



WEATHER MONITORING SYSTEM USING ARDUINO UNO

¹Vaishnavi Gotmare, ²Rajesh Kolte, ³Rutwik Thengodkar

Information Technology Usha Mittal Institute of Technology Santacruz(w), India^{1,2}, Life Science & Biotechnology Cyanofarm Research Lab UVSS, Keshavrushti, Bhayander(w), India³
vaishugotmare@gmail.com¹, raj_kolte@gmail.com², cyanofarm@gmail.com³

ABSTRACT

This project presents a design of weather monitoring system. It stores data collected at some pre-determined sampling interval, with date and time stamps for later retrieval with real-time notifications for supervision and analysis of different environmental parameters like temperature, humidity, atmospheric pressure, wind speed, wind direction, air quality, light intensity, amount of rainfall and co-ordinates of the location. It consists of an Arduino UNO (micro-processor) which acts as a gateway to collect data and information through different probes. Such type of system can be used in controlled environment like agriculture farms and aqua culture. The idea behind it is mainly weather monitoring and forecasting at micro-ecological level, monitoring upcoming situations to sound alerts during unfavorable circumstances.

Keywords- *Arduino Uno, Microprocessor, Weather forecast.*

INTRODUCTION

Weather is a daily aspect but climate is the average of atmospheric conditions over a longer period of time. Weather changes with respect to the latitude and longitude of a place so even small changes may lead to large effects on the system. In the past few years, the increase in human activities and growing industries has had a drastic impact on the weather conditions. We need to be aware and ready for the upcoming disasters hence weather forecasting is important. In India, weather forecasting system are setup at a proximity of 32kms, due to their cost constraint. The data gathered by those stations is insufficient, eventually the accuracy is affected to a greater extend. In order to monitor the changes an effective system needs to be designed. A weather station is used to measure atmospheric conditions at different locations at different periods of time for weather forecasts and to study different climatic conditions. Weather is mainly driven by temperature, humidity and atmospheric pressure. Other parameters like wind speed, wind direction and precipitation amount can also be measured. These parameters can be recorded periodically and a statistical analysis can be obtained which can determine the future conditions. India is an agriculture-based country, almost 17-18% of the country's GDP is contributed by agriculture which accounts to 50 percent of the workforce, but it is totally dependent on weather and rainfall, so weather monitoring needs to be accurate as well as zone specific in order to plan contingency for the upcoming situations.

LITERATURE REVIEW

Weather Forecasting using Arduino Based Cube-Sat, by M. Rahaman Laskar, R. Bhattacharjee, M. SauGiri and P. Bhattacharya[1]. They have designed an autonomous small cube satellite which provides the weather information without using any internet network. The limitations of this system are that it may not communicate to a long distance without powerful transceivers section, there may be problem in recording data at higher altitude

with the help of gas balloon. The components have no protection from rain so they may get damaged even due to long time use.

Arduino Based Weather Monitoring System by Jitendra Singh, Rehan Mohammed, Mradul Kankaria, Roshan Panchal, Sachin Singh, Rahul Sharma[2]. They have presented an automated system for weather monitoring which uses different sensors like DHT11, Light dependent resistor and Rain sensor.

Implementation of Weather Monitoring System by Kiranmai Nandagiri and Jhansi Rani Meetu[3]. The authors have proposed a system which senses the temperature and humidity of a particular room. The system cannot be operated from anywhere and the data collected is not accessible.

Wireless Arduino Based Weather Station by Amber Katyal, Ravi Yadav, Manoj Pandey[4]. The authors have described a system with Arduino which functions using a Wi-Fi shield and different sensors like DHT11, BMP 185, Rain sensor, soil moisture sensor, etc. They used Thinkspak in order to use MATLAB to get knowledge from the information obtained from the readings on the server.

Design of Weather Monitoring System Using Arduino Based Database Implementation by Sarmad Nozad Mahmood Forat Falih Hasan[5]. The R language is used to evaluate results and reveal outputs. They have setup a control unit which can operate other appliances like a.c, heater, fans etc.

Raspberry Pi Based Weather Monitoring System by Meetali V. Rasal, Prof. Jaideep G. Rana[6]. The authors have proposed a model which can visualize and store various weather parameters and with the help of sensors interfaced to raspberry pi which stored data in SD card and it can be controlled using the LCD display which shows results. A web application with the current status recorded can be accessed by logging in using the username and password which will give the output in the form of graphically represented data.

IoT Based Weather Monitoring System using Raspberry Pi by Shubham R. Vilayatkar, Vaibhav R. Wankhade, Pranjali G. Wangekar, Nikhil S. Mundane[8]. The authors have proposed a system in which different sensors it is read by server and stores it in a csv and textual format.

Arduino Based Automatic Wireless Weather Station with Remote Graphical Application and Alerts by Hardeep Saini, Abhishek Thakur, Satinderpar Ahuja, Nitant Sabharwal, Naveen Kumar[9]. The model proposed in this system includes Zigbee wireless technology which measures the meteorological data.

PROPOSED SYSTEM

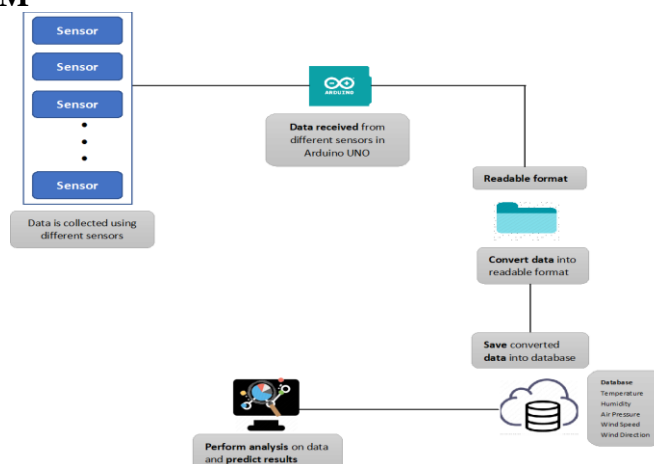


Fig 1: Architectural Diagram of the System

SYSTEM MODULES :

Arduino UNO is a Micro-chip Atmega-328p microcontroller which is open-source, it consists of a physical program control board and a software which can be installed on your computer, you can program code in the computer and then upload it on the physical board. It is a IDE (Integrated Development Environment) it has resources like, source code editor, automation tools and a debugger.

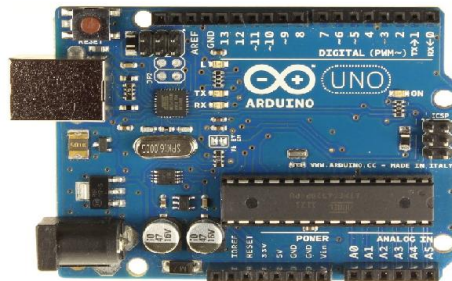


Fig 2: Arduino UNO Atmega 328p board[13]

- Temperature and Humidity Module :

Temperature / Humidity sensor (DHT) measures the values of and periodically based on the period with digital signal output. The Temperature / Humidity sensor (DHT11) is given by 3 pins identified as VCC connected to the 5V of Arduino, GND connected to Arduino GND, and DATA pin connected to the digital pin of Arduino board. DHT sensor is constructed of resistive type element that reads humidity and negative temperature coefficient NTC element. It uses a capacitive humidity instrument and a thermistor to measure the surrounding air. The sensor demonstrate sensitivity, reliability, stability, high response and can be found in a low cost.

1. Temperature range: $0-50^{\circ}\text{C} / + / -2^{\circ}\text{C}$

2. Humidity range: $20-80 / + / -2^{\circ}\text{C}$

3. Sampling rate: 1Hz (one reading every second)

4. Body size: $15.5\text{mm} * 12\text{mm} * 5.5\text{mm}$

5. Operating voltage: 3-5 V.

6. Max current during measure: 2.5mA

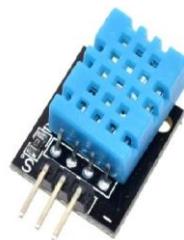


Fig 3: DHT 11 Temperature and Humidity Sensor[13]

- Pressure Module :

The BMP 180 sensor records actual barometric pressure (station pressure) and not the sea level. It is a digital module. No analog pins are required.



Fig 4: BMP 180 Air Pressure Sensor[13]

- Anemometer Module :

Anemometer is a device used to measure wind speed and wind direction. It measures wind speed in a local specific location. Anemometer is designed to be equipped outdoor in order to efficiently transfer the analog signal to the Arduino board. The working principle of the proposed wind speed sensor depends on the construction of the anemometer. The interior structure of the device is constructed of a motor that works in synchronous with the revolving cups rotation. The rotation of the revolving cups gives a synchronous moving to the motor due the pole combination between the motor and the Hub, which carries the cups. The wind speed sensor attached to the analog pin of employed Arduino board. The amount of voltage generated by the rotation of the cups is handed up to the analog pin of the Arduino and hence the wind speed is calculated based on conclusive formulas represented by Arduino IDE code.

a. Style: three/four cups suspended perpendicular to each other attached to the centre piece with a stand.

- Air Quality Module :

A. MQ-9 Carbon Monoxide, Methane and LPG Gas Sensor Module.

a. Carbon Monoxide (CO) sensor, suitable for sensing CO concentrations in the air.

b. This sensor has a high sensitivity and fast reaction time. The sensor's output is an analog resistance.

c. Standard working Temperature: 20°C +/-2°C.

d. Relative humidity: 65% +/-5%.

e. RL: 10K s Ω +/-5%.

f. Detecting range:20ppm-2000ppm carbon monoxide.



Fig 5: MQ-9 Sensor.[13]

LIGHT INTENSITY MODULE

Light intensity is measured using an LDR. An LDR is a component that has a (variable) resistance that changes with the light intensity that falls upon it. A light dependent resistor (LDR) is a light-controlled inconstant resistor. The resistance of this decreases with increasing incident light intensity; in other words, it exhibits photoconductivity. Photocell sensor or light dependence resistance (LDR) component is the part responsible of measuring the value of the lights falling over photo resistor element that equipped at the top of the module piece as exposed. The proposed sensor provides four input pins denoted by VCC, GND, digital pin D0, and analog pin A0. The digital pin D0 is the pin responsible of transferring the signal between the sensor and the microcontroller for instantaneous signalling reactions. The proposed connection scheme regarding photocell sensor based Arduino microcontroller is put into account such that VCC of the sensor is connected to the 5V of Arduino, GND of the sensor to the GND of Arduino, and D0 is attached to pin 2 of Arduino.

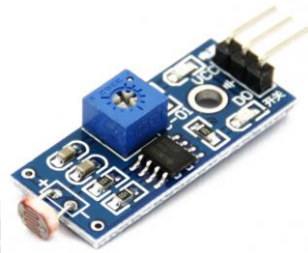


Fig 6: Light dependent resistor sensor[13]

RAIN GAUGE MODULE

Rain gauges generally measure the precipitation in millimetres in height collected on each square meter during a certain period, equivalent to litres per square metre. Water Level Depth Detection Sensor for Rain Gauge. It is an instrument used by meteorologists and hydrologists to gather and measure the amount of liquid precipitation over an area in a predefined period of time. It calculates the amount of liquid present in the container and computes volume and gives the capacity to with the container is filled. A Tipping bucket module is being proposed in this module.



Fig 7: Water level Sensor.[13]

CO-ORDINATE MODULE

A geographic coordinate system is a system that uses a three-dimensional spherical surface to determine locations on the Earth. Locations north of the equator have positive Latitudes that range from 0 to +90 degrees, while locations south of the equator have negative latitudes that range from 0

to -90 degrees. But Longitude lines run north-south. They converge at the poles. And its X-coordinates are between -180 and +180 degrees.



Fig 8: Geographic coordinate Sensor.[13]

Open-source software tools are being used to store data collected from the Arduino. Data collected is stored in databases and can be easily retrieved when required.

Pre-defined time stamps are set so that continuous storage of data is not hampered. Analytical models are used to infer further conclusions based on the results obtained from the sensors.

IMPLEMENTATION

Arduino IDE with inbuilt libraries was used. DHT11 and Adafruit libraries were installed with their latest versions.

An Arduino program was written to obtain temperature and humidity from DHT11 sensor in Fahrenheit and Degree Celsius.

```

DHTTester | Arduino 1.8.9
File Edit Sketch Tools Help
DHTTester
#include "DHT.h"
#define DHTPIN 2
#define DHTTYPE DHT11
DHT dht(DHTPIN, DHTTYPE);

void setup()
{
  Serial.begin(9600);
  dht.begin();
}

void loop()
{
  delay(2000);
  float h = dht.readHumidity();
  // Read temperature as Celsius (the default)
  float t = dht.readTemperature();
  // Read temperature as Fahrenheit (isFahrenheit = true)
  float f = dht.readTemperature(true);
  // Check if any reads failed and exit early (to try again).
  if (!isnan(h) || !isnan(t) || !isnan(f))
  {
    Serial.println(F("Failed to read from DHT sensor!"));
    return;
  }
  // Compute heat index in Fahrenheit (the default)
  float hif = dht.computeHeatIndex(f, h);
  // Compute heat index in Celsius (isFahrenheit = false)
  float hic = dht.computeHeatIndex(t, h, false);

  Serial.print(t);
  Serial.print(" ");
  Serial.print(h);
  Serial.println();
}

```

Fig 9: Arduino code for DHT 11 sensor.

It was connected to the open-source data collection tool using python programming which gets connected to the MYSQL database server in which the data is being stored in specific intervals.

The COM4 port interacts with the python program, the program contains the database name which will be used to store data. The task scheduler is used to carry out the task in specified intervals of time for the amount of days data needs to be monitored.

CONCLUSION

Arduino Uno was successful in fetching data from sensors i.e. DHT11 that will compute the temperature and humidity. The data from DHT11 is being sent to the open-source database used to store data at regular intervals. It is displayed in graphical/bar plots for easy understanding.

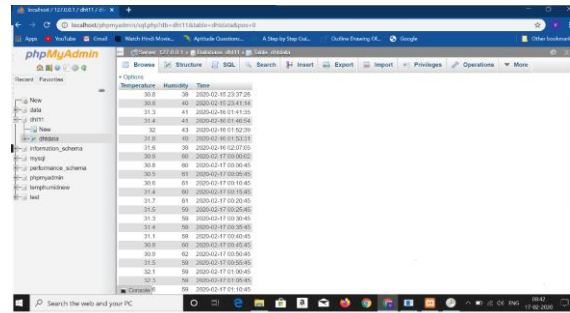


Fig 10: Data obtained and stored in MySQL database.

Data was extracted in graphical formats like bar graphs, line graphs, column graphs etc.

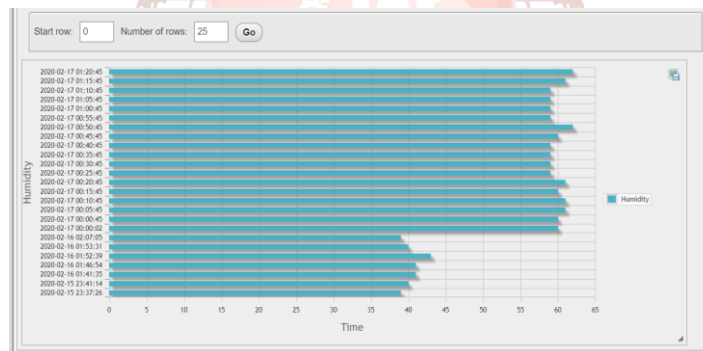


Fig 11: Time vs. Humidity plot of data in graph

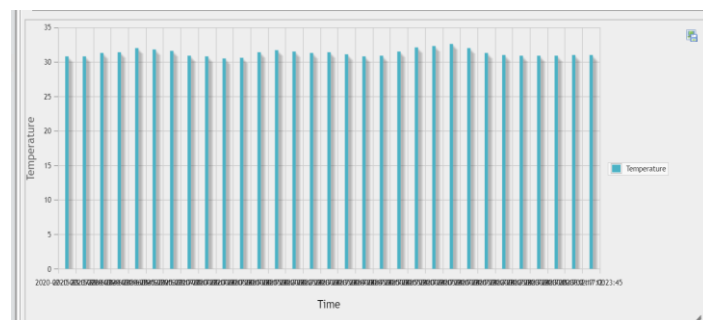


Fig 12: Time vs. Temperature plot of data in graph.

REFERENCES

[1] Laskar, M. Rahaman, R. Bhattacharjee, M. Sau Giri, and P. Bhattacharya. "Weather forecasting using Arduino based cube-sat." *Procedia Computer Science* 89 (2016): 320-323.

- [2] Jitendra Singh , Rehan Mohammed , Mradul Kankaria , Roshan Panchal, Sachin Singh , Rahul Sharma, "Arduino Based Weather Monitoring System", *International Journal of Advanced in Management, Technology and Engineering Sciences* 3, vol. 8, 2018.
- [3] Nandagiri, Kiranmai, and Jhansi Rani Mettu. "Implementation of Weather Monitoring System." *International Journal of Pure and Applied Mathematics* 118, no. 16 (2018): 477-493.
- [4] Katyal, Amber, Ravi Yadav, and Manoj Pandey. "Wireless arduino based weather station." *International Journal of Advanced Research in Computer and Communication Engineering* 5, no. 4 (2016): 274-276.
- [5] Mahmood, Sarmad Nozad, and Forat F. Hasan. "Design of weather monitoring system using Arduino based database implementation." *Journal of Multidisciplinary Engineering Science and Technology (JMEST)* 4, no. 4 (2017): 7109.
- [6] Meetal V. Rasal, Prof. Jaideep G. Rana . "Raspberry Pi Based Weather Monitoring System.", *International Journal of Advanced Research in Computer and Communication Engineering* 10, vol. 5, 2016.
- [7] Krishnamurthi, Karthik, Suraj Thapa, Lokesh Kothari, and Arun Prakash. "Arduino based weather monitoring system." *International Journal of Engineering Research and General Science* 3, no. 2 (2015): 452-458.
- [8] Shubham R. Vilayatkar, Vaibhav R. Wankhade, Pranjali G. Wangekar, Nikhil S. Mundane. "IoT Based Weather Monitoring System using Raspberry Pi." *International Research Journal of Engineering and Technology (IRJET)* 1, vol. 06, 2019.
- [9] Hardeep Saini, Abhishek Thakur, Satinderpar Ahuja, Nitant Sabharwal, Naveen Kumar,"Arduino Based Automatic Wireless Weather Station with Remote Graphical Application and Alerts" , *International Research Journal of Engineering and Technology* 4, no. 5 (2017): 3184-3189.
- [10] Gheorge, A. C., and M. S. Chiran. "Raspberry Pi Based Weather Station." *The Scientific Bulletin of Electrical Engineering Faculty* 18, no. 2 (2018): 63-66.
- [11] Yashaswi Rahut, Rimsha Afreen, and Divya Kamini. "Smart weather monitoring and real time alert system using IoT." (2018).
- [12] Rao, Bulipe Srinivas, K. Srinivasa Rao, and N. Ome. "Internet of Things (IoT) based weather monitoring system." *International Journal of Advanced Research in Computer and Communication Engineering* 5, no. 9 (2016): 312-319.
- [13] Robu : <https://robu.in/>