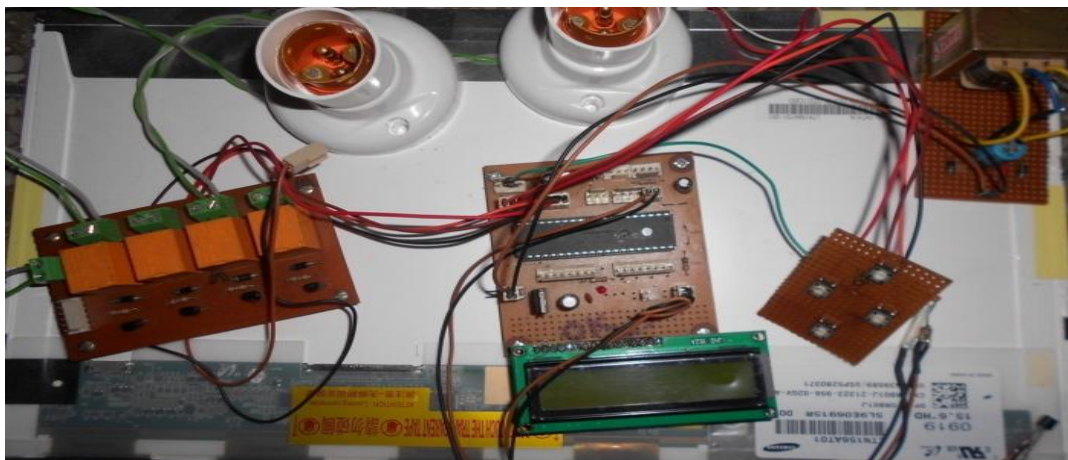


Fig 8: View of Complete Hardware System

V. TEMPERATURE VALUES

1. Temperature When the User Inputs 25°C

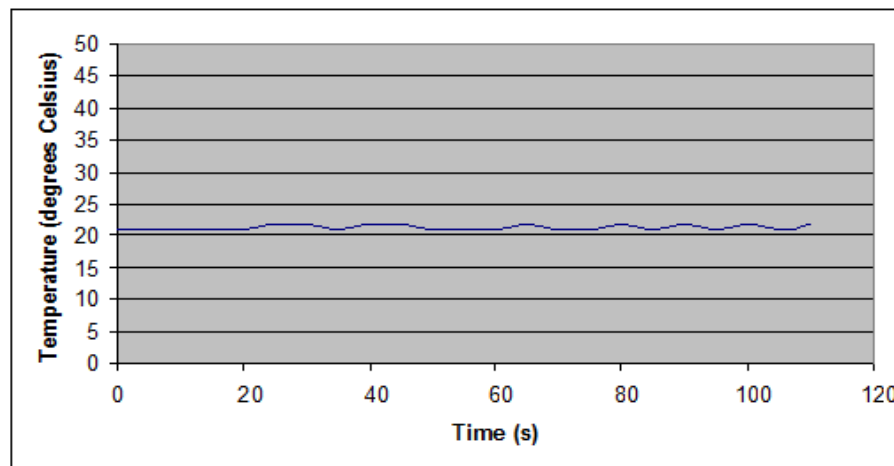


Fig 9: Temperature Sensor Placed at the Other End of the Room when the User input is 25°C

2. Temperature sensor is placed at approximately the centre of the room

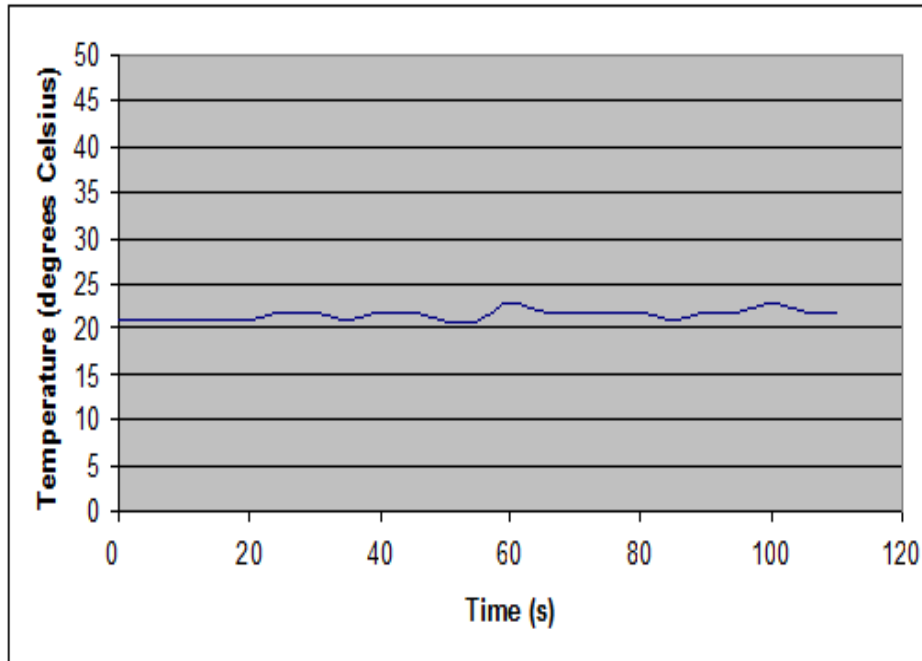


Fig 10: Sensor Placed at the Centre of the Room with the User Input of 25°C

VI. CONCLUSION

In this Paper temperature and light intensity monitoring and control is done with the help of two sensors. One is the temperature sensor and the other one is the light sensor. The temperature and light intensities are displayed on the LCD screen and also we can set the desired values of light and temperature with the help of provided keypad. The entire decision making is done with a help of a microcontroller. This type of system can be installed in any place where we need to maintain light and temperature intensities approximately constant. Another objective of the project work is to conserve energy by using only the necessary amount of energy. The system can be further enhanced by developing necessary software for offline analysis. Also if we employ some more sensors like barometer and humidity sensor then the measurements of temperature, atmospheric pressure, light intensity and relative humidity remotely are not only important in environmental or weather monitoring but also crucial for many industrial processes. The system has various advantages over other similar systems as it is relatively cheap, smaller size, on-device display, less complexity and greater portability.

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