Bluetooth Based Weather Station

Akhilesh Chawla[1], Tejas Bangera[2],Chinmay Kolwalkar[3], Mahalaxmi Bhat[4]

Student [1,2,3], Professor[4],Electronics and Telecommunication Engineering[1,2,3,4],University Of Mumbai[1,2,3,4]

Atharva College Of Engineering[1,2,3,4], India

Abstract*-The weather has always been a universal concern , and the contemporary changes in the climate is becoming an issue, in particular, has made us realize the importance of having precise, robust and trustworthy sensors that are capable of predicting change of weather conditions over a specific period of time. Nowadays, the requirement for portable weather surveillance instruments which can be trusted on for real-time alerting and reporting on the changing environmental conditions becomes increasingly necessary.To meet these requirements, we have designed an efficient, compact and cost effective weather station that gives us valuable information about temperature and humidity using highly reliable sensor DHT11 sensor and HC-05 Bluetooth module.The DHT11 sensor serves the purpose of high accuracy in terms of measuring temperature and humidity whereas the HC-05 Bluetooth module enables high data rate, better range and portability.*

Keywords — *DHT11 sensor, HC-05 Bluetooth module, SENA BTERM, Arduino Uno, weather station, temperature, humidity*

I. INTRODUCTION

Sensing the humidity and temperature has been important to man over the centuries. The main concept behind the weather station is to stay updated with the frequent changes of weather. Various significant weather occurrences have affected the mankind over the years. Today, the temperature and humidity are of major concern as global warming is constantly jeopardizing the environment. The usual weather stations are bulky in size and consume more power with limited reliability. In case of exigent situations, we need weather station that are not only portable and compact in order to measure different environmental factors at remote places but also improve the efficiency and reduce power consumption. For matching these novel needs, we designed and implemented a weather station that uses sensors (DHT11) for measuring the temperature and humidity of a particular area. Moreover, it makes use of a Bluetooth module (HC-05) so as to transmit the data obtained through the sensors to the Android Application (SENA BTERM) that enables the data in the form of relative temperature and humidity to be seen on the mobile phone of the user.

The goal of this project is to design an easy portable weather station that complies with the demand of user friend interface and ease of accessibility. The project emphasises on the use of Arduino Uno board which is interfaced with DHT11 sensor and the Bluetooth module. The android application is required which will enable the user to access all the measurements performed on the weather station with just one tap. It allows the user to observe the details of the humidity and temperature at regular instance as set by the user.

II. EXPERIMENTAL SETUP

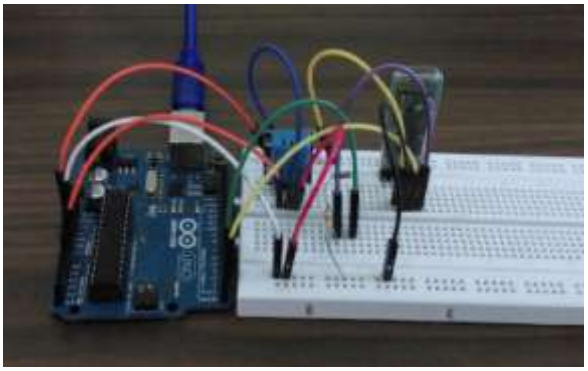

Fig.1 Bread Board Layout

The Bluetooth weather station is implementedusing Arduino Uno Board. The board is used to interface the DHT11 sensor and the Bluetooth HC-05 module as shown in Fig.1. The Arduino accepts the data from the sensors and displays the output on the PC using serial communication. The HC-05 Bluetooth module is responsible for transmitting the data obtained from the sensors to the android mobile which is later displayed on the mobile using the SENA BTERM android application.

A. Arduino Uno Board

Arduino Uno board is heart of the project and is responsible for all the major operations in the project. Due to its robustness and open source nature, it is interfaced with the DHT11 sensor and the Bluetooth module easily. The Arduino Uno board has a microcontroller based on ATmega328P [4].This board provides the services of serial communication for displaying the received data on the PC and provides an Integrated Development Environment for easy programming.

Fig. 2 Arduino Uno Board

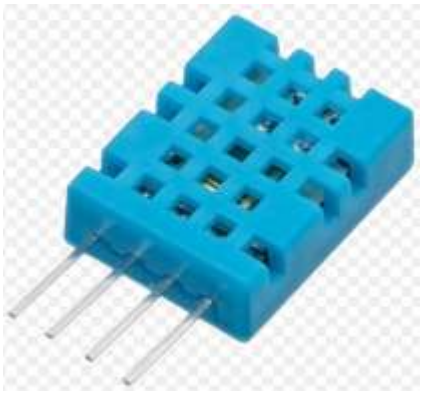

Fig.3 Digital Humidity Temperature sensor

B. Digital Humidity Temperature Sensor(DHT11)

DHT11 is a digital temperature and humidity sensor which provides a calibrated digital signal output of the temperature and humidity. Due to its exclusive digital modules and the temperature and humidity sensing technology, it makes sure that the output obtained is of high reliability and stability. The sensor consists of a resistive sense of wet components and an NTC temperature measurement devices , and connected with a high-performance 8-bit microcontroller [5][8]. DHT11 sensor ensures fast response, low consumption of power, low cost. In addition to this, it also has the ability to avoid interference and can transmit data to a long distance. The communication and synchronisation between microcontroller unit and the DHT11 sensor takes place using a single wire two way connection and requires single bus data format for the same. The information packet transmitted by the sensor is of 40 bits[5]. The sensor operates in 2 different modes-low power consumption mode and running mode. The start signal signifies the transformation from low power mode to running mode. As the start signal is completed, the sensor sends a response signal containing the information regarding the relative temperature and humidity.

For the Bluetooth based weather station, the sensor used is a 3 pin module consisting of Vcc , Data and Ground (GND).The Data pin is connected to the A0 pin of the Arduino board whereas the Vcc is connected to the 5V pin of Arduino. The sensor transmits the information of temperature and humidity to the Arduino board which is later displayed on the serial monitor using serial communication

C. HC-05 Bluetooth Module

HC-05 as shown in Fig. 4 is a Bluetooth module which operates on the principle of Serial Port Protocol (SPP). This module is specifically designed for wireless serial communication. This module is equipped with Bluetooth V2.0+EDR (Enhanced Data Rate) 3Mbps Modulation with complete 2.4GHz radio transceiver and baseband. It makes use of CSR Bluecore 04-External single chip Bluetooth system with CMOS technology and with AFH(Adaptive Frequency Hopping Feature)[6]. The Bluetooth module is used for its low cost, low consumption of power and high range that enables the user to access the weather station from a considerable distance. The Bluetooth module has a sensitivity of -80dBm.It makes use of UART interface whose baud rate can be programmed. Typically the baud rate used is 36800 and the data packet usually involves 8 bit of data, 1 stop and no parity bits.

These Bluetooth modules have two modes: master and slaver device. Those device with even number (HC-04) can be configured as master or slaver when it is out of factory and can't be changed to the other mode. However, for the device with odd number like HC-05, the user can configure the mode as master or slave using AT commands.

The Bluetooth module used in the project is HC-05 which operates in the slave mode. HC-05 is a 6 pin IC where the TX and RX pin is connected to the RX and TX pin of the Arduino board respectively. The potential divider circuit used is to reduce the Arduino 5V potential to 3.3V for proper transmission and reception between the Arduino and the Bluetooth Module. We have to make sure that the baud rate of the Bluetooth module is synchronised with that of the Arduino so that there is no loss of data and proper communication is achieved.

Fig.4 HC-05 Bluetooth Module

D. Android Interface

The android interface is used in this project to showcase the data obtained in the form of temperature and humidity. It is a VT-100 Terminal Emulator for Bluetooth communication. It enables the connection of Android devices with any Bluetooth device which is associated with Serial Port Profile. This allows easy exchange of data between the two systems in both master and slave mode. In this project, the data in the form of temperature and ambient humidity is displayed on the android mobile phone[7].

The main advantage of using this application is to provide a user friendly interface which avoids any ambiguities for the user as shown in Fig 5. The interface has different panes for configuring the device and the incoming data. The data which is to be sent or displayed is highlighted on the terminal pane. There are other panes available which have their own specific application like the toolbar pane which has special characters function. The status of SENA BTERM is contingent upon the Bluetooth status and the terminal mode. The former deals with the status of the Bluetooth adapter of the local device whereas the later specifies whether the adapter is performing AT commands or transmitting data.

Fig.5 SENA BTERM Android Application

III. RESULT

The Bluetooth based weather station was tested at Atharva College Of Engineering. The sensor grabbed the information about the humidity and temperature in the lab which was displayed on the serial monitor screen of Arduino as seen in Fig. 6. The data is also displayed on the android mobile using SENA BTERM application through HC-05 Bluetooth module as seen in Fig. 7.

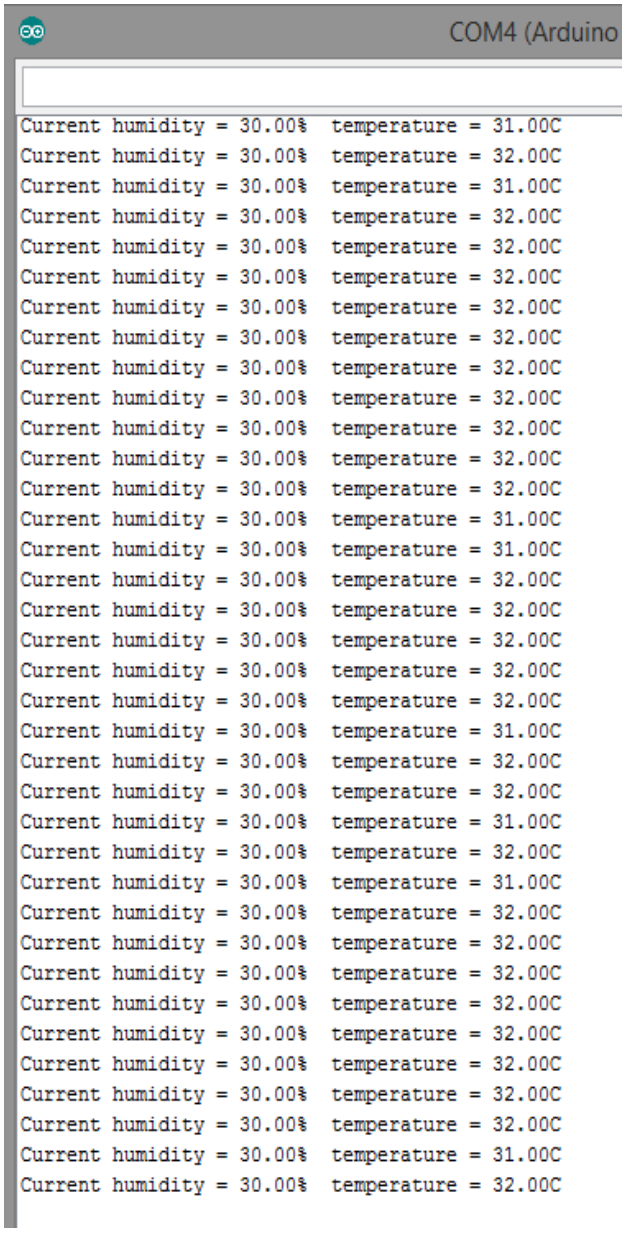

Fig.6 Weather Station Output on Serial Monitor

Place: Atharva College Of Engineering
Temperature: 31^0C- 32^0 C
Humidity : 30%-32%

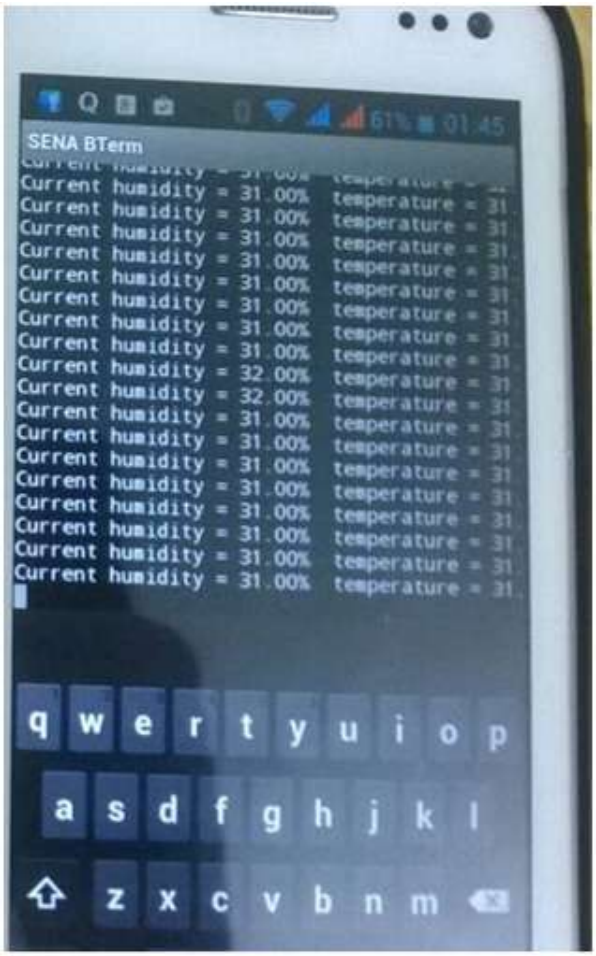

Fig.7 Weather Station Output on SENA BTERM Android Application

IV. ADVANTAGES

1. Due to the use of Bluetooth module, the data transmission and reception is faster [3].
2. The ability of receiving the updates regarding temperature and humidity using an android cell phone automatically reduces the man power [3].
3. The Digital Humidity and Temperature sensor enhances the weather station with its high reliability and accuracy.
4. The overall circuitry required to implement this project is very small eventually providing a compact, cost efficient and time saving system for monitoring the basic weather factors.
5. Due to the use of Arduino, the Bluetooth based weather station can be easily interfaced with other hardware and software.
6. Low power consumption makes the weather station more robust and durable [3].

V. CONCLUSION

Bluetooth based weather station serves as a reliable and efficient system for accurate measurement of the environmental parameters like temperature and humidity. It not only allows user to reduce the human power, but it also allows user to see precise changes in it. This project can be further extended towards measuring the light intensity using an LDR (Light Dependent Resistor). Furthermore, we can also use IOT (Internet Of Things) in the same project and display the results on a server, thereby making a mini data acquisition system.

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