

Digital Wireless Thermometer Using Universal Asynchronous Receiver Transmitter

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Abstract: The main objective of this project is to develop an embedded system, which can be used for sensing the room temperature or the temperature of the surroundings. This system is based on the UART technology. With the advancement in the digital era, everything is going to be digital and hence the idea to get the ambient temperature directly on the android screen is proposed in this project. It can have many applications to the scientists where every temperature change matters. By introducing this we can display the temperature directly on our mobile screens. The proposed system can eradicate the chances of fire in workstations and the action can be taken immediately in such severe conditions.

Keywords: Android with Bluetooth, UART (universal asynchronous receiver transmitter), Android phone, MCU (Microcontroller unit), Embedded C, PU (Processing unit), Hex file, Sensor (LM35), LED (Light Emitting Diode).

I. INTRODUCTION

This project has an immense application in research laboratories or in places where a little change in temperature matters. By just one click one will be able to know the temperature in the other room or outside the lab. Using the UART Technology one can easily able to get the temperature conditions at one place easily. The decentralized architecture of the wireless sensor network and its flexibility of deployment make wireless networks most suitable for various process plants, industries and remote & rural communication. In this work, applications of wireless sensor network is carried out on online measurement and monitoring of reaction chamber, furnace etc, which is to be measured in the industries [13].

While working on long term experiments which are specially related to conduction, convection and radiation concepts, the temperature conditions must be focused on. The proposed device can be used for the ease of the researchers for keeping an eye at the temperature conditions. This project uses AVR microcontroller. A Bluetooth device HC05 is interfaced to the microcontroller using UART communication protocol. Once the user connects Android application device to this system using Bluetooth, the current temperature can be sent using Android app based GUI and at receiving end, this code from Bluetooth device is transferred to the microcontroller. This command is further transferred to the ADC unit which records the temperature.

Embedded AD/DA converters, better support for communication protocols and more flexible programming have proved to be more efficient in many cases of real applications comparing to even a small PLC controllers. LM35 is the temperature sensor and can be used to monitor the room temperature to prevent severe fire conditions.

Temperature is measured with a precision IC linear temperature sensor (LM35D) and time is counted using the MCU's timer circuits [6]. As soon as the command is received, temperature is recorded and further transferred to mobile phone via UART. The main controlling device of the whole system is MCU, Bluetooth module (HC05) and LM35, ADC. The temperature sensor acquires the temperature of the system. In the proposed system we use the temperature sensor LM35. The analog output of temperature which is in analog form is converted into digital form with ADC [14]. So, this technology can help to keep a look upon the various temperature based experiments. In a work by Raza (2010), a microcontroller based system for data acquisition and logging as needed was designed. The device could be used for monitoring and controlling environment temperature [8].

II. DESCRIPTION OF HARDWARE

MCU is a device which integrates a number of the components of a microprocessor system on a single chip. The MCU used in our project is ATmega16. It has inbuilt processing unit, memory, ADC and peripheral to make it as a mini computer. UART of MCU is used to interface Bluetooth module (HC-05) for serial communication. LCD is interfaced to MCU which is used to display the temperature on the spot. MCU is connected to the temperature sensor LM35 which is used to sense the temperature. LM35 is connected to the ADC channel 0 of the MCU; this gives the temperature to the MCU for the further processing [1].

An LM35 temperature sensor mounted on the bread board is used for monitoring room temperature. The advantage of this sensor has more memory, processing and communication capabilities than other sensor nodes. The LM35 series are precision integrated – circuit temperature sensors, whose

output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 thus has an advantage over linear temperature sensors calibrated in 0 Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Centigrade scaling. The LM35 does not require any external calibration or trimming to provide typical accuracies of $\pm 1/40^\circ\text{C}$ at room temperature and $\pm 8/40^\circ\text{C}$ over a full -55 to $+150^\circ\text{C}$ temperature range. 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 $60\mu\text{A}$ from its supply, it has very low self-heating, less than 0.10 in still air. The LM35 is rated to operate over a -55 to $+1500$ temperature range [3].

Formula used for Voltage to Temperature Conversion is as follows,

$$V = \frac{5.00 \times (D+1)}{1024} \quad (1)$$

$$T = 100 \times V \quad (2)$$

HC-05 Bluetooth module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial communication to connect to any other Bluetooth device with SPP (Serial Port Profile), such as mobile phone and laptops. Serial Port Bluetooth module is fully qualified Bluetooth v2.0+EDR (Enhanced data rate) 3Mbps modulation with complete 2.4 GHz radio Transceiver and baseband. A HC-05 module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. Serial port Bluetooth module is fully qualified Bluetooth V2.0+EDR (Enhanced Data Rate) 3Mbps Modulation with complete 2.4GHz radio transceiver and baseband. It uses CSR Blue core 04-External single chip Bluetooth system with CMOS technology and with AFH (Adaptive Frequency Hopping Feature) [4].

III. DESCRIPTION OF SOFTWARE

The Proteus Design Suite is an Electronic Design Automation (EDA) tool including schematic capture, simulation and PCB Layout modules. The micro-controller simulation in Proteus works by applying either a hex file or a debug file to the microcontroller part on the schematic. It is then co-simulated along with any analog & digital electronics connected to it. This enables it's used in a broad spectrum of project prototyping in areas such as motor control, temperature control and user interface design [5].

Code vision AVR compiler is a C cross-compiler, Integrated Development Environment (IDE) and Automatic Program Generator designed for Atmel microcontroller series made AVR. C cross-compiler is able to translate almost all orders of ANSI C language, to the extent permitted by the architecture of the AVR, with the addition of some special features to take advantage of

the AVR architecture and the needs of the embedded system [7].

Khazama software is used to burn the hex file to the microcontroller. From the latest version you can override chip signature check (for example for ATmega48 and ATmega48PA chip signatures are different but with overriding sign check you can program this chips truly). You can change programming clock speed too [10].

IV. ADVANTAGES

There are number of advantages for the proposed system like it is wireless hence the temperature can be sensed at distance. It is cost effective. It is accurate and easy to implement. The main advantage if the proposed system is that it fastens the processing of data.

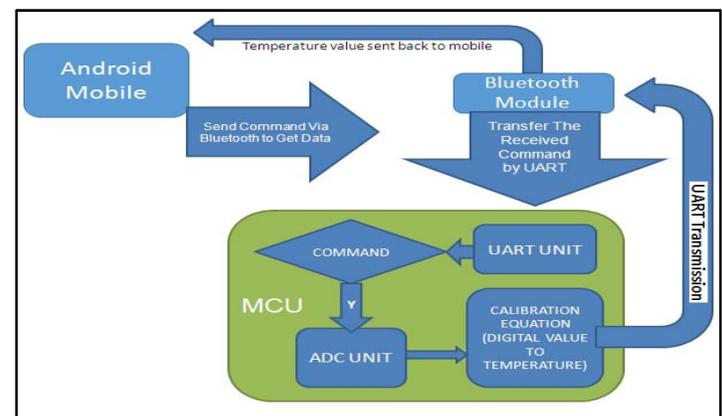


Fig. 1: Flow Chart of the Proposed System

V. WORKING

This system is designed as such to display the temperature of the ambient on LCD screen as well as this system can also be used to sense the temperature of the ambient through an android phone with a suitable application. The MCU has an inbuilt ADC which is controlled by the commands. The LM35 which is the temperature sensor senses the temperature of the ambient and displays it on the android phone continuously.

Here, the calibration of the temperature is done by converting the digital value calculated by the LM35 into temperature. The system is also connected the Bluetooth module which acts as UART. The calculated temperature is transmitted through UART transmission using HC05 module.

The HC-05 receives the requested data and after entering the command it sends back the ambient temperature to the android mobile as the acknowledgment of the request that has been received. The data is transmitted in no time. This reduces the time of transmission hence prevent the chances of fire accident.

VI. CONCLUSION

The proposed system can be used to sense the ambient temperature using LM35 which can be displayed on the android phone using UART. This can be very useful in the labs and the research centres. It can be used to sense the temperature in very less time without actually visiting the place for which we need to sense temperature at respective time intervals.

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