Available online www.jsaer.com

Journal of Scientific and Engineering Research, 2022, 9(5):61-68

Research Article

ISSN: 2394-2630
CODEN(USA): JSERBR

The Construction and Implementation of a Data Logger for the Measurement of Temperature and Relative Humidity in Selected Areas in Auchi, Etsako West L.G.A, Edo State, Nigeria

Esekhaigbe, F.[1], Okoedion, P[2], Abode, H.O[3]

[1,2]Department of Science laboratory Technology, Federal Polytechnic, Auchi
[3]Department of Physical Science Laboratory Technology, Federal Polytechnic Auchi
Corresponding Author's Email: abode_harr@yahoo.com

Abstract Humidity is the amount of moisture in the air. Since humidity is a key factor of our environment it becomes important for us to measure and monitor the humidity of a place. Data loggers are electronic devices which automatically monitor and record environmental parameters over time, allowing conditions to be measured, documented, analyzed and validated. Humidity data loggers are used for a wide range of applications in many industries worldwide. The principle of operation of the circuit is that it contains a voltage regulator LM 7085 which helps in regulating the voltage when the circuit is Switched ON. It also, consist of a DHT11 sensor for sensing the temperature and relative humidity of a place, a microcontroller and a Liquid Crystal Display (LCD) which helps in displaying the temperature in degree and the relative humidity in percentage respectively. The results obtained were collected in different environmental locations. The locations include, Area 1, Area 2, Area 3, all situated within Auchi polytechnic, Aviele, Iyakpi, Ibienafe, Jattu, all located in Auchi, Etsako West local government area (L.G.A), Edo State, Nigeria.

Keywords Humidity, Temperature, Data logger, DHT11 Sensor, Microcontroller

Introduction

In facility management, where precision measurement or temperature-sensitive processing is carried out, a record of temperature and humidity variation can be useful in identifying inefficiencies. In scenarios like these, combinations of temperature and humidity data logger provide a time-stamped record of the experienced conditions over an extended period [1].

Humidity is the amount of moisture in the air. Since humidity is a key factor of our environment it becomes important for us to measure and monitor the humidity of a place. Humidity is related to our daily life comfort. It is very uncomfortable for a person to be in a place when the humidity level is too high. The higher the humidity the warmer we feel. Humidity has been seen to contribute greatly to a worker's productivity in a working place. Humidity also plays a vital role in determining the overall climatic condition of a region, thus it is important to consider the humidity pattern of a place before setting up home or industries. Humidity data logger also finds its application especially in the health care logistics and electronics.

Humidity data loggers measure the amount of moisture in the air. They can measure specific aspects of humidity such as relative humidity (%RH), dew point, and water vapor concentration. Like temperature, humidity can have an adverse effect on certain products or practices and, in highly regulated industries, it is important to always know the humidity levels in a space.

One common area where humidity data loggers are important is in industrial greenhouses. The plants or foods grown in greenhouses all have specific humidity levels that help them grow, maintain freshness, and prevent disease or the proliferation of certain pests. A humidity data logger allows precise monitoring of these conditions, raising or lowering the humidity to maintain conditions within a desired range [2].

Materials and Methods

Materials for construction

The material used for the construction of this project work are stated below:

i. Soldering iron
ii. Soldering lead
iii. De-soldering pump
iv. Soldering stand
v. Miulti-meter
vi. Vero board
vii. Bread board
viii. Jumpers wire
ix. Plastic casing

Table 1: Electronic component analysis, quality and value

Components Name	Quantity
NE555 Timer IC	1
ATmega2560	1
DHT11 Sensor	1
220 ohm Resistor (R1)	1
10K variable Resistor (Trimmer Potentiometer)	1
Slide Switch (SW1)	1
9V Power Supply	1
PCB board	1
Connecting Wire	As required in the circuit diagram
LCD Screen	1

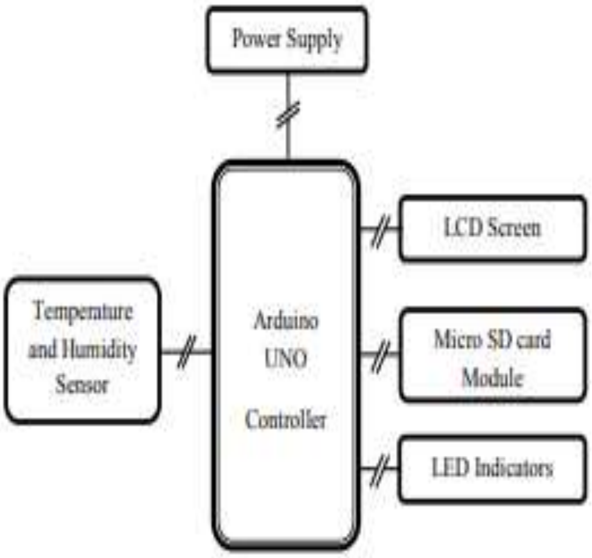

Figure 1: Block diagram showing the data logger

Hardware Connections and Connectivity

As shown in Figure 1, the different hardware components, humidity sensor, LCD screen, micro-SD card module and LED indicators are connected to the Arduino Uno (controller). The controller is connected to the power supply.

Power Supply Unit

This unit consists of a 9 Volt DC battery at 2 Ampere is used to power Arduino UNO, Temperature and humidity sensor, LED indicators and LCD screens [3].

Controller

Arduino Uno board is used as a controller which is based on ATmega 2560. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), a 16 MHz ceramic Resonator, a USB connection, a power jack, an ICSP header and a reset button [4]. Arduino board is programmed via Universal Serial Bus (USB), implemented using USB-to-serial adapter chips such as the FTDI FT232 [5]. Arduino program is written by interfacing the board with a computer in order to create a programming user interface area to startup controlling tasks properly [6].

DHT11 Sensor

DHT11 capacitive humidity sensing digital temperature and humidity module is one that contains the compound that has been calibrated digitally to signal output of the temperature and humidity sensors [7]. The sensor includes a capacitive sensor, wet components, and a high precision temperature measurement device, and connected with a high-performance 8-bit microcontroller. The product has excellent quality, fast response, strong anti-jamming capability, and high cost [5].

LCD Screen

Liquid crystal display (LCD) is a screen to display alphanumeric characters. 16 x 2 LCD is used as a user interface. Here, 16 x 2 refers to the 16 characters in 2 lines in the module [8].

Circuit Diagram

Figure 2.0, shows the circuit diagram of the developed temperature and humidity monitoring system. The Arduino Uno board has 13 digital outputs and 6 analogs to digital converters (A0 to A5) connected to other components. 5V power is provided to the Arduino board through the 9v battery. The DHT11 sensor, LCD, LED's are connected to the Arduino Uno board.

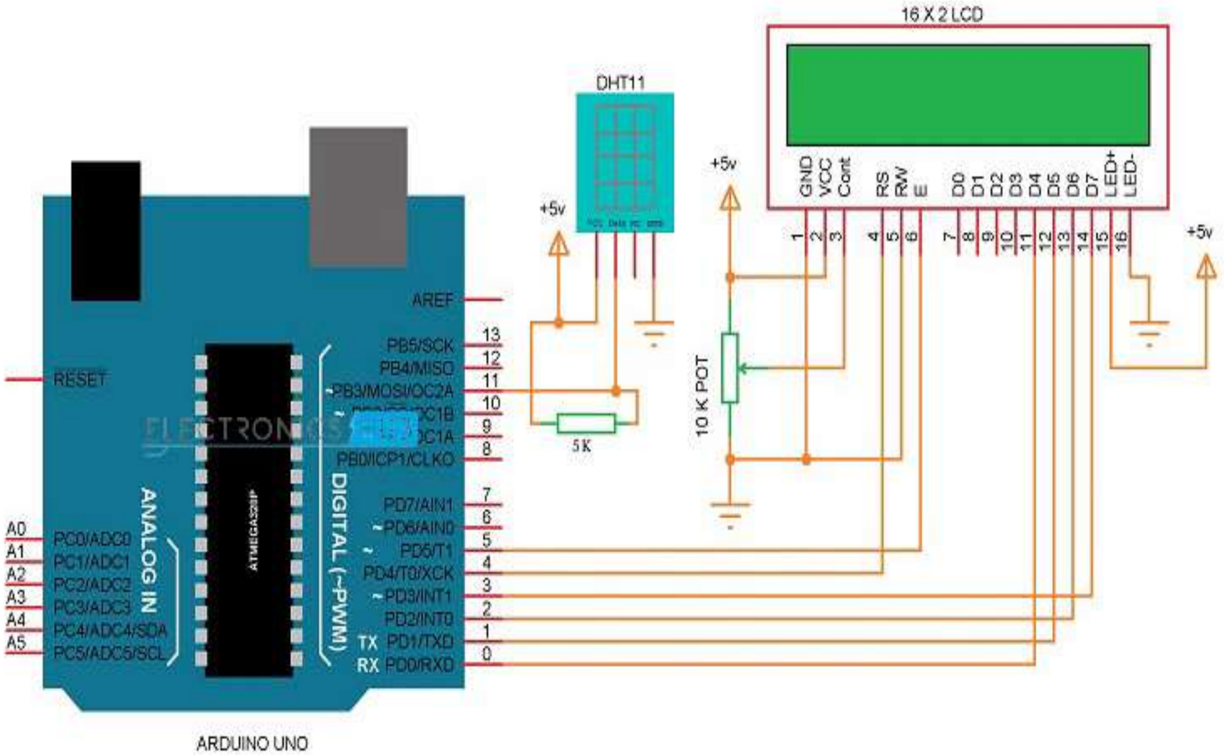

Figure 2: Circuit diagram of a data logger

Working Principles of a Humidity Data Logger

When the data logger is switched on, the LED indicates the supply of voltage around the system. The DHT11 sensor measures both temperature and humidity in the room. The working temperature is -40°C ... + 80°C and the humidity range is from 0-100%. The temperature has an accuracy of 0.5° C, and the humidity, 2%. Pin 2 of the sensor which is connected to the 2-digital pin of the Arduino Uno board sends data to the Arduino Uno which in turn sends it to the LCD screen to be displayed. The LCD used can display 16 characters on two lines. Arduino Uno board communicates with it, via I2C. LCD contrast can be adjusted via a potentiometer. The Arduino Uno development board is powered at 5V.

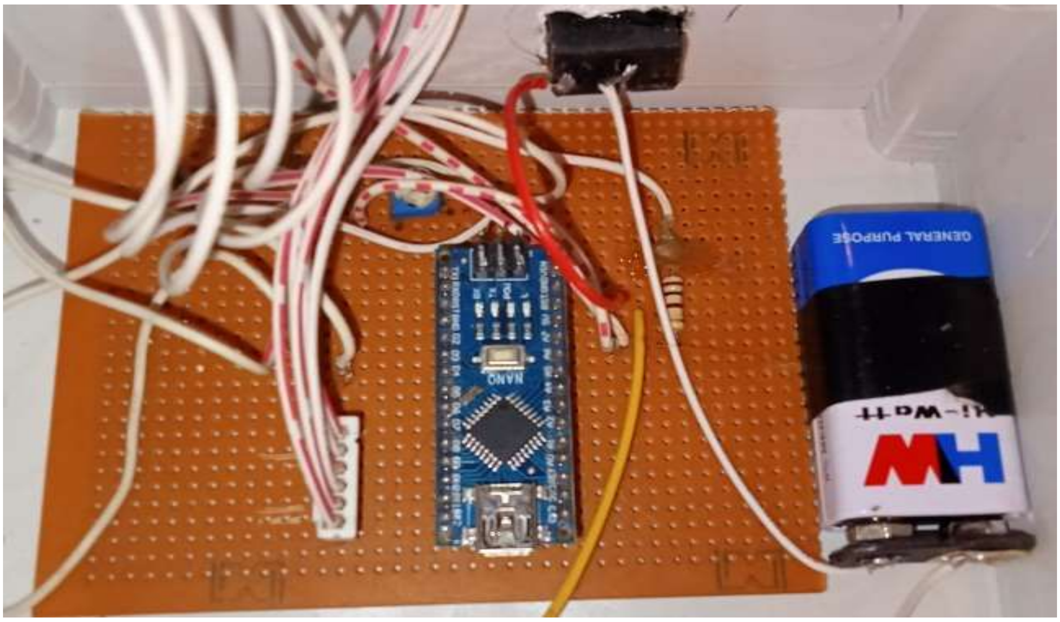

Figure 3: Inside view Arduino setup box

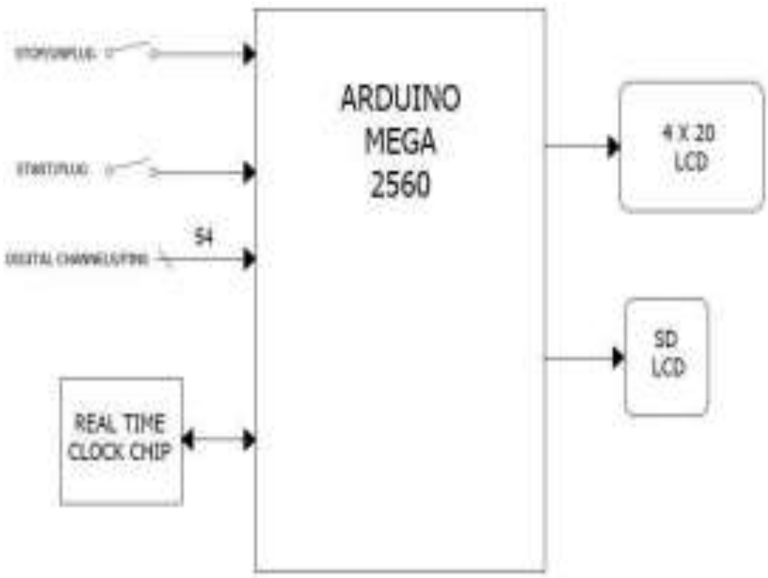

Figure 4: The Block diagram of ATMega 2560

Method of Construction

Stage One: Power Suply Unit

The power supply unit is made up of a 9v battery supplying direct current to the circuit.

Stage Two: Soldering And Connection

This stage consist of connecting and soldering together all the components used as shown in the diagram below.

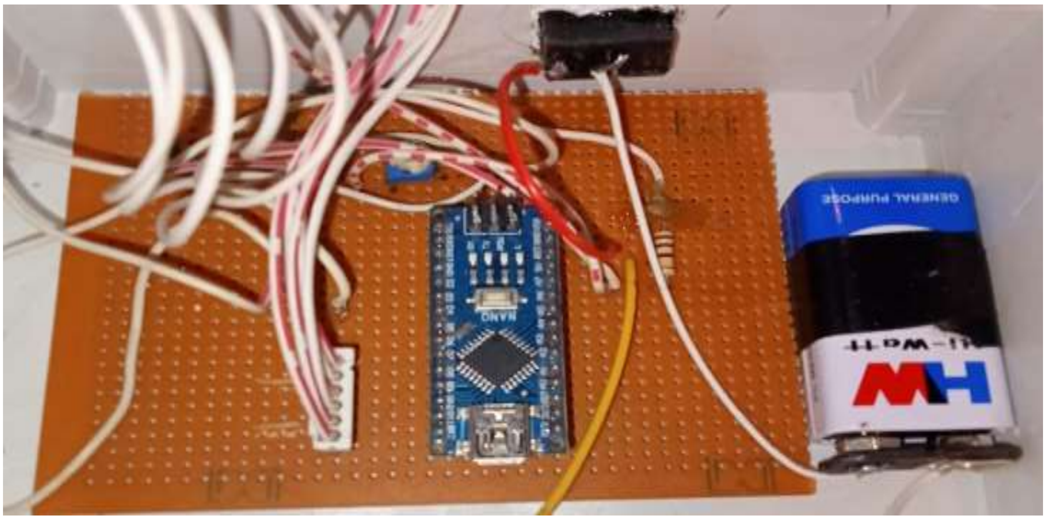

Figure 5: Inside view of the data logger

One jumper wire from the 5-volt pin on the Arduino was connected to Vcc. Another jumper wire from a ground pin on the Arduino was connected to ground (GND). DHT11 Positive pin (Vcc) to positive power rail, Negative pin (GND) to negative power rail, Signal pin (DATA) to Arduino Analog A3.

The LED was connected to the pin number 9 with jumper wire. The negative terminal was interface with the 330 Ohms resisters to the GND.

LCD has 16 terminals which were connected to the Arduino as: Pin 14 to Pin 7, Pin 13 to pin 6, Pin 5 to GRD, pin 4 to pin 2, Pin 6 to pin 3, Pin 11 to pin 4 as shown. The 5V pin from the Arduino was connected to the positive line. Also, the ground pin from the Arduino was connected to the negative part. For the re-set of the intensity of the LCD screen, a 10kΩ potentiometer was interfaced to the LCD with it's middle terminal to pin 3. Potentiometer was connected, the positive terminal to the positive pin and the negative terminal to the ground pin to the ground pin.

Stage Three: Assembly and Casing

After all the electronic were soldered permanently, all stages were fixed together in a plastic box as shown below.

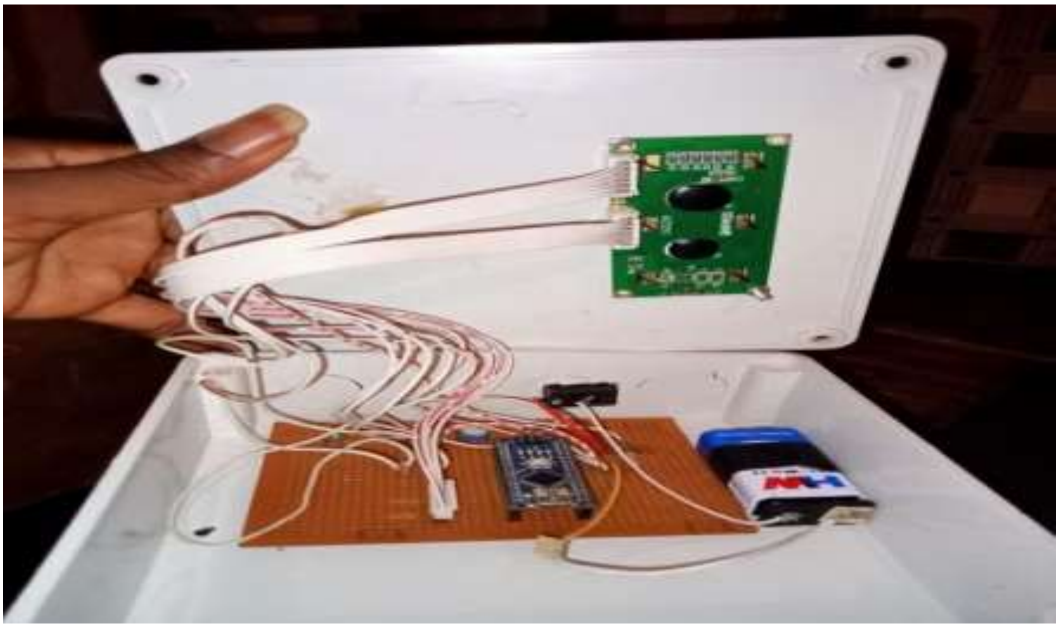

Figure 6: Assembled project

Casing

The casing of this project work was done and fixed in an adaptable box with a cover and all stages were permanently fixed to the box as shown below.

Figure 7: Top view

Figure 8: Side view

Discussion and Results

Testing

To test the relative humidity and temperature the constructed data logger was used and result obtained were displayed on the LCD.

To achieve this, Auchi in Etsako west L.G.A was chosen as the test location. At the beginning of the test, the time was 8:20am on 8th February 2022. The relative humidity of the first test site (Area 1, 2 and 3) Auchi Polytechnic, was 30% and temperature was 32°C which is a safety level for living being. The relative humidity level decreased to 28% at noon as the temperature gradually increased to 36°C, and the relative humidity slightly increased as it approaches evening.

Another test was carried out on 9th February 2022 on another test site in Etsako west (Aviele, Iyakpi, Ibienafe and Jattu). At the beginning of the test, the time was 8.05am. The relative humidity of the second test site (Aviele) was 30% with a temperature of 32°C, from there we moved on to the next test site (Iyakpi) at 9:10am and the relative humidity was slightly higher (31% with a temperature of 30°C). Thereafter, we moved on to the next site (Ibienafe) at 10:18am and the relative humidity was 30% with a temperature of 32°C. Moving on to the next site (Jattu) at 11:50am, the relative humidity dropped to 28% with a temperature of 34°C. On returning back to Aviele at 2:10pm, the relative humidity was 28% with a temperature of 36°C.

Results

Table 2: Results obtained for temperature and relative humidity measurement using the constructed device

Location	Date	Time	Humidity %	Temperature °C
Area 1	8/02/2022	8:20am	30%	32 °c
Area 1	8/02/2022	12:20pm	28%	36°c
Area 2	8/02/2022	9:20am	31%	31°c
Area 2	8/02/2022	2:20pm	29%	34°c
Area 3	8/02/2022	9:50am	30%	32°c
Area 3	8/02/2022	1:48pm	27%	39°c
Aviele	9/02/2022	8:05am	30%	32°c
Aviele	9/02/2022	2:10pm	28%	36°c
Iyakpi	9/02/2022	9:10am	31%	30°c
Ibienafe	9/02/2022	10:18am	30%	32°c
Jattu	9/02/2022	11:50am	28%	34°c

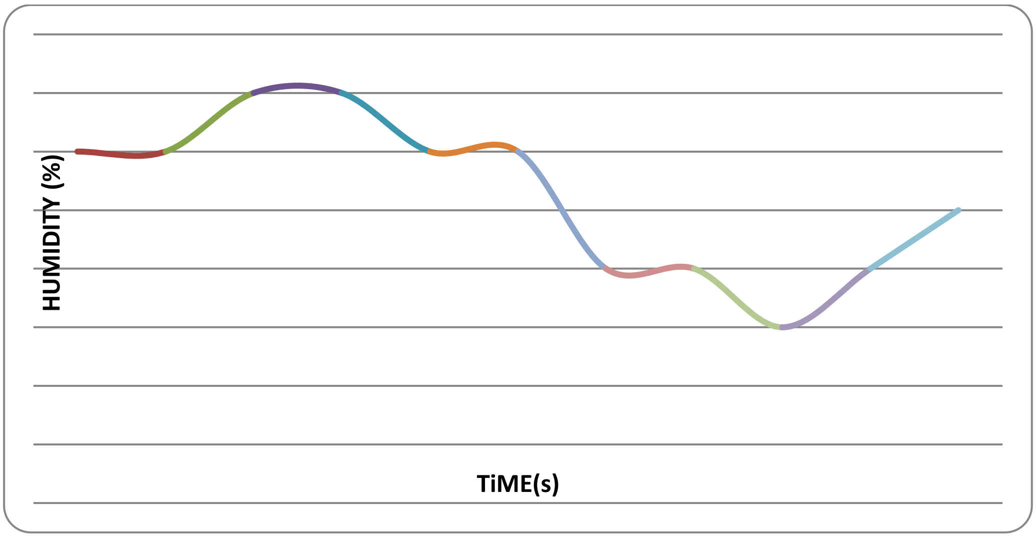

Figure 9: Graph of relative humidity against time

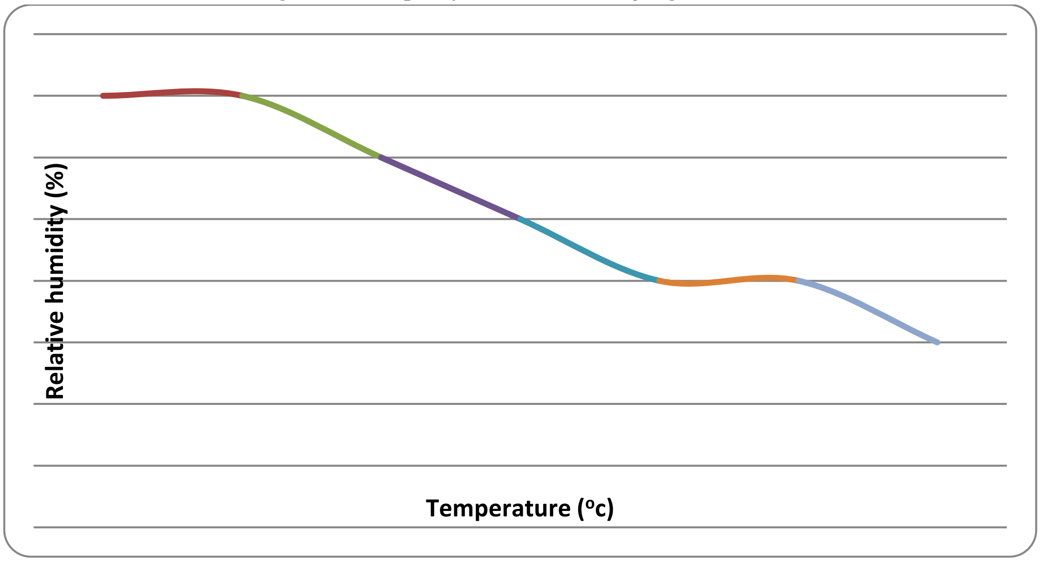

Figure 10: Graph of relative humidity against Temperature

Discussion of Results

From the graph in figure 9, relating relative humidity with time, it can be deducted that relative humidity increased from 8.05am to 9.20am and decreased as the time increased from 9.50am to 1.48pm. It shows that as the time increasesd, the amount of water in the atmosphere is decreased. That means, there is much water in the atmosphere in the early hours of the day as compared to mid-day. As the time increases, the relative humidity begins to increase slightly, that is as from 2.10pm . showing that moisture is increasing gradually in the atmosphere and then reduces when it is evening as from 4pm

In figure 10, comparing relative humidity with temperature, it can be deduced that as the temperature increases, relative humidity decreases. A temperature of 15 ºC and relative humidity of 40% is considered too dry. Region 23 ºC and 70%, relative humidity too moist, while 24 ºC temperature and 50%, humidity is acceptable. The result obtained from the constructed data logger, therefore indicates an acceptable level of relative humidity in the areas determined.

Conclusion and Recommendation

Conclusion

The humidity data logger could help user identify the relative humidity of the surroundings and also identify the temperature. The data obtained by the device was compared with Etsako West hourly Weather Forecast to be certain of its capabilities. The results showed it can perform the required task.

The objective of this work was achieved. However, there are still improvements which can be done on the existing prototype system such as the addition of a dehumidifier to help maintain the humidity level of the surrounding if the result from the test is unfavorable to man and equipments.

Recommendation

Humidity data logger should be provided in places around Etsako West and should be used in many institutions and industries to help identify and maintain humidity level to safeguard living beings and equipment that can be affected by relatively high or low humidity.

References

[1]. Michael L., Edward P. Fody, and Larry E. Schoeff, eds. Clinical Chemistry: Principles, Techniques, and Correlations. Lippincott Williams & Wilkins, 2013.

[2]. Dickson, O. (2021). Temperature Data Loggers vs. Humidity Data Loggers: What’s the Difference? available at: https://tech-ish.com/2021/04/21/temperature-data-loggers-vs-humidity-data-loggers-whats-the-difference/

[3]. Shirsath, D., Kamble, P., Mane, R., Kolap, A. and More R. (2017). IOT Based Smart Greenhouse Automation Using Arduino. International Journal of Innovative Research in Computer Science and Technology. 5(2):234-238.

[4]. Krishnamurthi, K., Thapa, S., Kothari, L. and Prakash, A. (2015). Arduino Based Weather Monitoring System. International Journal of Engineering Research and General Science, 3(2): 452-458.

[5]. Kale, V. and Kulkarni, R. (2016). Real Time Remote Temperature & Humidity Monitoring using Arduino and Xbee S2. International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering, 4(6): 175-179.

[6]. Mahmood, S. and Hasan, F. (2017). Design of Weather Monitoring System Using Arduino Based Database Implementation. Journal of Multidisciplinary Engineering Science and Technology (JMEST), 4(4):7109-7117.

[7]. Manghnani, S., Chittampally, R. and Kasaram, P. (2017). Arduino Based Wireless System for Temperature and Humidity Monitoring. International Conference on Emerging Trends in Engineering, Science and Management, 521-528.

[8]. Sipani, J., Patel, R. and Upadhyaya, T. (2017). Temperature & Humidity Monitoring and Control System based on Arduino and Sim900 GSM Shield. International Journal of Electrical, Electronics and Data Communication. 5(11):62-68.