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GREEN HOUSE TECHNOLOGY USING ZIGBEE MODULE

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Abstract:- The climate change is one of the most important factors affecting the quality of life and the activity of the increasingly population. The current means of meteorological parameters data collection are indeed rather limited and make use of some very expensive weather stations, leading to a lack of comprehensively monitoring due to cost constraints and inconveniences. In this paper we have proposed and developed a low cost hardware module based on Arduino Uno Board, which measures the meteorological data, including air temperature, atmospheric pressure, relative humidity, dew point temperature, wind speed and wind direction. It sends this information to the GUI running on a PC through Zigbee wireless link. The user friendly GUI is, a standalone application for windows, developed in LabVIEW. The application displays the current conditions graphically, logs the data in a format accessible by MS Excel and has a facility to host the same information on a webpage. This system is also a mathematical model which is capable of generating short time local alerts based on these weather parameters. This gives on line and real time effect. The idea behind this program is to monitor, condition mapping, weather forecasting and further to warn the people from its disastrous effects. It will be highly useful in landing the aircraft, navigational and the ship borne effects, tornado, tsunami, cloud bursts and in healthcare alerts etc. In future we are going to link with satellite system as a global feature of this system.

Keywords: Weather Monitoring Station (WMS), GUI, LabVIEW, Weather Parameters, Zigbee, Arduino IDE

I. INTRODUCTION

The climate change is one of the most important factors affecting the quality of life and the activity of the increasingly population. The current means of meteorological parameters data collection are indeed rather limited and make use of some very expensive weather stations, leading to a lack of comprehensively monitoring due to cost constraints and inconveniences. Nevertheless, the acquisition of comprehensive meteorological data is the prerequisite condition for the accuracy of weather forecast. If there is not enough data gathered of meteorological parameters, the publicly available information about weather forecast would be inaccuracy. Warm days have become warmer and cold days colder. The average temperature of earth has risen by 0.5°C over the past century. The rains have also become erratic. The seasons have started overlapping, warm weather during winter and cold conditions during spring or summer. The seasonal climatic variations have been converted into daily variations. These weather conditions strongly affect the health of plants and animals. The changes in climate are perceptible in Punjab, as is their effect on agriculture. The changing climatic conditions have baffled meteorologists as well, for whom it has become really difficult to predict the seasonal or daily weather conditions. Punjab, agriculturally the most important state of the country, has also witnessed climatic changes like in other parts of the country. Considering the importance of agriculture in Punjab in national food security and livelihood security of about 16 million people dependent on agriculture and its vulnerability to climate change, it is important that efforts be made to carry out extensive research on developing

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adoption technologies in relation to climate change. In this scenario it has become very important to have good monitoring over weather conditions.

Typical weather stations have the following instruments:

- Thermometer for measuring air temperature
- Barometer for measuring atmospheric pressure
- Hygrometer for measuring humidity.
- Anemometer for measuring wind speed
- Wind Vane sensor for the detection of Wind Direction
- Rain gauge for measuring liquid precipitation over a set period of time.

The proposed system will measure the parameters of the weather by low cost digital sensors and communicate these values to a computer system via Zigbee wireless link. And then it will display the information in a graphical application and host it on the web. The proposed system will also consist of a mathematical model to generate short time local alerts based on the local data. We have used LabVIEW and Arduino platform to achieve this objective.

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II. IMPORTANCE OF WEATHER PARAMETERS

In weather forecasting stations the meteorological data is entered into a computer calculated model. It takes the data of a big area which includes a number of weather stations on ground and the data of upper layers of the atmosphere calculated by weather balloons. The satellite pictures and graphs are also included for making the forecast of next few days. This whole process is accurate only when the readings are as accurate as possible. Secondly the modern forecast systems uses one system per 32km resolution in India. Lower resolution is difficult to produce because of high cost constraints. But to improve the simulation a smaller resolution is needed. Hence a low cost system for Indian market with high accuracy of parameter calculation is required. Another importance of weather data is in agriculture, it is necessary to know the past and actual conditions on the fields to plan the use of fertilizer, aerial spraying, watering or harvest or in zoology, the population of insects and bigger animals is directly corresponding to the former weather condition which makes these data necessary for research and fight against upcoming pests. In hospitals, this information can be very useful for generating healthcare alerts and precautions. For example, some people experience difficulty breathing in high humidity environments. Some cases may possibly be related to respiratory conditions such as asthma, while others may be the product of anxiety. Sufferers will often hyperventilate in response, causing sensations of numbness, faintness, and loss of concentration, among others. Wind data may also help in generating alerts when the wind is coming from some industrial area, causing high pollution levels. And local weather data can also be used to make short term local alerts. This can help in landing the aircraft, ship-borne, navigational, tornado, sunami & storm alerts etc.

III. SENSORS

In this project we will measure the parameters to make a real time digital system, which will measure the temperature, pressure, humidity, wind speed and wind direction. For this purpose various sensors are used.

A. Arduino Uno:

Arduino Uno is an open-source electronics prototyping platform based flexible hardware and software. Arduino can sense the environment by receiving input from a variety of sensors and can affect its surroundings by controlling lights, motors, and other actuators. The microcontroller on the board (ATMega328) is programmed using the Arduino programming language (based on Wiring) and the Arduino development environment (based on Processing). Arduino projects can be stand-alone or they can communicate with software running on a computer.

Fig.1: Arduino UNO based on ATMega-328 Microcontroller

B. BMP180:

We are using barometric digital pressure sensor BMP180 which calculates pressure and temperature with great accuracy. The BMP180 is based on piezo-resistive technology for EMC robustness, high

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accuracy and linearity as well as long term stability. Robert Bosch is world market leader for pressure sensors in automotive applications. Based on experience of over 200 million pressure sensors in the field, the BMP180 continues a new generation of micro-machined pressure sensors.

Fig.2 BMP180 based Digital Sensor

C. DHT11

DHT11 is digital humidity and temperature sensor from Sensirion. The DHT11 utilizes a capacitive sensor element to measure humidity, while the temperature is measured by a band gap sensor. Both sensors are seamlessly coupled to a 14-bit ADC, which then transmits digital data to the Arduino over the I2C protocol. Because of the sensor's tiny size, it has incredibly low power consumption, making it suited for virtually any application.

Fig.3: DHT11Temperature & Humidity Sensor

D. Anemometer

A three cup anemometer assembly is used to calculate the wind speed by calculating the rotation per minute of the anemometer cups symmetry, with the help of a reed switch and a magnet.

Fig.4: Anemometer Reed Switch Symmetry

With each rotation the switch closes and opens for a single time. As shown in Fig.4 a magnet is placed on the shaft of rotating cup symmetry which rotates with the rotation of cups. As the magnet passes the reed switch while rotating, the switch toggles twice.

E. JHD204A LCD Module:

This is a 20x4 LCD display, meaning that it has four rows having twenty characters in each row. It has 16 pins which can be interfaced to any microcontroller in two modes, i.e. either 4 pin mode or in 8 pin mode. In 4 pin mode it can be operated by four data pins and in 8 pin mode 8 data lines are needed. Here we will use 4 pin mode. It also has backlit of yellow colour. Here is shown in the figure below the JHD204A LCD.

Fig.6: JDH 204A LCD Display

G. Xbee Radio

XBee is the brand name from Digi International for a family of form factor compatible radio modules. Digi XBee 802.15.4 modules are the easiest-to-use, most reliable and cost-effective RF devices. The 802.15.4 XBee modules provide two friendly modes of communication – a simple serial method of transmit/receive or a framed mode providing advanced features. XBees are ready to use out of the package, or they can be configured through the X-CTU utility or from your microcontroller. These

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modules can communicate point to point, from one point to a PC, or in a mesh network.

Fig.7: XBee Module

H. XBee Explorer USB, CP2102 based

This is a reliable USB interface for Xbee modules, for configuration or communication with PC. It is simple to use, USB to serial base unit for the XBee line. This unit works with all XBee modules including the Series 1 and Series 2.5, standard and Pro version. Plug the unit into the XBee Explorer, attach a USB cable, and you will have direct access to the serial and programming pins on the XBee unit using X-CTU software. LEDs Indicate various Activity. instruments, such as oscilloscopes and multimeters contains a comprehensive set of tools for acquiring, analysing, displaying, and storing data, as well as tools to help you troubleshoot code you write.

V. METHODOLOGY

The proposed system has integrated all of these sensors on the same Arduino Uno board. The BMP180 and DHT11 sensors have I2C interface, hence can be connected on the same line. On the other hand all of the other sensors are connected through different lines to the Arduino. The two Xbee modules, one connected to Arduino's Tx and Rx terminals and other on the Xbee Xplorer, connected through the usb to computer system, are the link between the Arduino and Computer system after successful uploading the program in ATMega328 microcontroller in the Arduino Uno Board.The proposed system is a complete automatic wireless system. shows a screenshot of the hardware.The controller is programmed in this way that it will send the sensor values to the computer system at the rate of one string in one second, and also to display the whole values in the LCD display. The mathematical calculations are done on the basis of these parameters for generating short term alerts. The computer system receives the string of data and processed by a current parameters on the screen of the computer system, has data logging function as an option and also has the capability to host this graphical view to the internet.A good internet connection is needed to host this real time system to the internet. We can buy static domain name or we can work on www.no-ip.biz or similar sites, which provides dynamic domain names. And enabling the right settings for the router such as port forwarding and settingup the right port addresses, we can host and view the same.

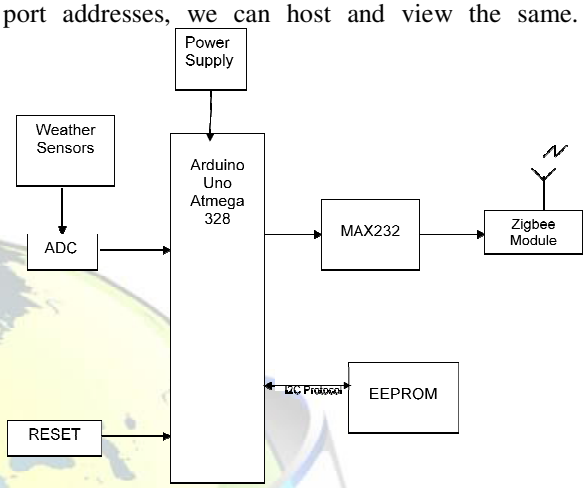

Fig.Transmitter section

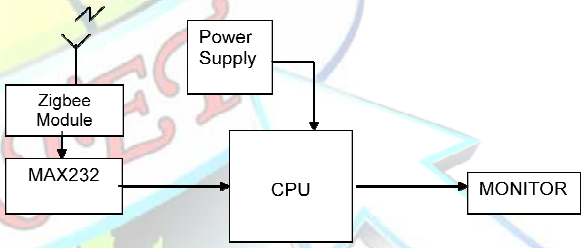

Fig.Receiver section

weather monitoring model from anywhere in the world.

VI. RESULTS

After developing and calibrating the proposed system, the output data (April, 2014) is being compared with the data of "Meteorological Centre Chandigarh (MCC), Sector-39 Chandigarh" and "Snow and Avalanche Study Establishment (SASE), Sector-37, Chandigarh, Laboratory by DRDO". The results, comparisons and correlation factor are discussed below.

A. Temperature

When compared the temperature values calculated by the proposed system in April, 2014 and the temperature data of the MCC Chandigarh, the correlation factor of 0.92 has been calculated. Fig.10 shows the comparison graph of the readings of temperature.

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X Axis: Data Points, Y Axis: Temperature (^{0}C)

Fig.10: Temperature Plots

B. Pressure

The pressure readings correlation factor comes out to be 0.86. These readings are being compared with the data of SASE. And the comparison is shown in Fig.11.

X Axis: Data Points, Y Axis: Pressure (hPa)

Fig.11: Pressure Plots

C. Relative Humidity

The relative humidity (%RH) results when compared with the MCC data, are very good with a correlation factor of 0.98. The comparison of both the data values is shown in Fig.12 below.

X Axis: Data Points, Y Axis: Humidity (%RH)

Fig.12 Humidity Plots

D. Wind Rose:

Wind Rose has been plot with a good correlation factor of 0.98. The wind rose plot of the values is shown in Fig.13 below.

Wind Speed is in km/h

Fig.13: Wind Rose

VI. CONCLUSION AND FUTURE WORK

In this paper we have proposed a low cost automatic wireless weather monitoring station equipment with software application for monitoring, logging and web hosting facilities. It is capable of calculating temperature,pressure, humidity, wind speed, wind direction and a mathematical model for calculating dew point temperature and short time local alerts. The results are very good with a correlation factor greater than 0.85, while compared with the readings of Meteorological Centre Chandigarh and SASE Chandigarh Laboratory. The proposed system is very useful in Indian market due to low budget, high accuracy, and user friendly interface along-with low maintenance charges. In future one can add a few more sensors like rain gauge, light sensors etc. Using Zigbee mesh networks and satellite communication, this type of low cost systems can give a good resolution and accuracy of environmental parameters over a wide area, for making more accurate forecasting and study of weather patterns more accurate and easy.

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