Wireless Temperature Controlling and Monitoring System using ARM and XBee

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ABSTRACT

In this paper we have implemented ARM based temperature controlling and monitoring system using LPC2148 kit and temperature sensor LM35. The designing system can be used to measure the room temperature value. Depending on the threshold value of temperature (set manually) the LPC2148 will turn ON/OFF the fan. This system is used to control the temperature and also display the same on LCD screen. The system acquires the temperature from the sensor (LM35) and if it is greater than threshold value fan will be turned ON automatically .As soon as the temperature lowers than the set value the fan will be turned OFF accordingly. The System is fully controlled by ARM7 LPC2148.For wireless controlling the temperature we will use pair of XBee one at the sensor end and other at the user end. The current temperature will be continuously displayed on users PC screen and user will be able to change the threshold value for control purpose using serial communication.

Key words: LPC2148, ARM, Temperature Sensor, XBee, LM35.

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INTRODUCTION

In temperature sensitive systems, controlling the temperature is a vital task. It requires special arrangement for temperature controlling and monitoring task. In this paper we have proposed a system that can not only control and monitor temperature of the temperature sensitive systems but also can do the same wirelessly. The proposed paper maintains the temperature of the system as per the requirement. The design is associated with the combination of the software and the hardware support. The proposed system consist of Temperature Sensor, ARM7 controller, 16x2 LCD Module, XBee, temperature lowering unit, temperature increasing unit. Upon sensing the temperature the ARM7 will convert that analog input into digital form and will display it on the LCD module and simultaneously will serially communicate it wirelessly using XBee. Using this method we can remotely monitor the temperature within the range of the XBee module effortlessly.

MATERIALS AND METHODS

A. Components Required

1. Temperature Sensor-

LM35 is a kind of precision temperature sensor used for sensing temperature. It provides analog output voltage proportional to the Celsius temperature. Thus we get temperature directly in Celsius and it saves calculation for conversion into Kelvin. The accuracy for LM35 at room temperature is as good as ±¼°C and over its range i.e. -55 to +150°C its accuracy is ±¾°C. It is one of the apt sensors for remote applications. It can withstand harsh environmental conditions. Below table shows Temperature Vs Vout for LM35.

Table1.Temperature Vs Vout for LM35

Temperature	*Voltage (mV)*
20	200
22	220
24	240
26	260
28	280
30	300
32	320
34	340
36	360
38	380
40	400
42	420
44	440
46	460
48	480
50	500

2. Relay-

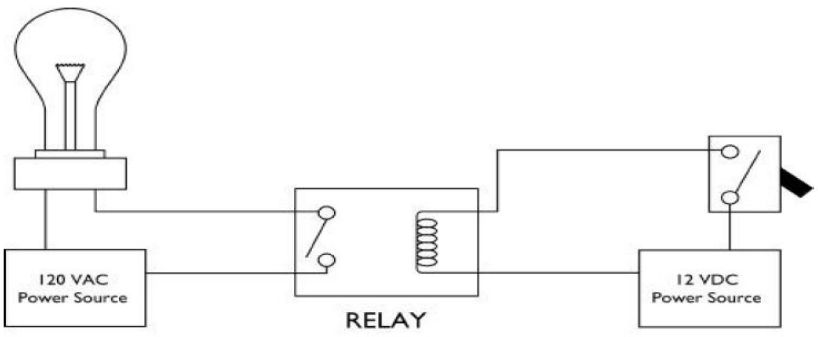


Fig 1: Schematic for working of a Relay

Relay acts as a switch which is electrically operated. The magnetic field is created by the current running in the coil and this current attracts the lever to change the switch position. The relay can have two conditions either ON or OFF depending on the current in the coil. Relay can be single pole double throw and double pole double throw switches. If there are two different circuits then relay can be used to switch second circuit which has nothing to do with first circuit. For instance battery circuit with a low voltage can utilize relay to switch a 230VAC mains circuit.

3. ARM Processor (LPC2148)-

LPC2148 is an ARM7TDMI-S based processor. It was founded by NXP semiconductors. It is a high performance 32-bit RISC machine. It has 512kb on chip flash ROM with In-system programming, In-application programming functions available. Its RAM is of size 32kb. It is an 64 pin IC with 47 GPIO lines. For our system we will require its serial communication ability and analog to digital conversion capability. The additional advantage of LPC2148 is that it has two 10-bit ADC's hence no signal conditioning required for LM35 output. LPC2148 has 12 MHz on chip crystal oscillator which can be extended up to 60Mhz by using Phase Lock Loop (PLL).

4. XBee Module-

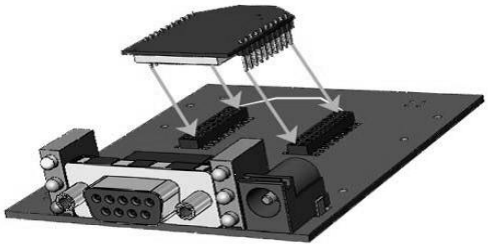


Fig 2: XBee module

The XBee radio frequency Modules are built to meet IEEE 802.15.4 standards and has the unique advantage which offers less cost, less power wireless sensor networks. The XBee operates at minimum power and provides reliable data delivery between source and destination. ISM 2.4 GHz frequency band is the operating band for XBee modules. The range of XBee for indoor in urban areas is between 30m to 100m and for outdoor areas (Line of Sight), the range increases up to 100m to 1500m. XBee makes use of direct sequence spread spectrum (DSSS) technology and each DSSS sequence channels contains different network addresses.

Fig 3: XBee RF unit used in system

B. Methodology

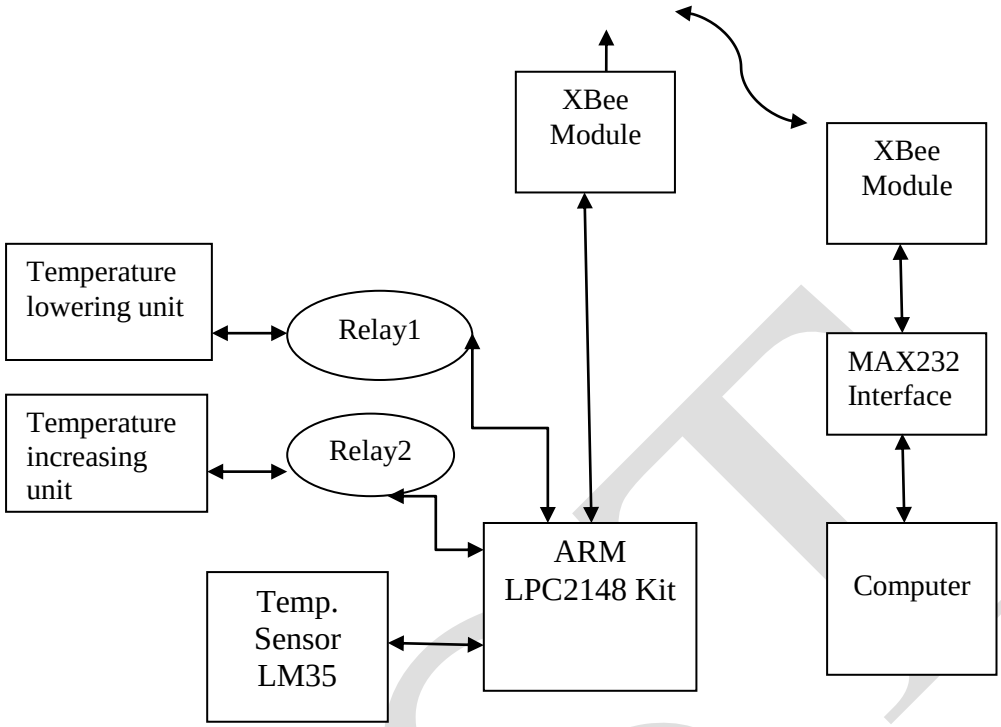
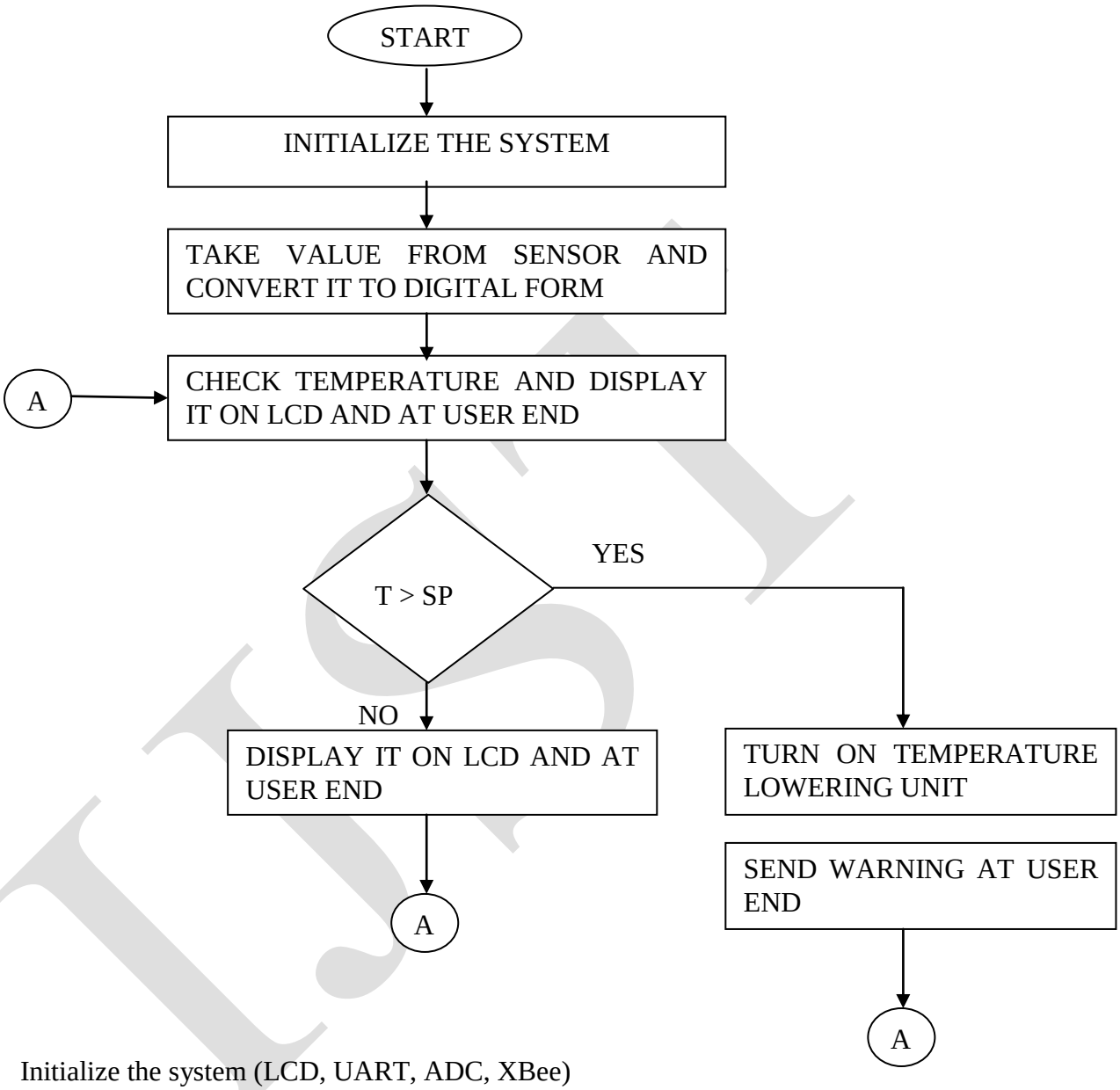


Fig 4: Block Diagram

Initially, LM35 temperature sensor interfaced with LPC2148 will sense the current temperature of the surroundings and will provide analog output which will be input of the ADC pin of the LPC2148. As processor is having two adc units any one of them can be used for analog to digital conversion. Here, we have selected AD0.1 channel hence we have applied LM35 output to AD0.28 pin of LPC2148.Alongwith temperature sensor, another two units are interfaced with ARM and those are XBee module and 16x2 Liquid Crystal Display.

After Analog to Digital conversion, the temperature value will be displayed on LCD screen and simultaneously it will be sent to users pc by making use of pair of XBee modules communicating with each other serially. Using this system, user will be able to set threshold value for temperature dynamically according to applications requirement. If temperature value exceeds threshold value the processor will turn ON temperature lowering unit and simultanously will send the warning at the user end. And if temperature plumets below threshold value the processor will turn OFF temperature lowering unit and will turn ON temperature increasing unit and in this way temperature will be maintained.

FLOWCHART



1. Initialize the system (LCD, UART, ADC, XBee)
2. Get the analog reading from the sensor LM35.
3. Convert analog value into digital form using ADC function of ARM processor.
4. Check the temperature and display it on the LCD and simultaneously at the user end.
5. If temperature (T) is greater than threshold value (SP) turn on the temperature lowering unit and send warning to the user.
6. If T<SP then continue as it is and keep on checking the temperature and displaying continuously on LCD and user's PC.
7. Using Xbee user can change the threshold value.

EXPERIMENTAL RESULTS

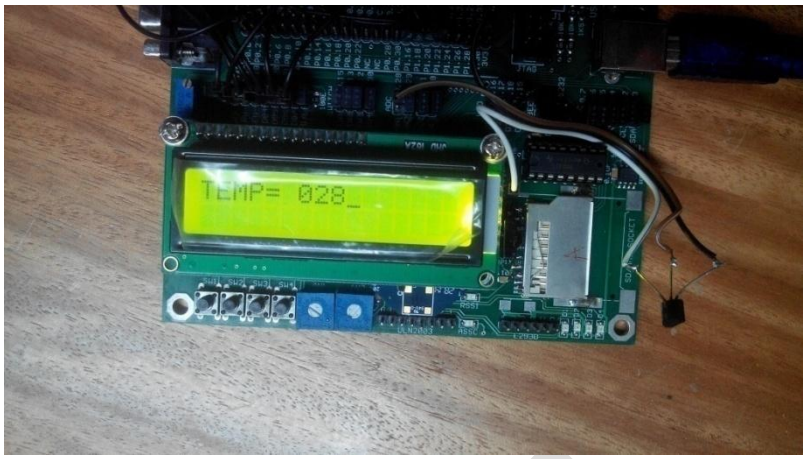


Fig 5: Displaying current temperature at processor end

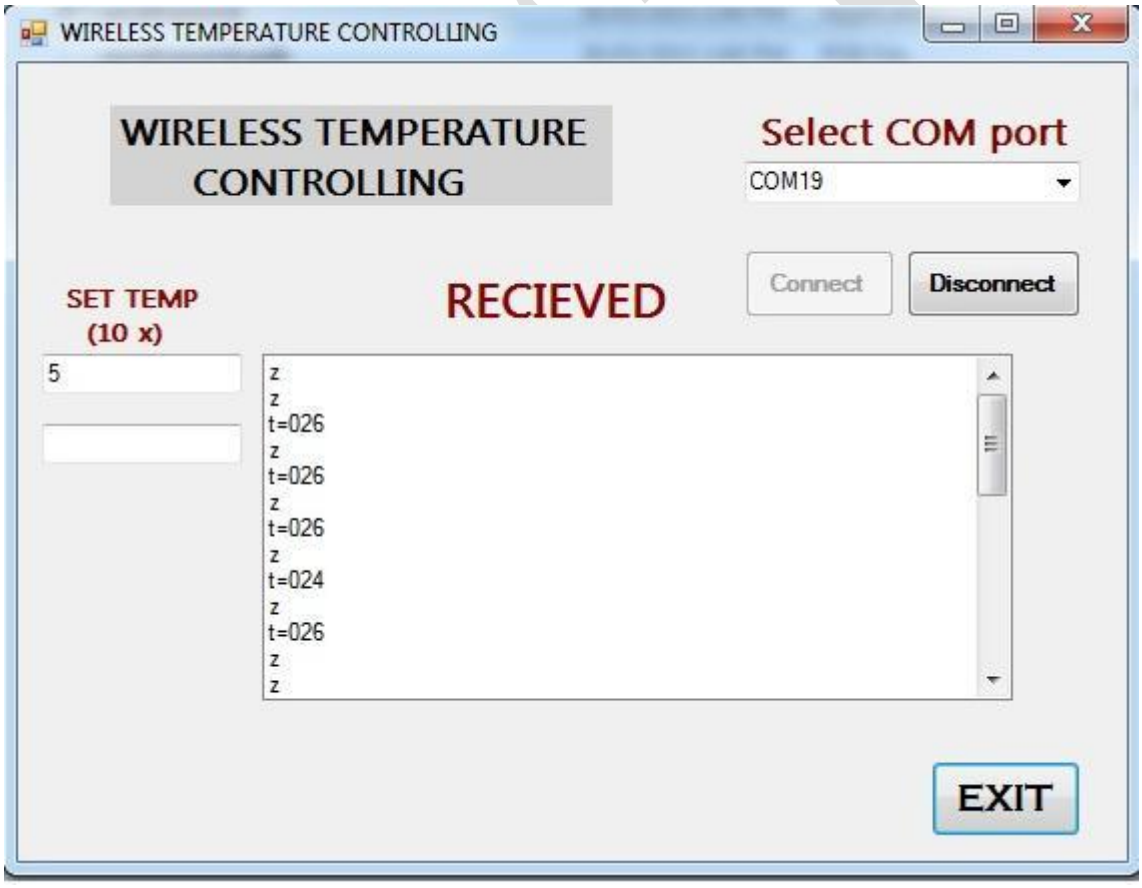


Fig 6: Displaying current temperature at user end

Above figure 5 shows the current temperature displayed at users end. The layout is achieved by using microsoft visual basic studio. The visual basic provides the graphical user interface to design and develop various softwares. After selecting COM port to which XBee is connected and as soon as we click on connect XBee at user end will start communicating with XBee at processors end. User can change the threshold value using the set temp box.

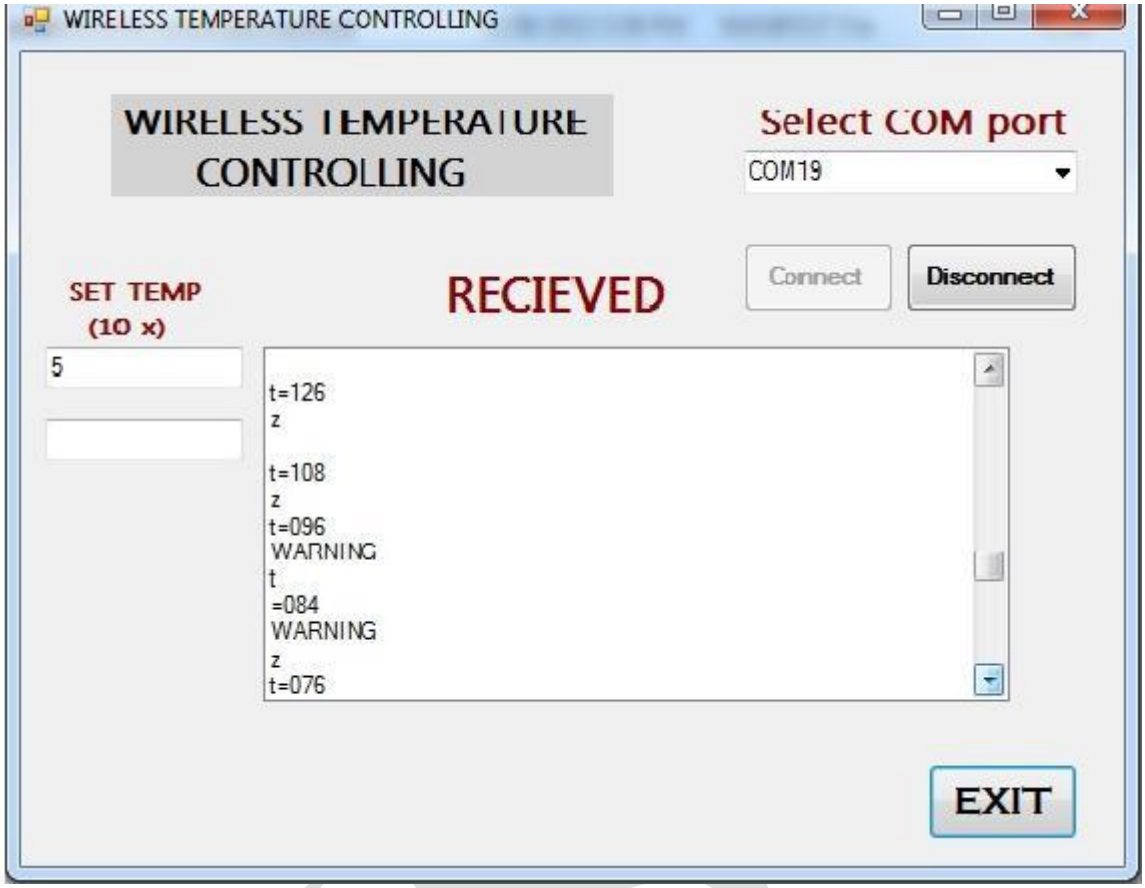


Fig 7: Warning message for user when temperature exceeds threshold

CONCLUSION

The core intension of this paper is to control and monitor temperature sensitive system. This is accomplished using LPC2148 and XBee module. Our system will be helpful to reduce manpower and to increase work efficiency by protecting temperature sensitive system from overheating and under heating. This system can be used for critical industrial application such as detecting and controlling temperature of Blast furnace and boiler and providing this information to the control room by buzzer, alarm or some other effective way. This system can be used to control and monitor the room temperature wirelessly within the radius of the XBee.

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