Remote Weather Station Design Using Zig-Bee

Y. Sreeja

Department of Electronics & Communication Engineering
Siddhartha Institute of Technology & Sciences
Hyderabad-501301, T.S, India.

Abstract

This project is designed by developing Sensor Networking and Weather Station Monitoring System without human intervention using Wireless ZigBee Technology. The advanced development in wireless sensor networks can be used in monitoring various parameters in air. The project is mainly targeted towards the reliability of the weather Monitoring system. A WMS keeps track of humidity and the system displays these readings in real time on a display. This data can be display on LCD. Various techniques are used to monitor the weather like satellites, radars, microcontrollers and many other simple instruments. Weather can also be monitored by using remote wireless sensors. Zigbee is the latest wireless weather monitoring technique. The existing monitoring systems of Weather Monitoring System are manual. We need human support for so. There are limitations for human to know about exceeding hazardous parameters of Environment. There are chances of human errors. Like human calculations may not be precise sometimes. Or human may not cover larger area. We need some smart system which will automatically measure the parameters. In this application, Wireless sensor network can solve the problem, where parameters calculations and controlling will be precise even over the larger area.

Wireless Sensor Networks have gained a tremendous attention in the last decade. The ability to monitor environmental conditions is crucial to research in fields ranging from climate variability to agriculture and zoology. Being able to document baseline and changing environmental parameters over time is increasingly essential important and researchers are relying more and more on unattended weather stations for this propose. The smart weather station consists of microcontroller based measuring units which collects the value of humidity using HSM-20g sensor. These units send their data wirelessly to a Base station, which collects all the data and display in LCD. The facility of adding a few more sensors and a few more stations has been provided.

INTRODUCTION

Data acquisition is the basic property of the weather monitoring /logging systems, as the name implies, are used to collect information from some sensors to document or analyze the phenomenon of our climate. Our data acquisition system is embedded system boards designed to measure and log some parameters [1-3]. The purpose of the data acquisition system is generally to analyze the conditions of our surroundings. The data acquisition system is normally electronics based, and it is made of hardware and software. The hardware part is made of sensors, cables and electronics components (among which memory is where information is stored). The software part is made of the data acquisition logic. The data acquired from the surroundings i.e. the temperature value will be continuously displayed on the LCD for every 5 min by using real time clock. And also microcontroller sends the data to the mobile number programmed into micro controller whenever it receives a SMS.

WSN based environmental sensor station, where the environmental sensors interfaced directly to the Zigbee module and data transmission takes place by using Zigbee module [7-8]. There are several different procedures of weather stations, with all kind of sensors.

These stations can be wireless or connected with a wire to a Server storing the data and make it possible to access them. These Stations can only be operated with the given software which makes it difficult to access the data and use them for different purposes; additionally these stations are very expensive.

Therefore, this research motivates to develop a new weather station which is efficient, flexible. The present paper describes the development of a wireless environment monitoring station measuring temperature, humidity, wind speed and light intensity.

Sensing the winds and weather has been important to man over the centuries. Athenians built the eight sided Tower of the Winds in the first century B.C. in honor of the eight gods of the winds. The Tower of the Winds stands to this day in the ancient agora, or market, in Athens. Many significant weather events have affected mankind over the years. Today, the winds and other weather variables are of equal concern and can have an even greater impact on our modern, high-tech life style. Weather affects a wide range of man's activities, including agriculture, transportation and leisure time. Often the affects involve the movement of gases and particulates through the atmosphere [4]. Modern weather monitoring systems and networks are designed to make the measurements necessary to track these movements in a cost effective manner. In weather monitoring systems, different parameters like time and date, temperature, relative humidity, dew point, wind direction and speed, rainfall amount, and weather forecast are all shown on the LCD display. Temperature and humidity are indicated for both indoor and outdoor locations. Programmable alarms are also available in the monitoring systems which indicate out-of-range conditions. Thermometer, barometer, and dew point functions have min/max memories [5]. Barometer also features sea level reference, pressure trend indicator and weather forecasting symbols (sunny, cloudy, and rainy). Serial port permits linking to a PC or laptop for data transfer. System is supplied with sensors, an AC adapter, and four AA backup batteries. The conventional weather monitoring system consisted of individual sensors to measure one meteorological variable, each connected to a data collection device or recorder. Modern technology has allowed the combination of several sensors into one integrated weather station that can be permanently located at one site, or transported to a site where localized weather is needed.

EXISTING SYSTEM

The existing monitoring systems of Weather Monitoring System are manual. We need human support for so. There are limitations for human to know about exceeding hazardous parameters of Environment [5]. There are chances of human errors. Like human calculations may not be precise sometimes. Or human may not cover larger area. We need some smart system which will automatically measure the parameters.

PROPOSED SYSTEM

The Proposed System design consists of transmitter as well as receiver. The Proposed block diagram of transmitter and receiver is shown in fig.1. Transmitter section consists of different type of sensing unit such as humidity sensor. Microcontroller for time domain multiplexing i.e. multiplexing the data obtained from different type of sensor as well as for converting the analog data into digital one.
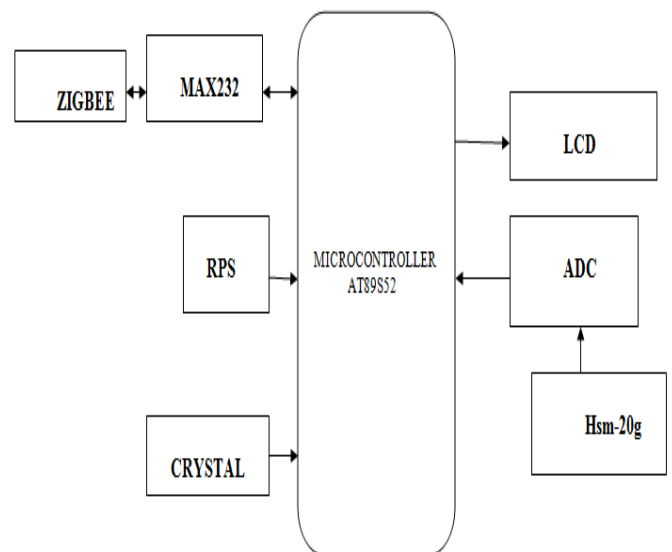
Fig. 1(a): Block diagram of the transmitter
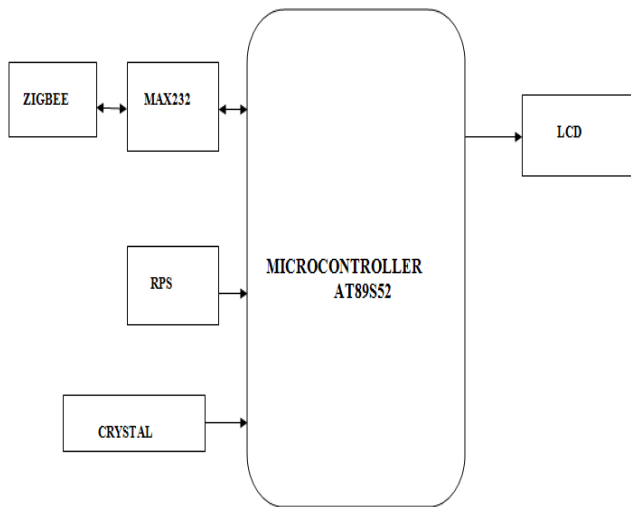
Fig.1 (b): Block diagram of the receiver

AT89S52 Microcontroller

The microcontroller is the heart of the whole system. Analog and digital sensors are input of the Microcontroller. Displays unit is an output of the microcontroller. It receives Analog and digital signals equivalent to the quantity of the weather variable to be measured; from sensors connected to it and conversion and processing through pre- programmed instructions written in C language to ensure that corresponding measurement made by these sensors are available in forms that are meaningful and useful for human analysis, interpretation and record. The microcontroller AT89S52 has been used for the measurement of weather conditions and transmission of data to the receiver. It has 40-Pin packages. It has a 10-bit A/D converter. The microcontroller uses 11.0592MHz clock.

Liquid Crystal Display (LCD)

The 16 x 2 LCD display is capable of displaying different characters and symbols. It is used to display the measured parameters such as pressure, temperature, relative humidity and dew point temperature.

Humidity Sensor HSM-20g

Humidity Sensor is one of the most important devices that has been widely in consumer, industrial, biomedical, and environmental etc. applications for measuring and monitoring Humidity. Humidity is defined as the amount of water present in the surrounding air. This water content in the air is a key factor in the wellness of mankind. For example, we will feel comfortable even if the temperature is 00C with less humidity i.e. the air is dry. The module of HSM-20G is essential for those applications where the relative humidity can be converted to standard voltage output.

Zigbee Module

The XBee RF Modules are designed to operate within the ZigBee protocol and support the unique needs of low-cost, low-power wireless sensor networks. The modules require minimal power and provide reliable delivery of data between remote devices. The modules operate within the ISM 2.4 GHz frequency band. It operates over a range of 100-200 meters. The receiver module consists of an Xbee RF module which is connected to another controller through MAX232.

Analog To Digital Converter (ADC)

An analog-to-digital converter (ADC, A/D, or A-to-D) is a system that converts an analog signal, such as a sound picked up by a microphone or light entering a digital camera, into a digital signal. An ADC may also provide an isolated measurement such as an electronic device that converts an input analog voltage or current to a digital number representing the magnitude of the voltage or current. Typically the digital output is a two's complement binary number that is proportional to the input, but there are other possibilities. Here the humidity sensor takes the analog data and applied to the ADC which converts to the digital data and sends to the controller.

WORKING DESCRIPTION

The system is divided into two main parts: transmitter and receiver section. Transmitter section mainly consists of: the sensor circuit, the microcontroller unit, the display unit and Zigbee module. The sensor circuit contains the relative humidity sensor. One sensor provides analog output, which is converted to digital form using ADC in the controller and another sensor provides digital output and which is further processed to

get humidity temperature. Those measured parameters will be displayed in an LCD display. Block diagram of the overall system is shown in fig 1. Receiver section consists of a another zigbee unit which is interfaced to another microcontroller. The proposed hardware of this system includes AT89S52 Microcontroller, HSM-20g humidity sensors, LCD, zigbee modules and related driver circuitry. The system is low cost &low power consuming so that anybody can afford it. The data monitored is collected at the receiver. It can be used in precision farming. The system should be designed in such a way that even illiterate villagers can operate it. During irrigation period they have to monitor their distant pump house throughout the night as the electricity supply is not consistent. The system can be installed at the pump house located remotely from the village, it is interfaced with the pump starter & sensors are plugged at different location in the field for data acquisition.
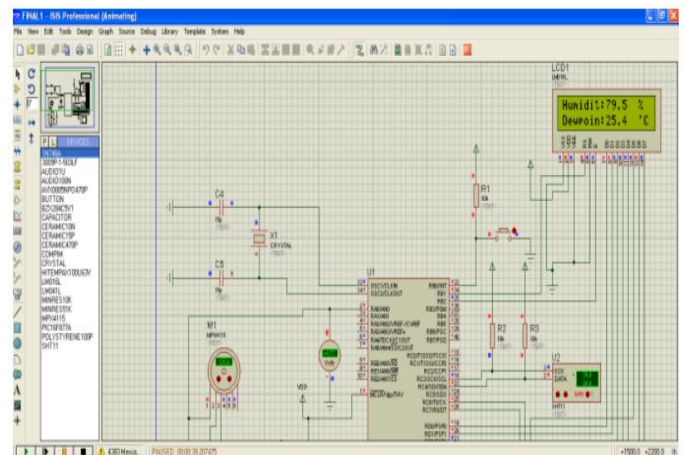
RESULTS

Proteus is software for microprocessor simulation, schematic capture, and printed circuit board (PCB) design. It provides many inbuilt components for simulation. Below figures shows the simulation of weather monitoring device using proteus simulation tool. After design and construction of the whole circuit, test and result is carried out. Simulation is working fine and displaying all measured parameter with very small margin of error.

Fig.2: Experimental hardware setup

The calibrations of the monitored parameter are done using the validation against the observed humidity and dew bulb temperature over the different locations in the City of Hyderabad. It seems the present developed device can be adopted for the real time monitoring of the weather parameters which can be used for the data assimilation in the short term prediction of the parameters.

Fig.3: Simulation result for the system displaying humidity

CONCLUSION

Zigbee-based weather monitoring system serves as a reliable and efficient system for efficiently monitor the environmental parameters. Wireless monitoring of field not only allows user to reduce the human power, but it also allows user to see accurate changes in it. It is much cheaper in cost, consumes less power, which in turn leads to the development of lots of new technologies like Home Automation, Health Care Automation etc. . A project of such a comprehensive coverage cannot be prepared without help from numerous sources.

In the specific application needs of Weather monitoring system and analysis those problem existing in monitoring system, we designed and implemented a wireless sensor network based on the soil temperature humidity monitoring system. The system can realize rapidly automatic networking and real-time data acquisition, transmission, display. With the characteristics of low cost, low power consumption,

flexibility networking, without cabling, friendly interface, etc.

Initial component testing of sensor performance has reflected good results in sensing and radio communication. The outcome provides a variable platform for different sensors to measure necessary values. In future we can add GSM module at coordinate side of developed system to get records on Mobile phones.

FUTURE WORK

In future, we can monitor the ground water level using appropriate sensor. Further the research could also be enhanced to produce a system that can monitor the whole weather condition for a large area like state or country. In future we can add GSM module at coordinate side of developed system to get records on Mobile phones.

REFERENCES

[1]. M. Haefke*, S. C. Mukhopadhyay! and H. Ewald "A Zigbee Based Smart Sensing Platform for Monitoring Environmental Parameters", 978-1-4244-7935-1/11/©2011 IEEE.

[2]. V.M. Quan. "Review of Sensors and Interfacing for Greenhouse Climate Monitoring," in SAS Conference, 2011, pp.1-3.

[3]. Jue Yang, Student Member, IEEE, and Xinrong Li, Member, "Design and Implementation of Low-Power Wireless Sensor Networks for Environmental Monitoring" IEEE 978-1-4244-5849-3/10/©2010 IEEE

[4]. Guillermo Barrenetxea, Franc¸oisIngelrest, Gunnar Schaefer, and Martin Vetterl "SensorScope: Out-of-theBox Environmental Monitoring", 2008 International Conference on Information Processing in Sensor Networks.

[5]. Khusvinder Gill, Shuang-Hua Yang, Fang Yao, and Xin Lu, "A ZigBeeBased Home Automation System", MAY 2009.

[6]. Izzatdin Abdul Aziz, Mohd Hilmi Hasan, Mohd Jimmy Ismail, Mazlina Mehat, Nazleeni Samiha Haron, "Remote Monitoring in Agricultural Greenhouse Using Wireless Sensor and Short Message Service (SMS)", 2008.

[7]. Jeonghwan Hwang, Changsun Shin, and Hyun Yoe "Study on an Agricultural Environment Monitoring Server System using Wireless Sensor Networks",2010.

[8]. Zhang xihai, Zhang changli Fang junlong. Smart Sensor Nodes for Wireless Soil Temperature Monitoring Systems in Precision Agriculture 2009. 237-241