ISSN 2394-3777 (Print)
ISSN 2394-3785 (Online)
Available online at www.ijartet.com

International Journal of Advanced Research Trends in Engineering and Technology (IJARTET)
Vol. 5, Special Issue 12, April 2018

Design and Implementation Of Self Powered Weather Monitoring System

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Abstract: In the current era, monitoring the weather is very important for all genres of work because it is a very significant phenomenon that impinges the consolidated environment without any prejudice. We can easily find the nature of weather using internet in cities, but the same cannot be said about remote locations. The desideratum of this perspicuous system is to monitor and transmit the data to the user to avoid any hazardous circumstances. The system monitors the miscellaneous parameters of weather parameters like Temperature, Humidity, Atmospheric Pressure, Wind Speed and Wind Direction and accumulates the data in a micro SD card for every sixty seconds.

Keywords: Weather,temperature,pressure,humidity,wind direction,wind speed.

I. INTRODUCTION

The aim of this project is to develop a low cost self powered weather monitoring system with fast and accurate data transmission using emerging wireless technologies [1]. Current technological innovations involve controlling and monitoring of versatile activities. An efficient environmental weather monitoring system is required to determine and store the conditions of weather. By using the embedded intelligence into the environment makes the environment interactive with our monitoring system [2]. Sensors are devices that measure physical properties and convert them into electrical signals. In weather monitoring, for instance, various parameters of weather such as temperature, pressure, humidity, wind speed and wind direction need to be measured. By combining these sensors withdata acquisition system has proved to be a better approach for weather monitoring [3]. The purpose of wireless data transmission is to provide simplified mechanism instead of wired system and lower cost for long range communication [4].Weather monitoring is very much beneficial to the farmers to monitor weather parameters at their farms. This is also advantageous for the industrial processes, ultimately the weather monitoring possess prominent importance and has a positive impact on the society [5]. The collected data by weather monitoring system can easily be exported to a PC via a serial port to make subsequent data analysis or graphic and digital storage thus automatic data collection is possible without giving up PC resources [7] .Hence, the purpose of this project is to develop a low cost weather monitoring system with data logging and data visualization using commercially available and affordable components without sacrificing reliable and efficient data acquisition and monitoring capabilities of the system [8].

The procedure by which this perspicuous system operates has been explained in chapter 2. The brief overview of the entire system has been given in the chapter 3. The block diagram of the system has been included and the same has been explained. The various hardware components such as temperature and humidity sensor(DHT11),pressure sensor(BMP180),anemometer ,wind vane(HMC588L),GSM module, Microsd card, liquid crystal display(LCD) are used and explanation are given in the chapter 4.

The simulation for the system is done by using Proteus 8.6 professional and outputs are displayed using a liquid crystal display .The detailed explanation on this regaled has been given in the chapter 5.

II. METHODOLOGY

In this project, the proposed embedded system is used to monitor the miscellaneous weather parameters such as Temperature, Humidity, Atmospheric Pressure, Wind Speed and Wind Direction by using corresponding sensors.

The data from the sensors are collected by using ATmega328p microcontroller. The microcontroller is the main block of this particular system. The microcontroller processes the data sensed by the sensors and notify the user by various methods which include LCD, microSD card and GSM module[1][2]. The LCD module receives the data from the microcontroller and displays it in a legible format. The data is stored frequently in order to analyze and detect anomalous circumstances before hand. The microSD card is

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ISSN 2394-3785 (Online)
Available online at www.ijartet.com

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used to store and retrieve the sensed data at anytime for further analysis. The GSM module is used to transfer the sensed data to end user who is miles away from the system through messages. The system can be incorporatedwith numerous sensors based on the requirements of the end user. Hence, the emphasis is on collecting the data and transmitting the information to the end user.

III. BLOCK DIAGRAM

The block diagram is shown in Figure 1.The supply for the system is generated by the PV panel which is stored in the battery bank. To prevent the battery from over voltage charge controller is used. The generated supply is given to Atmega328 and other sensors through power regulator. The sensed data from the sensors are given to signal conditioning unit to remove the noise and other disturbance.

The noiseless data is given to the microcontroller and the data is processed. Finally the information about the weather is transferred to the user by means of LCD display and message through GSM module. Also the information is stored in micro SD card for further analysis. Through I2C interface LCD display is connected with the microcontroller. The SD card and GSM module connected with microcontroller through SPI interface and UART respectively.

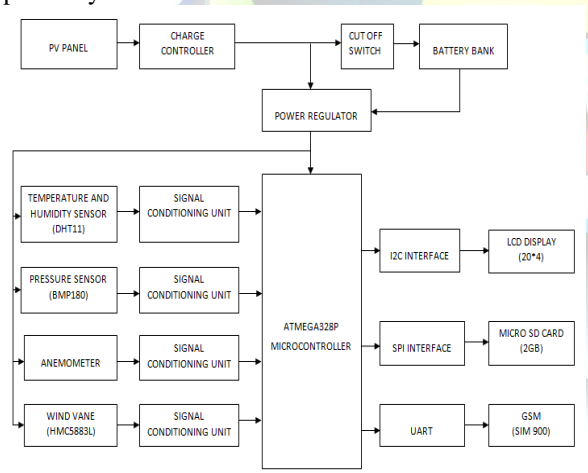

Fig. 1. Block diagram

IV. HARDWARE USED

A. *ATmega328 Microcontroller*

ATmega328 is an AVR based eight bit Microcontroller and can handle the data up to eight bit size. It has an inbuilt memory of 32kb. It operates from the range of 3.3V to 5V. The main advantage of ATmega328 is that when the supply to the biasing terminal is removed it is able to store the data. Cost efficiency, low power dissipation, programming lock for security purposes, real time counter with separate oscillator are some features of this microcontroller. It has 4K/8Kbytes of In-System Programmable Flash with Read-While-Write capabilities, 256/512/512/1Kbytes EEPROM, 512/1K/1K/2Kbytes SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible Timer/Counters with compare modes, internal and external interrupts, a serial programmable USART, a byte-oriented 2-wire Serial Interface, an SPI serial port[7][5].

B. *DHT11*

DHT11 is a low cost and high precision integrated temperature and humidity sensor [10]. It uses resistive humidity sensor to measure the surrounding air and a thermistor to measure the temperature. It sends output value on data pin of DHT11 and it is directly connected with analog pin of ATmega328[1][5]. It can measure temperature from the range of 0-50°C and humidity from 20-90% [4].

C. *BMP180*

BMP180 is digital barometric pressure sensor module [5]. It is a high precision sensor which measures the atmospheric pressure from the range of 300-1100hpa [10]. It is directly connected to ATmega through I2C interface. BMP180 consumes less power and it is smaller in size [1].

D. *Anemometer (Incremental Optical Rotary Encoder)*

The three cup anemometer is usedfor the measurement of wind speed. Itcontains an Incremental Optical Rotary Encoderwhich converts linear or rotary displacement into digital or pulse signals. Optical encoder consists of rotating disk, light source and photo detector. The two patterns are opaque and transparent sectors which are coded into the disk and the disk is mounted on the shaft [4].Pulse is generated by the incremental encoder for each incremental step in its rotation. The digital or pulse signal is generated when the disk rotates and patterns interrupt the light.

E. *HMC5883L*

Wind Vane contains HMC5883L triple axis magnetometer which is used for the measurement of direction from where the wind is blown [8][5]. HMC5883L is interfaced with ATmega328. The resultant direction is shown in the form of degree which ranges from 0 to 360 with the help of LCD.

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F. GSM Module

GSM Module provides the long range duplex data communication. The data packets will be uploaded into data storage cloud through General Packet Radio Service (GPRS). For the transmission of data quad band 900 MHz GSM Module is used [4]. The various weather parameters which are sensed by the sensors are transferred to the user through message [9]. Delay may occur during the processes of receiving messages [6].

G. Micro SD Card

Micro SD stands for Micro-Secure Digit. It is a removable flash memory card type. When SD card is connected with ATmega328 using SPI interface a new file is created. If the file is already existed the data from the sensors are over written [4]. The data from the file is stored and retrieved for further analysis.

V. RESULTS & DISCUSSION

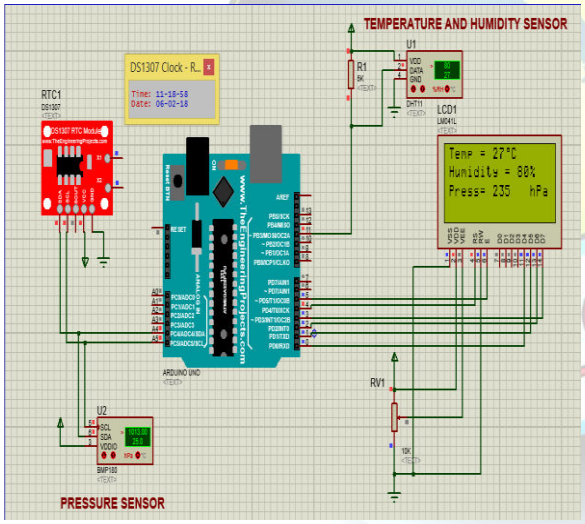

Fig. 2. Simulation diagram

The software used for simulation is Proteus 8.6 Professional. Especially this software is used forschematic capture, simulation and PCB layout design. It can be available in many configurations to meet the various requirements of microcontroller.

The 1st pin of temperature and humidity sensor is connected to 5V supply. The 2nd pin of temperature and humidity sensor is given to the analog pin 11 of arduino through a pull up resistance. The 5th and 6th pin of pressure sensor is connected to analog pin SCL and SDA pin of Arduino UNO. Through I2C interface, SCL and SDA pin of RTC module is given to analog pin of arduino. The 4 bit communication is used to display the temperature, humidity, pressure, wind speed and wind direction.

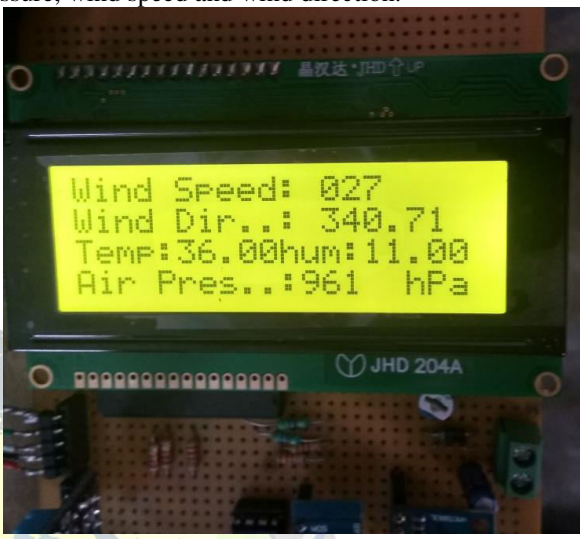

Fig. 3. Hardware output

VI. CONCLUSION

From this project, we have designed a cost effective, self-powered weather monitoring system that can operate remotely and store various parameters of weather along with time [1][5]. The wind speed is measured using incremental optical rotary encoder. Wind direction is estimated using triple axis magnetometer based wind vane. The temperature and humidity is measured using DHT11 sensor. The pressure is measured using barometric pressure sensor (BMP180). The parameters of weather that are displayed in an LCD and data acquisition are done in micro SD card.

ACKNOWLEDGMENT

This research was supported by KST Windengineering India. We would like to show our immense gratitude to the Chief Technical Officer of the above mentioned institution for sharing their pearls of wisdom with us during the course of this research and we also thank anonymously each and everyone who helped us for their insights.

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