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Challenges & Opportunities Before Indian Business Environment

Development of Wireless Sensor Network (WSN) for Monitoring of Humidity and Temperature using Bluetooth and Android

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ABSTRACT

Wireless sensors or networks got much attraction in order to system monitoring, actuation, automation and control applications. It reduces the cost and complexities associated with wired network systems. At present time, temperature and humidity are the important physical parameters to be monitored on various places such as in hospitals, warehouses, research laboratories, etc. Present work describes the development of a system for monitoring purpose based on Bluetooth and RS232 protocol. The embedded system is designed on ATmega2560 based Arduino Mega Board. The Physical parameters are monitored wirelessly with the help of Android application which has been developed for the same work

Keywords:

Arduino

Bluetooth

Humidity

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1. Introduction

WSN is defined as an assembly of nodes organized into a cooperative network [11]. WSN is said to bring new dimension in remote monitoring and data gathering fields.

Temperature and humidity monitoring is very much essential at several places like hospital, fabrication laboratories, cold stores and in weather prediction. Temperature affects the survival of virus, under the range 20.5°C to less than 30°C temperature along with humidity range 23% RH to 81% RH progressively decreases the survival of viruses for example: at mid-range of temperature 21°C and humidity 40% to 60% RH influenza survival is lowest [4].

In real product designing, humidity and temperature are the most recognized physical parameters which has to be controlled. This device prototype is useful to ensure safe environment, to reduce production losses and monitor certain environmental condition in which production activities are carried out is very vital within industries in the present age [2].

In industrial production and daily life, there is need of knowing the temperature and humidity. For this purpose, we need to access particular device for this reason. In present work, we have reduced this effort by making a system along with an android application for monitoring humidity and temperature data. Android application is used for the purpose of wireless monitoring of humidity and temperature, which is developed with the help of MIT App Inventor2 (an open source) web based android development platform. For sensing purpose, LM35 temperature sensor and HIH-4000-003 industrial humidity sensors are used.

Liu Yang [7] showed monitoring and control system of Granary temperature and humidity on ARM processor, the work is performed using LPC2290 microprocessor with hardware components LCD, Alarm module and serial communication module but, no wireless system has been used for real time monitoring.

In another work carried out by Anwar Hasan Ibrahim [2] temperature and humidity monitoring was done using Robot via smart phone, Wi-Fi was used as wireless communication. By sending robot to particular place controlled through mobile application humidity and temperature were monitored. In this work the use of robot was not much efficient for the earlier described purpose.

Lin Ke [12] reported on the monitoring of humidity and temperature using ZigBee technology and CC2430 hardware. This work lags in terms of

mobile phone integration to the wireless network. In comparison to past work, our designed system is work efficient, user friendly, cost effective and based on modern technology.

2. Hardware used and scheme of hardware

The present work is performed on Arduino Mega 2560 development kit which contains 54 digital input and output pins (15 can be used of PWM outputs), 16 Analog input, 4 UARTs with 16MHz clock frequency [9]. It communicates using the original STK500 protocol (reference, C header files). Mega 2560 has a resettable poly-fuse that protects computer's USB ports from short circuit, it is well known that if more than 500 mA is applied to USB port the fuse will automatically break.



Figure 1: Arduino Mega Board

2.1 Bluetooth

Bluetooth (BT) is a sort range data transfer technology using short wavelength UHF radio waves in the range of 15 m. band from 2.4 GHz. to 2.485GHz. At industry level different models of Bluetooth Module is available.

HC-05 Bluetooth module is used in the present work, the advantage of this module is that it can be switched for both master and slave modes through programming.

2.2 Schematic of Hardware

The simulated circuit using Proteus, a circuit design and simulation software, diagram of the system is presented below:

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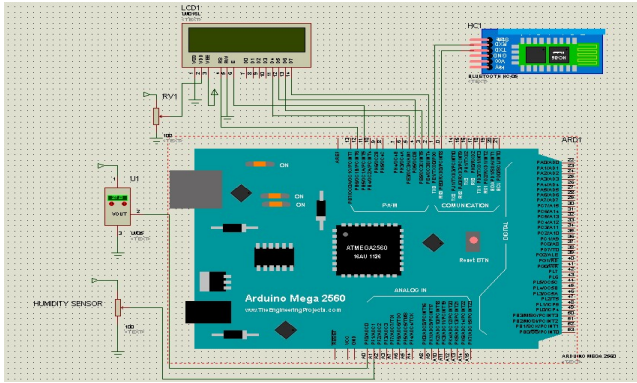


Figure 2: Simulated Circuit Diagram

From Figure1, it is clear that both sensors, Arduino, LCD and Bluetooth each requires +5 Volt power supply and Ground, which is provided separately. Temperature sensor is connected to Analog input pin A0 and Humidity sensor is connected to Analog input pin A1 of Arduino. For the interfacing of LCD, 4-bit communication is used and the connection pins 2,3,4,5 of Arduino are connected to D4, D5, D6, and D7 of LCD respectively. Further for interfacing of Bluetooth Module, UART pins (Rx0, Tx0) of Arduino are used; Rx pin of Arduino is connected to Tx pin of BT module and similarly Tx pin is connected to Rx pin.

3.Sensor description & interfacing circuits

(1) Humidity Sensor

The humidity sensor output equation and dependencies are following:

- At 5V input calculated values:
 Zero Offset = 0.826V
 Slope = 31.483mV/%RH
 $RH = (V_{out} - \text{Zero offset})/\text{Slope}$
 $= (V_{out} - 0.826)/0.0315$

Figure 3: Humidity Sensor Interfacing Circuit

(2) Temperature Sensor

LM35 Industrial temperature sensor is used which gives 10mV output for per 1°C temperature



Figure 4: Interfacing Circuit for Temperature sensor

4.Flow chart of programming Algorithm

Programming is done in Arduino IDE software with the help of C language. The main objects used in programming are ADC, UART and LCD. The program runs in this way;

1. Set PIN 13 as output pin.
2. Set BAUDRATE to 9600.
3. Initialize LCD.
4. Clear LCD.
5. Read sensor Data.
6. Formatting of data.
7. Print Humidity and temperature on LCD.
8. Check if the serial communication available?
9. If not go to step 5.
10. Yes, send temperature and humidity serially through Bluetooth.
11. If serial receiving data available?
12. Yes, set output PIN 13 to logic 1.
13. No, set output PIN 13 to logic 0.
14. Repeat from step 3.



Figure 5: Flow diagram of proposed Algorithm

5. MIT App inventor

MIT App Inventor2 is an open source web-based android development platform allows beginners to develop applications with no prior knowledge of any programming language dedicated for app designing. It provides drag and drop of GUI objects for interfacing object blocks to implement behaviour of graphical blocks as shown in Fig 6.

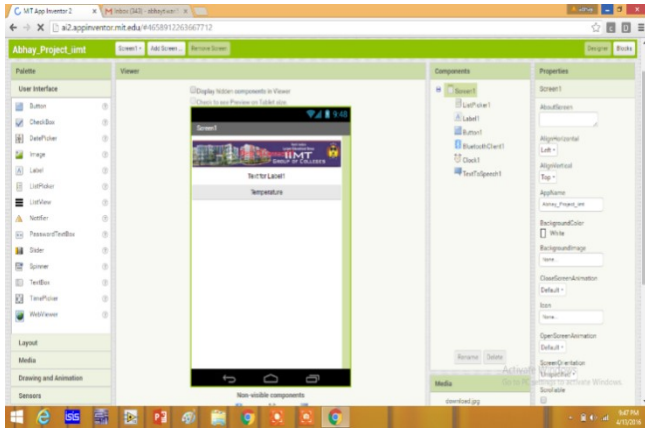


Figure 6: GUI design in MIT AppInventor2

6. System prototype

This work is completed with a device prototype in order to monitor humidity and temperature wirelessly on android phone presented Wireless sensor network system communicates with android phone with help of designed application. For monitoring connect the device to Robokits Bluetooth Network. For connecting the device to android phone following steps are followed:

- On the Bluetooth of Android mobile
- open application
- Click on BT connect Button
- Connect to Robokits_bluetooth
- Serially data is available in phone
- If appliance control needed use “Light ON”/ “Light OFF” Buttons.
- If want listen serially receive data press “Temperature” Button.

7. Result & Discussion

The whole sensor network putted in programmable environmental chamber where different temperature and humidity range programmed for a particular time interval. On other side monitoring is done on android application. Different readings for set temperature and monitored temperature, set humidity and monitored humidity is taken which is shown in Table.1 and Table.2 along with plots.

Table-1: Set Temperature vs Monitored Temperature

S.No.	Set Temperature (°C)	Monitored Temperature (°C)	% Error
1	10	9.61	3.90
2	15	15.12	0.80
3	20	20.45	2.25
4	25	25.22	0.88
5	30	31.11	3.7

6	35	34.56	1.25
7	40	40.55	1.37

Table-2: Set Humidity vs Monitored Humidity

S.No.	Set Humidity (%RH)	Monitored Humidity (%RH)	%Error
1	20	19	5.00
2	30	31	3.03
3	40	42	5.00
4	50	51	2.00
5	60	59	1.66
6	70	71	1.42
7	80	82	2.50

Figure 9: Plot 2- Set Humidity Vs Monitored Humidity

8. Conclusion

In this paper, a Bluetooth and android based wireless sensor network is developed on Arduino platform. Its accuracy in terms of humidity monitoring is high and the physical parameters can be monitored from a remote location in the range 15 to 18 meters. Some of features is being added in the application that are: application gives physical parameter output in sound and other is: control appliance can also be controlled from the same application.

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