Visualization of temperature and humidity of an area through Wireless Sensor Network

1.0 Introduction

Wireless sensor networks (WSNs) have gained worldwide attention in recent years, in order to overcome the hazards and complexities in operation caused due to the wired networks connecting all the hardware elements. A **wireless sensor network (WSN)** contains distributed sensors to monitor physical or environmental conditions, such as temperature, sound, pressure etc. and to cooperatively pass their data through the network to a main location without the use of wires. Cost effectiveness, scalability, reliability and high fault tolerance are the main important features of a wireless sensor network that makes them acceptable in place of wired networks. The basic components of a WSN kit performs the following functions: 1)gathering the information from a target source; 2)transmitting the data wirelessly; 3) processing and storing the data transmitting the data wirelessly and 4)supplying energy to the node. A WSN contains large number of small, low-cost wireless sensor nodes that are employed to track a wide target. Each such sensor network node has typically several parts:

1) A radio transceiver with an internal antenna or connection to an external antenna known as **ZigBee module**. This wireless sensor module works following IEEE 802.15.4 protocol and can work for frequency bands of 868 MHz, 915 MHz, and 2.4 GHz. It helps in RF communication upto 40 meters indoors and it covers a distance of up to 90meters outdoors.
2) A microcontroller, **ATMEGA324PA**
3) An electronic circuit for interfacing with the sensors and
4) An energy source, usually a battery or an external power source.

2.0 Network design

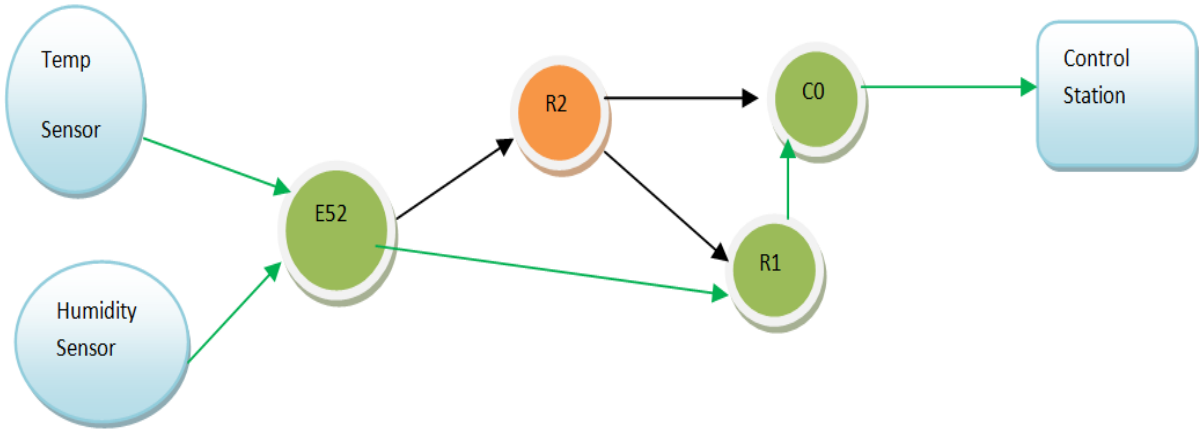

Fig.1. Block diagram of the application area

A. Hardware used

Temperature sensor MCP 9700: MCP 9700 is a NTC (Negative Temperature Coefficient) type thermistor which senses a temperature within a range of -40^0C to 125^0C.

Humidity sensor HIH 5030: HIH 5030 sensor is a humidity sensor which senses the relative humidity of the atmosphere and gives a voltage output of 2.7V which is sensed by the ADC (Analog to Digital Converter) of the WSN development board.

One tag or end device, E52: The atmospheric data collected by the sensors are gathered by the tag or end device for transmission. Tags can take address from E51 to E999. Here the tag chosen has an address E52.

Two routers, R1 and R2: The data is transmitted to the control station for monitoring by the help of these routers. Here we have used only two routers of address R1 and R2.

The coordinator or gateway G: The gateway G, better known as coordinator C0, feeds the transmitted data to the computer for monitoring.

Control Station: A computer acts as the control station in this work where the sensed values are observed and it displays the shortest path through which the data reach the control station.

B. Softwares used

MikroC: MikroC is a software where the programming for the microcontroller is written in C environment and the hex code is generated for the microcontroller.

Extreme Burner: Extreme Burner is the software which loads the hex file in the microcontroller of the WSN kit through the programmer.

Apache Tomcat 7.0: This software helps to set up local host network which helps to display the collected data in the control station.

MySQl 5.0: This software helps in displaying the output of the measured parameters in the software. This helps to set up the control station software where the network map of the entire area is displayed along with the tag and routers. It displays the measured outputs and the shortest path through which data has been transmitted.

3.0 Procedure for monitoring

The procedure for collecting the data and monitoring the data in the control station has been discussed in the steps that follow:

I. Start tomcat server.(go to my computer icon, then right click, select services and application, then select services, then start or restart apache tomcat 7.0).
II. Run the application from internet browser. (put the URL as : http://localhost:8080/wvs)
III. Attach the coordinator to the PC via serial port using USB cable. Now right click on My Computer and click on manage. Select Device manager and see which COMPORT (say COM19) the coordinator is attached with.
IV. Put the username and password as admin and admin respectively in the application.
V. Select configuration and select the map of the concerned area.
VI. Add a tag from Tag menu give a name as E52 and set channel 0 for temperature and channel 1 for humidity.

VII. Connect the temperature and humidity sensor with the 10 pin ADC present in the WSN kit through a FRC cable. Scale the temperature and humidity output with respect to the ADC output 0-127.
VIII. Add two routers as R1 and R2 and select their locations respectively.
IX. Click on System option and set the COMPORT value (COM 3) which was found earlier.
X. Visualize the temperature and humidity of the area displayed on the control station screen. Also note the path through which the data transmission has taken place.

4.0 Observation Table

When the temperature and humidity sensor is located inside a room			
Sl. No.	**Time**	**Temperature (^{0}C)**	**Humidity (%)**
When the temperature and humidity sensor is placed outside of the room			
Sl. No.	**Time**	**Temperature (^{0}C)**	**Humidity (%)**

The path of transmission as observed in the control station is:

Introduce a fault in one of the routers and now the path of transmission is:

5.0 Discussions

Limited amount of energy, short communication range, low bandwidth, and limited processing and storage memory in each sensor node are some of the limitations associated with this wireless sensor kit. Hence, any change in value smaller than the scaled interval cannot be detected and the lower interval limit is continued to be displayed.