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# Design and Development of Portable Weather System Using Arduino

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**ABSTRACT.**

This product is to design a weather station system using Arduino. The main concern of the product is the temperature and humidity. Even in some urban areas where we have weather monitoring systems and station, there are still barriers partly due to high import costs. Therefore, operating and managing some of the most technical difficulties for the public uses required expertise. In addition ,the product is simpler in its design making it more innovative. There are many potential users like small farmers, researchers, travellers, schools and institutions. The most unique things about this product is the uses of the Arduino microcontroller.

**Keywords** : Portable Weather Monitoring System, Arduino-based IoT Application, Temperature and Humidity Sensors, Real-time Data Visualization, WiFi-Enable Environmental Monitoring.

## 1. Introduction

The weather has always been a subject of universal interest, and as consequence, human beings have always been concerned about its environmental variations since the earliest days of recorded history[1]. Eye observation and guess forecasting were the original tools that had been used in the past to predict the weather. Only recently people started to understand the basics and elements that control the weather well enough to accurately predict how the weather is going to be, so that advanced planning and intelligent actions can be made based on it. [2]

The Weather station is used worldwide for climatology monitoring is facility with instruments and equipment observing atmospheric condition to provide information for weather forecasts [3]. It is a device that can monitor temperature and humidity of the surrounding Using sensors to measure different weather parameters is not a new idea. In fact, the science of metrology is said to be existed since the 7th century with the invention of the barometer and thermometer.[4]

As for that it will gain more people interest in this product [5-7]. Satellite sometimes gives a false warning of weather condition due to the distance of the satellite itself [8]. Even in some urban areas of the country where we have these weather monitoring systems and stations/devices, there are still some constraints; partly due to the high cost of importation. Also, operating and managing some of these technical expertise making their use some how difficult even for the public uses let alone users like small scale farmer or agriculturists, industrialist, researchers, travellers, school and institutions.

There are many mini weather station in the market but the problem is the price per each.Usually each of the product come without wireless features and not portable meaning that needs direct current or electric supply to power it. In my product ,I made an improvement where its comes with portable features and ready to use and WiFi supported.

Arduino Mega are widely available, globally supported and open source computing platforms for controlling hardware. There are many environmental monitoring sensors that are easy to interface with Arduino boards This product also make our life easier and can get the result as soon as possible. By using DHT22 the reading for temperature and humidity is more accurate compare to other sensor.

To make it connect to the cloud based server , ESP8266 WiFi Shield is used. This wifi shield worked with 5V and take minimum 5 seconds to boot up. Using this wifi shield, allowed me to add some other sensors such as Rain sensor, pressure sensor and real time cloak. When the wifi shield is powered up, the data will be sent to Blynk. Blynk is the smartphone application where can displayed the real time data. Also the data will be display at LCD, so that we can compare either the data is valid on LCD or Blynk [9].

We shall use a new technology IOT (Internet of Things) to get fastest notification of the data. We shall use a website or application under the IOT technology to get fastest response from the module. The other module and things which are used in this product is microcontroller with Wi-Fi module, LED for indication, a buzzer to notify local peoples and temperature and humidity sensors (DHT 22).

## 2. Design of Portable Weather System

*1. Arduino Uno R3 (microcontroller)*

**Figure 1.** Arduino Uno R3.

Arduino Uno R3 is a microcontroller board based on on ATmega328 show in figure 1. It has 14 digital Input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonators 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 a AC-DC adapter or battery to get started.

*2 Piezo buzzer.*

This buzzer consist of two wires, Red and Black. It apply an oscillation voltage to mke a noise. The buzzer case supports the piez0 element and has resonant cavity for sound.Oscillating voltage alternately squeezes and releases the piezo element. Must apply fluctuating voltage,a steady HIGH or LOW won't work.Piezo leads are very thin.Piezo buzzer also can produce a melody beside sound based on Arduino code.

*3 Temperature and humidity sensor (DHT22).*

**Figure 2.** Temperature and humidity sensor (DHT22).

Temperature and humidity sensor (DHT22) shown in figure 2. This economical sensor and here is spesification for DHT22, operating voltage is 3.3 V to 5 V. Operating current is 0.3 mA and 0.6 µA for standby mode. For communication and transfer data using serial data (analong/digital). Temparature range is -40 °C to 80 °C. for humidity range is 0% to 100% and accurancy tolerance in ±0.5 °C (temperature) and ±1%(humidity)

*4 Wifi Module (ESP 8266).*

**Figure 3.** Wifi Module (ESP8266).

Wifi module (ESP 8266) shown in figure 3. spesification for ESP 8266, operating voltage is 3 V to 3.6 V. Operating current is average value on 80 mA. Protocol data communication wireless in 802.11 b/g/n, intergated low power 32 bit MCU and Frequency range 2.4 GHz to 2.5 GHz.

*5 Measure Temperature, Pressure and Altitude (BMP280).*


**Figure 4.** Measure Temperature, Pressure and Altitude (BMP280).

Measure Temperature, Pressure and Altitude (BMP280) shown in figure 4. spesification for BMP280, Current consumption is 27 µA. Protocol data communication in digital $I^2C$/SPI. Pressure range is 300 to 1100 hPa.

## 3. Methodology

Figure 5 shown flow chart for portable weather station system. It is more focused on the how to make this weather station systems to work functionally. Mainly this product is powered by Arduino Uno and DHT22 temperature and humidity sensor. Using this sensor correctly will allow us to capture the temperature and humidity data. Also connect the board with WIFI module will allow us to access and view the data through online. And also liquid crystal displayed (LCD)16x2 with i2c module installed with the Arduino to view the data live.

The process of the programming is using Arduino IDE to synchronize programme the Arduino to communicate with the sensors and get the real time data easily. The DHT22 temperature and humidity sensor directly connected to Arduino microcontroller and programmed to collect the temperature and humidity data in degree celcius and percentage. The collected data are sent to Wifi module so that the data can be transmitted to cloud server. Once the ping signal is stable , users can access the data by turning on theirs mobile phones and internet through Blynk application.

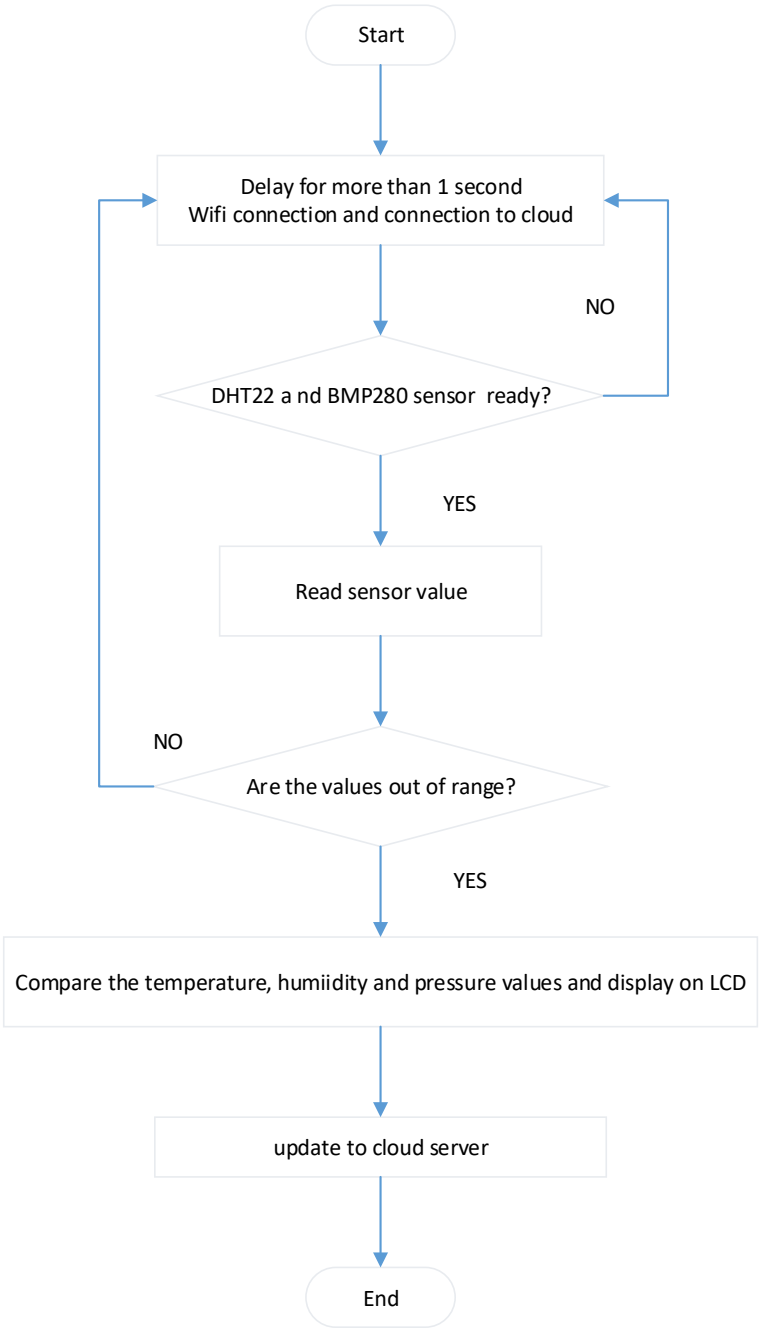


**Figure 5.** Flow chrat portable weather station system

In addition, it is suggested to add rain sensor can be placed outdoor and by adding rain sensor, users will alert with the alarm when the rain is pouring. It also suggested that by adding BMP280 Pressure sensor can be more advance because BMP280 pressure sensor will sense the pressure of the cloud either its heavier and want to rain or not.

## 4. Result And Discussion

Protable weather system is shwon in Figure 6. This prototype has been tested for the temperature humidity, pressure and network connection.The Arduino IDE was used in developing the sketches that were uploaded as firmware into the microcontroller. Thereafter, the system could work without the user's intervention. Libraries are required for a robust firmware development using Arduino. In this case, we used the 'LiquidCrystal' and 'dht' libraries. Next we set the Arduino pins and attached them to the LCD for display. Arduino pins SDA and SCL were attached to the SDA and SCL pins respectively on the LCD. The 'pinMode' of Arduino pin 5 was set as INPUT. This is the pin that reads the numeric values from the signal pin of the DHT11 sensor. At least a second delay is required to get reliable readings from the DHT11 sensor. However, we used three(3) seconds delay to ensure that the previous values have been displayed. It is also important to confirm that the temperate and humidity readings are within the acceptable range for the sensor. In this work the humidity range was between 0 – 100% relative humidity, while the temperature ranged between -40 to 80℃. Once the read values are within range, it is displayed on the LCD screen. Figure 7 and 8 shown that the temperature and humidity sensors working correctly and display the data through LCD.

**Figure 6.** Protoype Portable Weather System


**Figure 7.**Temperature and Humidity


**Figure 8.** Pressure and Altitude

Figure 9 show that Blynk apps is working correctly and the data received simultaneously with the ping on screen.

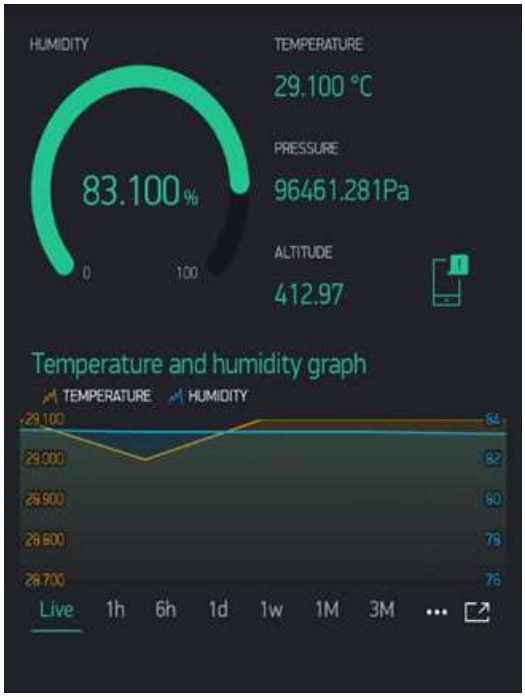


**Figure 9.** Blynk data

*Testing the sensors more than 8 hours and gathers all the data*

Figure 10 show that the data on 8 hour for temperature and humidity. The systems now working correctly for 12 hours.

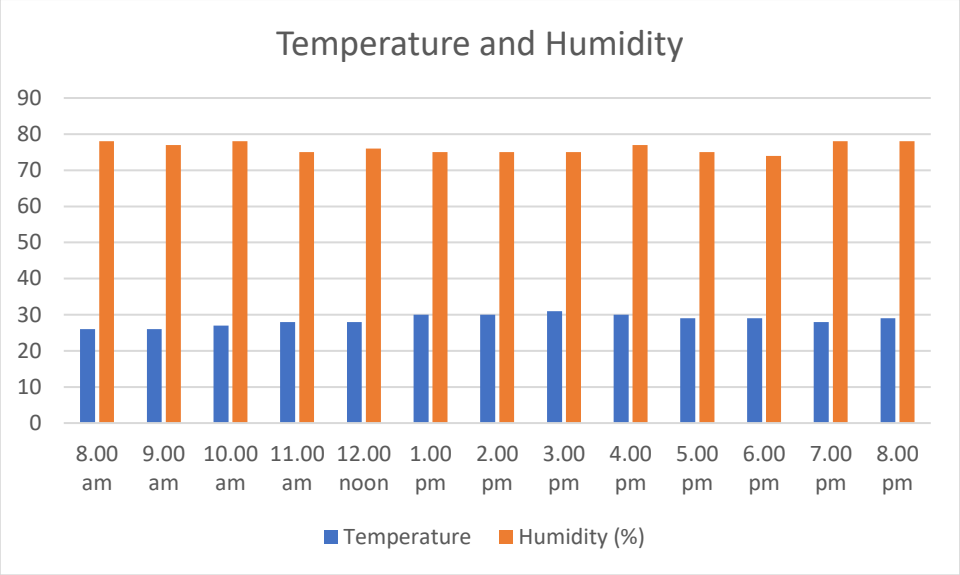


**Figure 10.** Temperature and humidity for 8 hours

Based on the results, all the data received and this system monitors the changes happening over the environment and provides the sufficient ways for the users to access the information from anywhere through cloud. The temperature and humidity sensor (DHT 22) will monitor and gives the details about the changes happening over the climate. The pressure and altitude sensor (BMP 280) is used for monitoring the pressure of the atmosphere and the altitude of the cloud, also by using this sensor we can predict the rain. The lower pressure air is always pushed by the surrounded higher pressure air (because air moves from high pressure to low pressure. When this higher pressure air pushes horizontally, the low pressure air moves vertically upward. As this air moves upward, it will become more denser and forms clouds and we will get rain.

## 5. Conclusion

In conclusion, there are many mini weather stations in the market but the problem is the price per each. Usually each of the product come without wireless features and not portable meaning that needs direct current or electric supply to power it. I made an improvement where its comes with portable features and ready to use and WiFi supported. Mainly this prototype used Arduino Mega, where are inexpensive, widely available, globally supported and open source computing platforms for controlling hardware. There are many environmental monitoring sensors that are easy to interface with Arduino boards. This prototype also make our life easier and can get the result as soon as possible. Based on the performance of the systems, it can be said that the performance is in line with objective of the product. Meaning that the objectives are achieved within a set of time. Last but not least, I hope that the product will be fully functional worked because this product can help the agriculture sector to collect data and maximizes their production combining with Malaysia Agriculture Organization (MOA) technology.

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