Real Time Weather Monitoring System

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Abstract— Weather reflects the short term change in our atmosphere, the volatile variable in our environment. Monitoring weather trends can give us an insight into the environment around us. The aim of this paper is to build an automated real time weather monitoring system by leveraging the power of Open Source Hardware. Never has the open source community been this much connected and implementation of this technology so convenient. All data is collected by different types of sensors available locally and are controlled using a microcontroller. Meteorological parameters being considered here are: Temperature, Humidity, Barometric Pressure, Rainfall and Wind Speed. Parameters like Heat Index and Wind Chill which are derived from combinations of Temperature &Humidity and Temperature & Wind-Speed respectively can also be calculated.

Key words: DHT11 , BMP 180, Tipping Bucket, Reed Switch, Arduino

I. INTRODUCTION

An automated weather system is a device that collects meteorological parameters in real time. Measured parameters can be then stored in data logger or transmitted to a remote link. Although there are many commercially available weather stations, but they are not tailored for a specific location and thus have features that might never be actually used e.g. suppose a weather station has a temp range of -50 *C to 100 *C, but we might not be fully able to this feature because here in New Delhi, temperature never drops below 0 *C or exceeds 50 *C. Also, these commercial weather stations are expensive. Thus, it is not feasible to establish these kinds of weather stations for a relatively smaller area. So, the challenge confronting us is cost effective weather station, hat is tailored for a particular geography.

A. Materials and Methods

1) Arduino Mega 2560

The Arduino Mega 2560 is a microcontroller board based on the ATmega2560. It has 54 digital input/output pins (of which 15 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started [1].

B. DHT 11Temperature and Humidity Sensor

1) Description

The DHT11 is a basic, ultra low-cost digital temperature and humidity sensor. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air, and spits out a digital signal on the data pin (no analog input pins needed). It is fairly simple to use, but requires careful timing to grab data. The only real downside of this sensor is you can only get new data from it once every 2 seconds, so when using our library, sensor readings can be up to 2 seconds old. Compared to the DHT22, this sensor is less precise, less accurate and works in a smaller range of temperature/humidity, but it is smaller and less expensive.

2) Technical Details

- Low cost
- 3 to 5V power and I/O
- 2.5mA max current use during conversion (while requesting data)
- Good for 20-80% humidity readings with 5% accuracy
- Good for 0-50°C temperature readings ±2°C accuracy
- No more than 1 Hz sampling rate (once every second) [2].

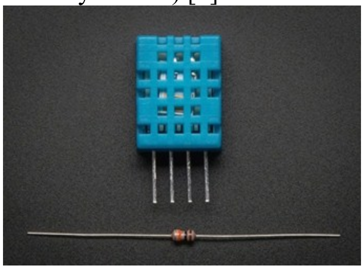

Fig. 1: DHT 11 Sensors [2]

C. BMP180 Barometric Pressure Sensor

1) Description

This precision sensor from Bosch is the best low-cost sensing solution for measuring barometric pressure and temperature. Because pressure changes with altitude you can also use it as an altimeter! The sensor is soldered onto a PCB with a 3.3V regulator, I2C level shifter and pull-up resistors on the I2C pins.

2) Technical Details
Vin: 3 to 5VDC
Logic: 3 to 5V compliant
Pressure sensing range: 300-1100 hPa (9000m to -500m above sea level) Up to 0.03hPa / 0.25m resolution
-40 to +85°C operational range, +-2°C temperature accuracy
This board/chip uses I2C 7-bit address 0x77 [3].

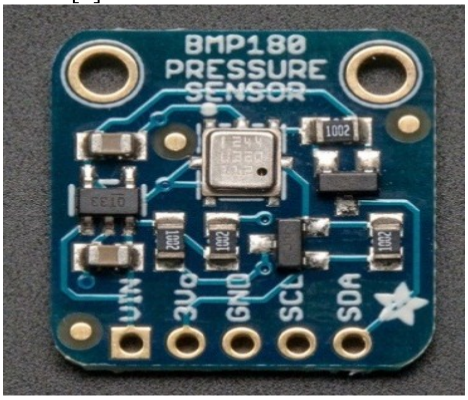

Fig. 2: BMP 180 Sensor[3]

D. Rain Gauge(Using a Tipping Bucket)

A tipping bucket rain gauge has several components that allow it to accurately measure of rainfall. As rain falls it lands in the funnel of the tipping bucket rain gauge. The rain travels down the funnel and drips into one of two very carefully calibrated 'buckets' balanced on a pivot (like a see-saw).

The bucket is held in place until it has been filled to the calibrated amount. When the bucket has filled to this amount, the bucket will tip. The water then empties down a drainage hole and raises the other to sit underneath the funnel. When the bucket tips, it triggers a reed switch (or sensor), sending a message to the display or weather station [4].

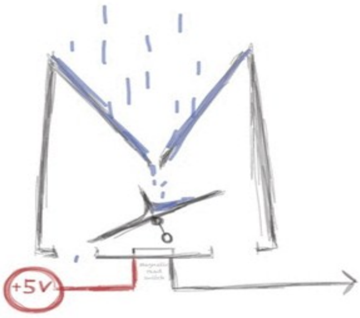

Fig. 3: Rain Gauge(Using a Tipping Bucket)

A tipping bucket rain gauge [5]

E. Anemometer

To measure wind speed here, a cup anemometer is used. On one of the cups, a magnet is placed, and just parallel to it a reed switch (or any other sensor that can detect magnetic field) is placed on a fixed disk. The Arduino measures, how many times the sensor switches from "off" to "on" in a fixed time and correspondingly gives the wind speed. This fixed time will determine sampling rate of this device. The maximum sampling rate will depend upon the sensor being used.

Fig. 4: Anemometer

A cup anemometer [6]

II. BLOCK DIAGRAM

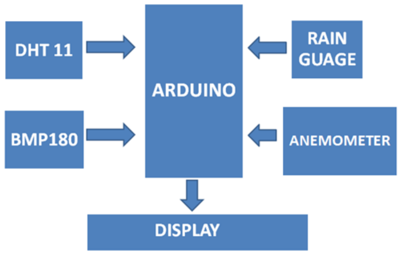

Fig. 5: Block Diagram

III. RESULT

This paper demonstrates the design and implementation of Real Time Weather Monitoring System used for monitoring the environmental parameters listed above. All the sensors have been integrated with the Arduino board to measure all the considered parameters successfully.

IV. DISCUSSION

The output data could be exported to MATLAB (or any other similar software) to plot graphs for each parameter. A wireless data transmitter like an Arduino Wi-Fi Shield [9] or ESP8266 [10] could be used to transmit data to a remote link. A SD card shield can also be added, that stores data (until the SD card is full) when the wireless transmitter fails.

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