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Thalavapalayam, Karur – 639 113.

DETECTING WEATHER STATION USING ARDUINO

A MINOR PROJECT - III REPORT

Submitted by

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BACHELOR OF ENGINEERING

in

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

M.KUMARASAMY COLLEGE OF ENGINEERING

(Autonomous)

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BONAFIDE CERTIFICATE

Certified that this **18ECP103/104L - Minor Project III** report **"DETECTING WEATHER STATION USING ARDUINO"** is the bonafide work of **"SNEHA R (927621BEC202) SUNMATHI S (927621BEC223) YAKSHINI M (927621BEC244)"** who carried out the project work under my supervision in the academic year **2023-2024-ODD SEMESTER**.

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This report has been submitted for the **18ECP105L – Minor Project-III** final review held at M.Kumarasamy College of Engineering, Karur on _____**.**

PROJECT COORDINATOR

INSTITUTION VISION AND MISSION

Vision

To emerge as a leader among the top institutions in the field of technical education.

Mission

M1: Produce smart technocrats with empirical knowledge who can surmount the global challenges.

M2: Create a diverse, fully -engaged, learner -centric campus environment to provide quality education to the students.

M3: Maintain mutually beneficial partnerships with our alumni, industry and professional associations

DEPARTMENT VISION, MISSION, PEO, PO AND PSO

Vision

To empower the Electronics and Communication Engineering students with emerging technologies, professionalism, innovative research and social responsibility.

Mission

M1: Attain the academic excellence through innovative teaching learning process, research areas & laboratories and Consultancy projects.

M2: Inculcate the students in problem solving and lifelong learning ability.

M3: Provide entrepreneurial skills and leadership qualities.

M4: Render the technical knowledge and skills of faculty members.

Program Educational Objectives

PEO1: Core Competence: Graduates will have a successful career in academia or industry associated with Electronics and Communication Engineering

PEO2: Professionalism: Graduates will provide feasible solutions for the challenging problems through comprehensive research and innovation in the allied areas of Electronics and Communication Engineering.

PEO3: Lifelong Learning: Graduates will contribute to the social needs through lifelong learning, practicing professional ethics and leadership quality

Program Outcomes

PO 1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO 2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO 3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO 4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO 5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO 6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO 7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO 8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO 9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO 10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO 11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO 12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes

PSO1: Applying knowledge in various areas, like Electronics, Communications, Signal processing, VLSI, Embedded systems etc., in the design and implementation of Engineering application.

PSO2: Able to solve complex problems in Electronics and Communication Engineering with analytical and managerial skills either independently or in team using latest hardware and software tools to fulfil the industrial expectations.

Abstract	**Matching with POs, PSOs**
Arduino uno,Temperature,Humidity, Weather station.	**PO 1,PO 2,PO 7,PO 9,PSO 1**

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ABSTRACT

A weather station is a facility located either on land or sea consisting of instruments and equipment which can be used to measure atmospheric conditions so as to provide weather forecasts information and to study the weather. The existing instruments used for measuring the weather elements are expensive which led to the development of a low-cost Arduino-based weather station. The developed low-cost weather station consists of three separate modules which are data collection, data storage, and data communication. These modules communicate serially with each other and are controlled by three separate microcontrollers (Arduino Uno). The data collection module is interfaced with a set of sensors that collects temperature and humidity. The weather data were viewed in real-time through a graphical user interface (GUI) located at the central station. The developed weather station was able to measure the temperature and humidity of a controlled environment, giving the reading at interval of five minutes. It was observed that the average temperature from results obtained (27.360C) with the developed low-cost Arduino based weather station falls within the range of the Accurate weather readings (24.00-28.000C). Also, the average humidity of the developed low-cost Arduino based weather station (80.41%) falls within the range of the Weather sparkhumidity (78-82%). Therefore, this system can be adopted as a weather station facility. The design can be extended to be web- based in the future to make it available worldwide.

Keywords- Arduino Uno, Humidity, Temperature, Weather Station.

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LIST OF ABBREVIATIONS

ACRONYM		ABBREVIATION
GDP	-	Gross Domestic Product
DTH11	-	Digital Temperature and Humidity
LCD	-	Liquid Crystal Display
GPS	-	Global Postioning system
RGB	-	Red Green Blue

CHAPTER 1

INTRODUCTION

1.1 BACKGROUND:

Weather is the state of the atmosphere and can be determined by several variables including pressure, wind, precipitation, solar radiation, temperature and humidity and so on. Temperature and humidity have shown to be suitable in forecasting weather condition in a short term (Danladi et al, 2017). These factors can be measured to determine the quality of local atmospheric conditions and weather forecast. Forecasting is a method of making future prediction using previous or present information (Danladi et al, 2017). Monitoring weather conditions is necessary to maintain quality working conditions and also needed for planning purposes.

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.

Weather monitoring station or weather monitoring system using Arduino is the simplest Arduino project which can help us to monitoring the temperature and humidity by using one sensor. There we are using the DHT11 sensor which is easily capable to measure the temperature and humidity. Also we are using the Arduino Uno there which helps to calculate & display the information to the display. DHT11 sensor have two things inside one is for detecting the temperature and other one is detecting the humidity. also, there are two system in this project one is transmitter and other is receiver. Both have NRF for communication.

1.2 OBJECTIVES:

The main aim of this project is to design a smart way of weather monitoring system using sense the weather in simplest form. The weather parameters are monitored using sensing devices like temperature and humidity sensors.

At the side of transmitter there are dht11 sensor which gives the output to the transmitter microcontroller and transmitter microcontroller of weather monitoring system send this information to the receiver via transmitter nrf. Now the receiver nrf receive the same information and send it to the Arduino microcontroller attached at the receiver end. Now the Arduino of weather station display this information to the Display. The device works by taking readings from various sensors.

All the sensors are connected using a breadboard. For temperature sensor to prevent any damage or unstable behavior a 10kΩ resistor is attached in parallel to the temperature sensor on the breadboard. We've used DHT11 temperature sensor to get the temperature and humidity readings connected to digital pin 7 on board for input signals. It gives us continuous reading of surrounding environment in the range of two to three seconds. A battery is connected in a circuit which the battery is a device that converts chemical energy contained within its active materials directly into electric energy by means of an electrochemical oxidation-reduction (redox) reaction. Hence our project will help us to sense the temperature and humidity of the place in simpler manner.

CHAPTER 2

LITERATURE SURVEY

Weather Forecasting using Arduino Based Cube-Sat, by M. Rahaman Laskar, R. Bhattacharjee,M. SauGiri and P. Bhattacharya. 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. 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[. 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. 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 Think speak 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.

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. 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. 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.Here the scientific invention can avoid the IOT based concept and design the simplest form of arduino based weather station.

Lab thermometer (°C)	Proposed system (°C)	Difference (°C)
29.5	29.7	- 0.2
29.8	29.6	0.2
29.9	29.1	0.8
29.9	29.3	0.6
30.1	29.6	0.5
30.2	29.5	0.7
30.2	29.2	1.0
30.8	29.7	1.1
30.8	29.8	1.0
30.8	30.0	0.8

Figure.2.1.Comparison table for actual weather station and arduino based weather station.

CHAPTER 3

MATERIALS AND METHODOLOGY

3.1 BLOCK DIAGRAM

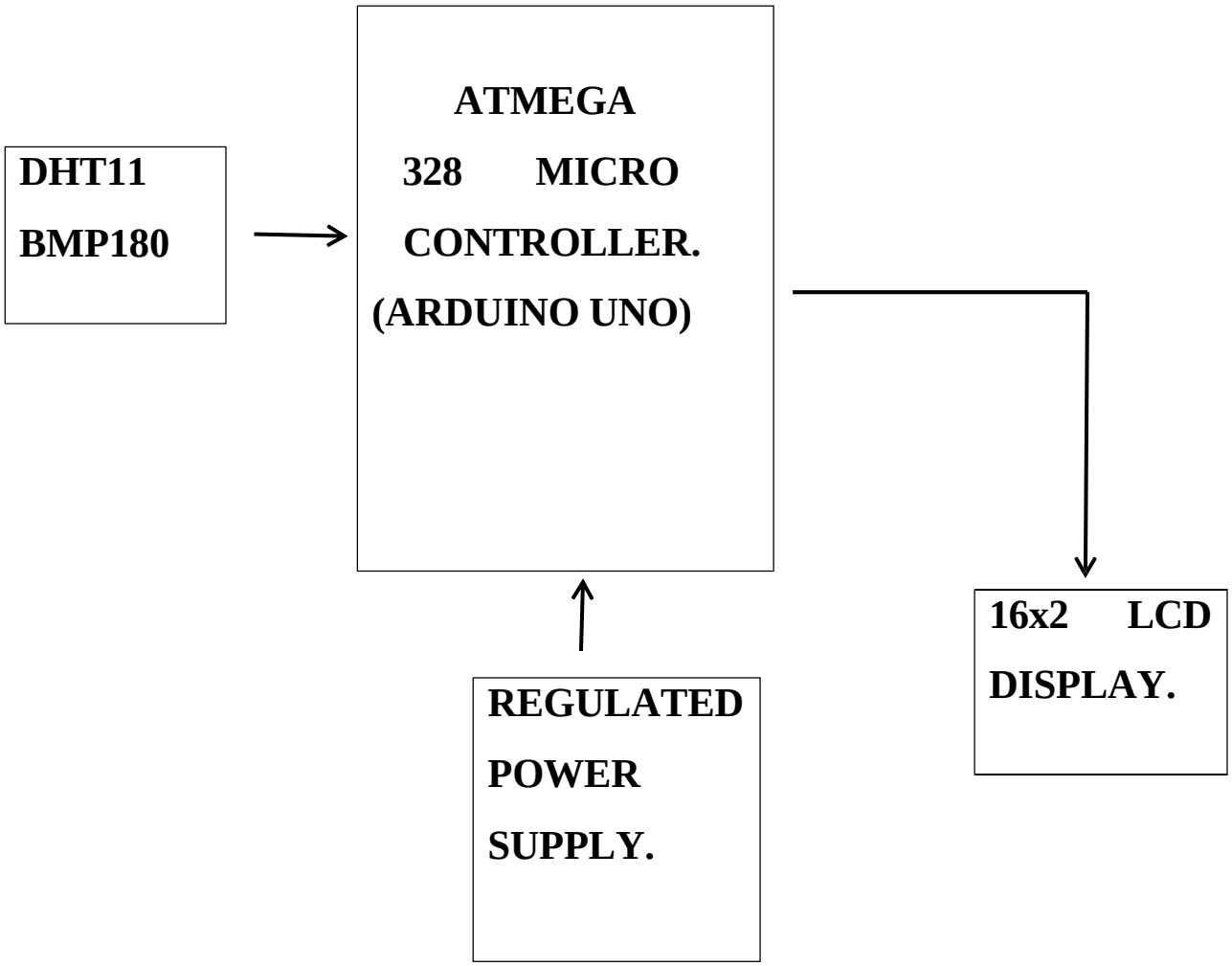

Figure 3.1.Block diagram for Arduino Based Weather Station.

Arduino is an open-source platform that enables us to quickly build electronic projects. We designed a simple weather station using Arduino Uno to program, calculate the output data and display the weather. This solves the forecasting future weather by using present data.

This sensor is enough to cover and collect temperature data in a room and it is a lot cheaper than DHT22 Sensor. The projects used with the same LCD, RGB Backlight LCD -16x2. The algorithm is coded in the Arduino ID.

Imaginative idea, keeping track of the humid content of your room helps you maintain your wood and metal objects. The device will track and monitor the level of humidity in a normal bedroom. The project will need the DHT11 Sensor which is on the less expensive price and it will help the project easier to obtain data of humidity and temperature. The Humidity Tracker will receive and project data gathered from the saturation changes in air temperature and calculates it. By keeping track of the humid content in a room, we can estimate and control the airflow and temperature in a room. Having things in a room with wood materials in our place gives us a hard time because once cold air and water enters the wood, the wood will easily warp and same case for metal things but instead it will rust. This is to prevent warping and rusting in our things and help maintain to always keep in quality.

3.2 CONSTRUCTION OF WEATHER MONITORING SYSTEM: COMPONENTS REQUIRED:

i) Arduino Uno.
ii) DHT11 Sensor.(Humidity and Temperature Sensor)
iii) I2C Module for 16x2 display.
iv) 16x2 LCD Display
v) Jumper wires

3.2.1 ARDUINO UNO:

The Arduino Weather Shield from Spark Fun is an easy-to-use Arduino shield that grants you access to barometric pressure, relative humidity, luminosity, and temperature. There are also connections to optional sensors such as wind speed/direction, rain gauge, and GPS for location and super accurate timing.

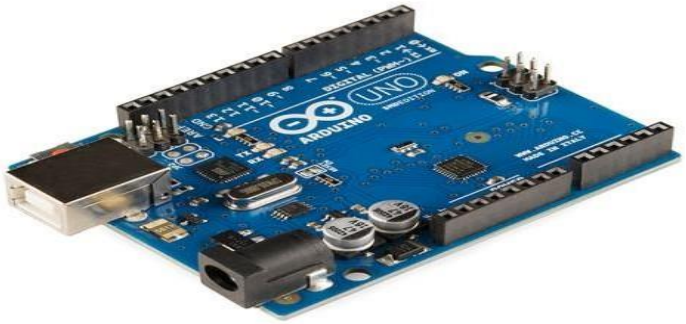

Figure 3.2.1.Arduino Uno

3.2.2 DHT11 SENSOR:

Varying temperature and humidity information of the environment are captured by the DHT11 component (see Fig 1). It is a Temperature and Humidity Sensor which has a calibrated digital signal output. The DHT11 ensures a high reliability and long-term stability by using the exclusive digital-signal-acquisition technique and temperature & humidity sensing technology. With a resistive-type humidity measurement component and a temperature measurement component, the DHT11 provides a reliable data. Its element is calibrated in the laboratory under extremely accurate humidity calibration conditions and stores the calibration coefficients in memory as programmes for later use (D-Robotics, 2010). The temperature and humidity sensor used for this study has a coverage range of up to 20meters. It complies with standard reference temperature for industrial measurement which is given as 200c – 250c; details of how this was arrived at were discussed by Doiron (2007) It has low power consumption and an impressively small size suitable for most projects. It is worthy of note that the DHT11 sensor requires a minimum of one second delay for it to stabilize.

This delay is imperative to guarantee a reliable data from the sensor (D-Robotics, 2010). Besides temperature measurements, DHT11 also measures relative humidity – which is the amount of water vapor in the atmosphere (D- Robotics, 2010). Normally, at the saturation point, water vapor begins to condense to form dew (Shelton, 2008). Changes in the air temperature greatly determine its saturation point. Notably, a higher air temperature holds more water vapor than a cold air temperature. At 0% Relative humidity –

expressed as The ranges and accuracy of the DHT11 is as follows (D-Robotics, 2010):

- Humidity Range: 20-90% RH
- Humidity Accuracy: ±5% RH
- Temperature Range: 0-50 °C
- Temperature Accuracy: ±2% °C
- Operating Voltage: 3V to 5.5Va percentage – the air is considered totally dry, but condenses at 100%

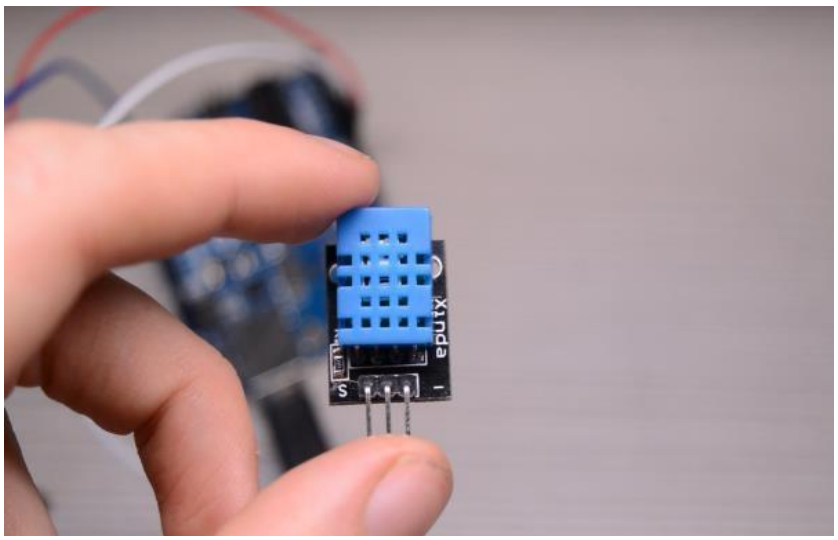

Figure 3.2.2.DTH11 Sensor

3.2.3 I2C MODULE FOR 16X2:

I2C Module is a parallel to serial converter compatible with LCD2004 and LCD1602. By using this module, LCD can be interfaced with using only 2 wires. . Because of its low cost it doesn't affect the overall system . It also has great libraries and support all around the world. The website for this project is an open source website named Thing speak by a community of Mathworks.

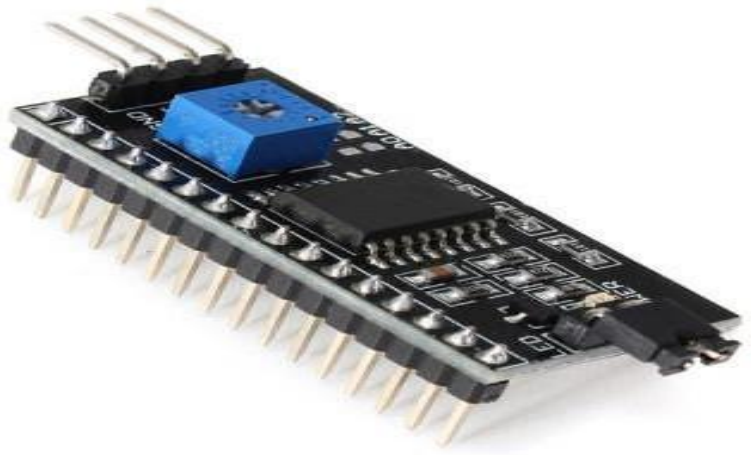

Figure.3.2.3. I2C Module For 16x2.

3.2.4 16X2 LCD DISPLAY:

An LCD is an electronic display module that uses liquid crystal to produce a visible image. The 16×2 LCD display is a very basic module commonly used in DIYs and circuits. The 16×2 translates o a display 16 characters per line in 2 such lines. In this LCD each character is displayed in a 5×7 pixel matrix. LCDs are used in a wide range of applications, including LCD televisions, computer monitors, instrument panels, aircraft cockpit displays, and indoor and outdoor signage. Small LCD screens are common in LCD projectors and portable consumer devices such as digital cameras, watches, calculators, and mobile telephones, including smartphones. LCD screens have replaced heavy, bulky and less energy-efficient cathode-ray tube (CRT) displays in nearly all applications.

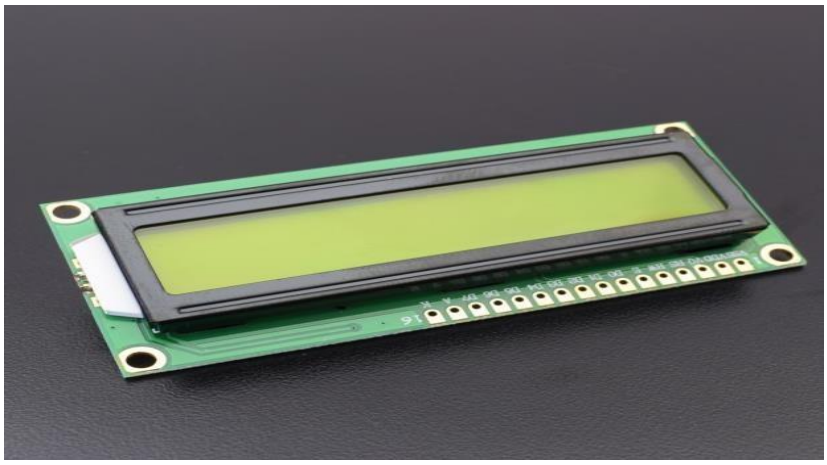

Figure.3.2.4.16x2 LCD Display.

3.3 WORKING PRINCIPLE:

The device works by taking readings from various sensor sat different pins in arduino microcontroller It increases the scope of this project. The various sensors are attached to the microcontroller each of them taking 5V input from arduino except one pressure sensor requiring 3.3V using a3.3V pin out from the board. All the sensors are connected using a breadboard. For temperature sensor to prevent any damage or unstable behavior a 10kΩ resistor is attached in parallel to the temperature sensor on the bread board. We've used DHT11 temperature sensor to get the temperature and humidity readings connected to digital pin7 on board for input signals. It gives us continuous reading of surrounding environment in the range of two to three seconds. Because of its low cost it doesn't affect the overall system . It also has great libraries and support all around the world. The website for this project is an open source website named Thing speak by a community of Mathworks. So it provides further facility to a information obtained from the reading son the server.

The website provides its DNS. On the Thing speak website, the first step is to register for the account .After registration, create a channel which will be for your device. A channel is made for taking all the information you want to display update send or receive. It is used for interaction between arduino and your channel. While creating the channel, specify or check the number of fields for data you want to visualize or post on the server. Thing speak website provide API write key and API read key for each of its own purpose. In order to send or update information regarding our device in live feed we will use API write key and

specify in our code while making requests to the website.dd code in Mat lab and various function to get knowledge.

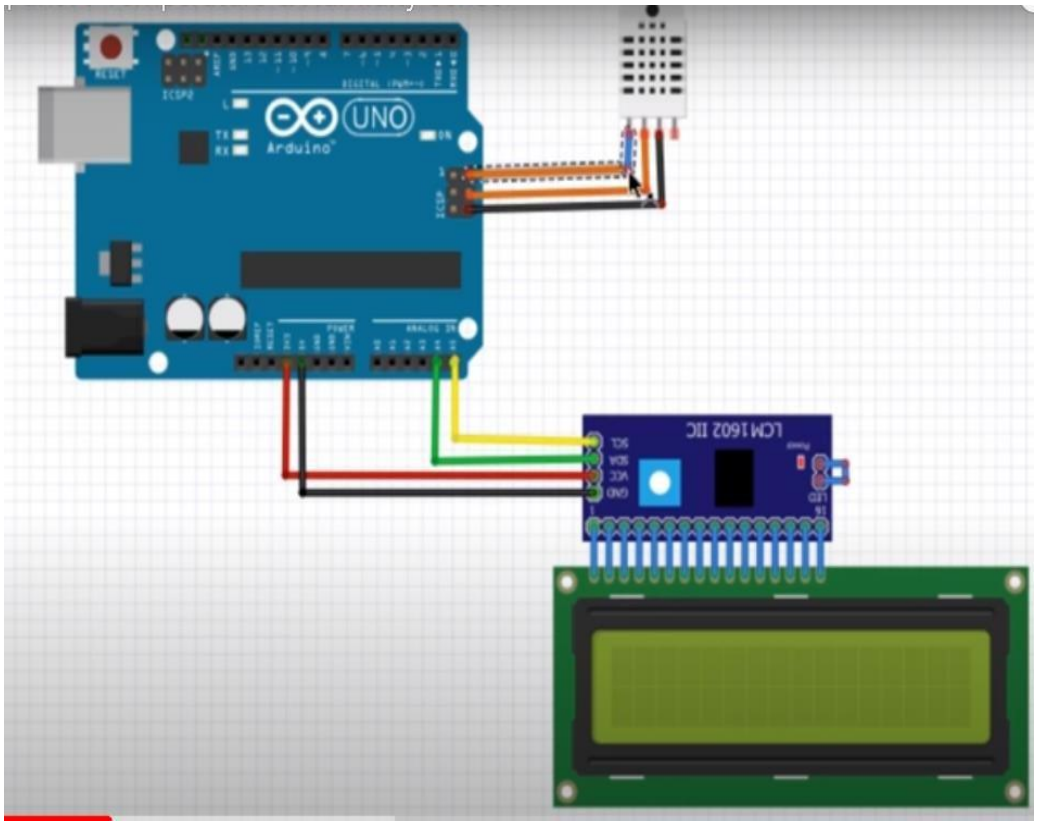

Figure.3.1. Circuit Connection.

CHAPTER- 4

RESULT AND DISCUSSION

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 'Liquid Crystal' and 'dht' libraries. Next we set the Arduino pins and attached them to the LCD for display. Arduino pins 9, 10, 4, 5, 6, 7 were attached to the RS, E, D4, D5, D6, D7 pins respectively on the LCD. The 'pinMode 'of Arduino pin12 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 20 - 90 relative humidity, while the temperature ranged between 0 - 500c. Once the read values are within range, it is displayed on the LCD screen as seen in Fig 4.1.

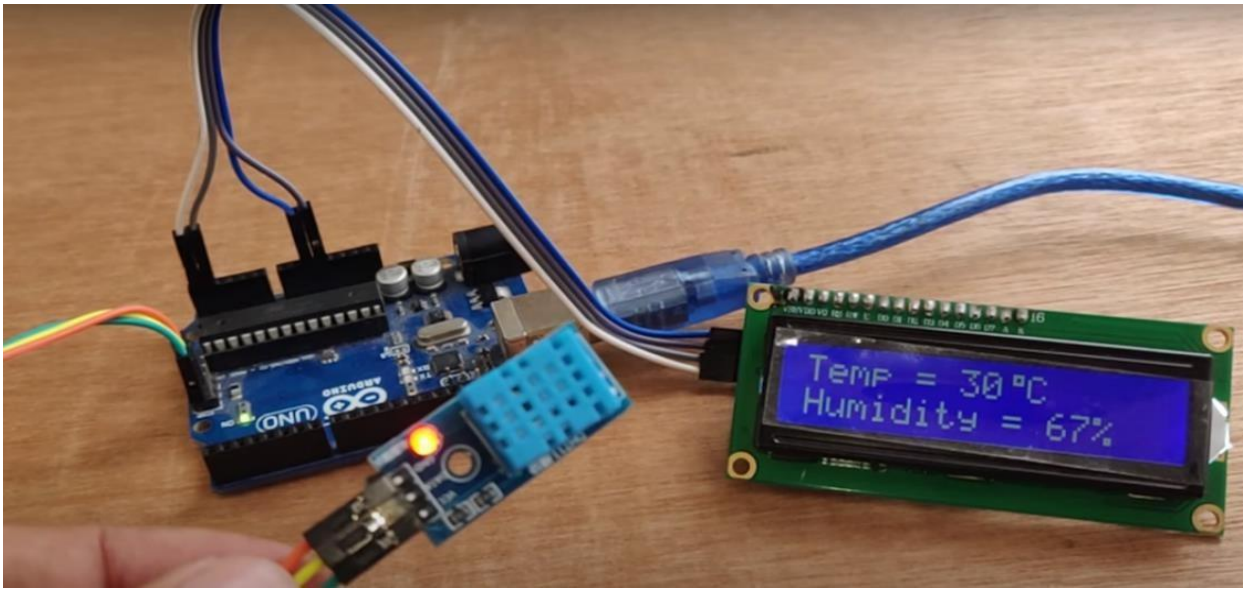

Figure 4.1.Arduino Based Weather Station

CHAPTER-5

CONCLUSION AND FUTURE WORK

We can determine if the weather is HOT, NORMAL, or COLD based on the air temperature and humidity read by a DHT11 sensor. All the components used in this project were cased with plastic foam – which would have otherwise being discarded as waste. The circuit diagram and the component connections used for the design are presented in Figure 3 and 4. We also presented the flowchart used for the firmware design which was uploaded into the Arduino-based microcontroller. The system was stable as appropriate delays were enforced to enable communication between the components before a report was displayed. This weather monitoring system will provide farmers, pharmacists, event planners and others with accurate information to guide them to take appropriate action. The system is not currently designed to control other devices. However, future studies can extend the system to control several task based on weather conditions.

APPENDICES

```
#include <LiquidCrystal_I2C.h>
LiquidCrystal_I2C lcd(0x27,16,2);  // set the LCD address to 0x27 for a 16 chars
and 2 line display
byte degree_symbol[8] =
{
0b00111,
0b00101,
0b00111,
0b00000,
0b00000,
0b00000,
0b00000,
0b00000
        };
int gate=11;
volatile unsigned long duration=0;
unsigned char i[5];
unsigned int j[40];
unsigned char value=0;
unsigned answer=0;
int z=0;
int b=1;
void setup()
{
lcd.init();
lcd.init();
```

```
lcd.backlight();
lcd.print("Temp = ");
lcd.setCursor(0,1);
lcd.print("Humidity = ");
lcd.createChar(1, degree_symbol);
lcd.setCursor(9,0);
lcd.write(1);
lcd.print("C");
lcd.setCursor(13,1);
lcd.print("%");
}
void loop()
{
delay(1000);
while(1)
{
delay(1000);
pinMode(gate,OUTPUT);
digitalWrite(gate,LOW);
delay(20);
digitalWrite(gate,HIGH);
pinMode(gate,INPUT_PULLUP);//by default it will become high due to internal pull up
// delayMicroseconds(40);


  duration=pulseIn(gate, LOW);
  if(duration <= 84 && duration >= 72)
```

```
{
 while(1)
{
duration=pulseIn(gate, HIGH);
if(duration <= 26 && duration >= 20){
value=0;}
else if(duration <= 74 && duration >= 65){
value=1;}
else if(z==40){
break;}
i[z/8]|=value<<(7- (z%8));
j[z]=value;
z++;
}}
answer=i[0]+i[1]+i[2]+i[3];
if(answer==i[4] && answer!=0)
{
lcd.setCursor(7,0);
lcd.print(i[2]);
lcd.setCursor(11,1);
lcd.print(i[0]);
}
z=0;
i[0]=i[1]=i[2]=i[3]=i[4]=0;
 }
```

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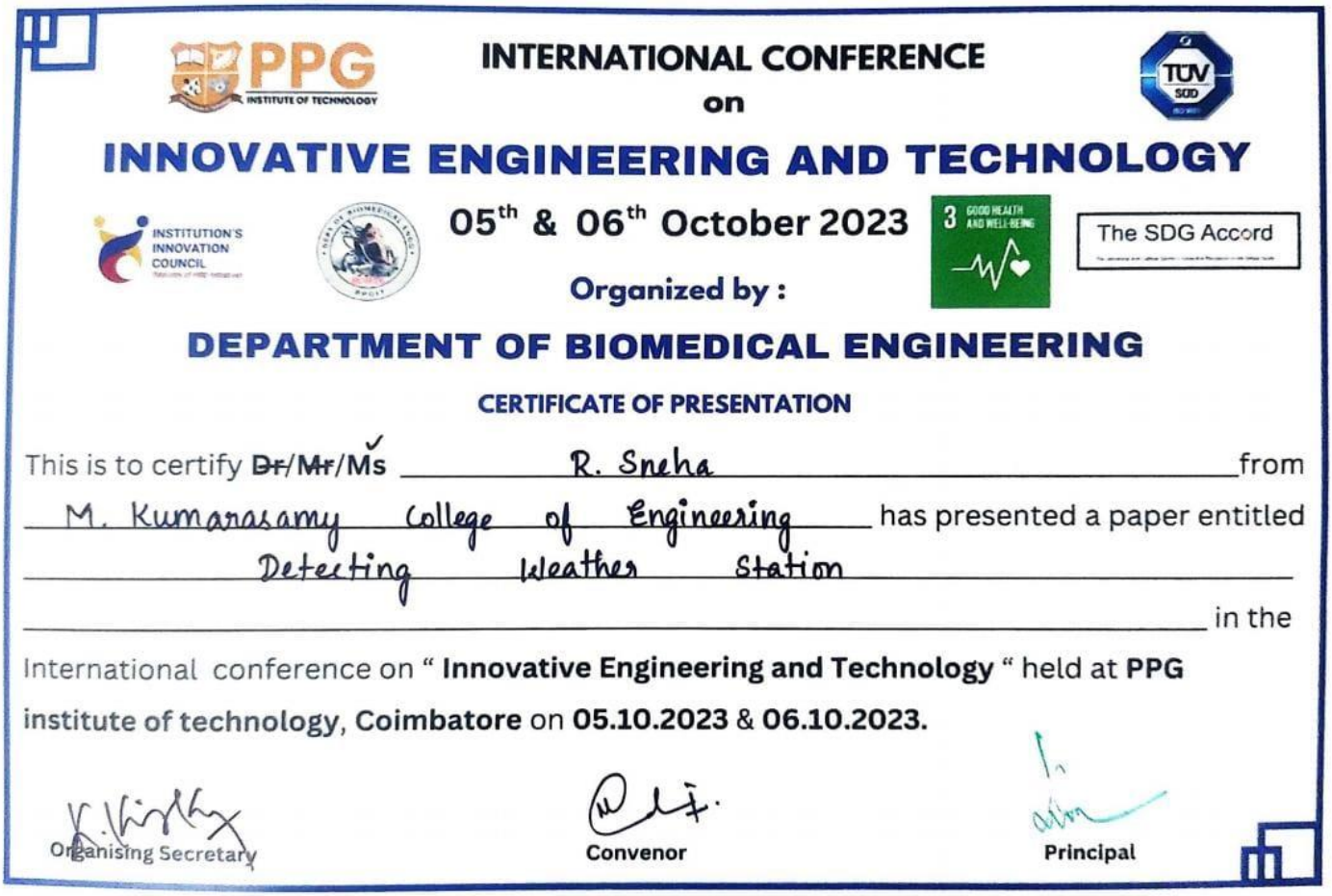

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