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Construction of a portable cost effective temperature and humidity measuring device

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Abstract. Temperature and humidity are the most significant weather parameters in human development. The monitoring of temperature and humidity manually has been characterized with inaccurate measurements due to human errors. This project describes the construction of a portable cost effective device for measuring temperature and humidity; it is based on wireless technology. The measuring device obtains temperature and humidity data by using DHT22 sensor. The hardware used for the project includes Arduino Uno, Liquid Crystal Display (LCD) and DHT22 sensor; the software employed is the Arduino IDE. C programming language was used and the libraries of each component were installed in the Arduino IDE. A program code in the Arduino IDE (sketchbook) was created to enable the DHT22 sensor, LCD and Arduino work. The DHT22 was initialized at 5 V. The readings were gathered serially and transferred to a computer which communicates with the Arduino and displays the values on the LCD for human interface. The device was tested at different locations and different times for two consecutive days. The results show that the cost effective, portable device is able to detect and record temperature and humidity effectively.

Keywords: Arduino IDE, Temperature, Humidity, C programming, DHT22

1. Introduction

Weather is the given condition of a place or an environment at a particular time; these conditions include temperature, humidity, and fog. Weather forecasting is a process in which different techniques are employed in predicting the future state of the atmosphere in a given place. Weather plays a fundamental role in human lives. It is of vital importance to different people in various ways. It controls the distribution of rain on earth. All living organisms on earth require water to survive; human beings require fresh water for drinking. Also, rain water is required for agriculture; the farmers are able to know when to plant and what precautions to take. Weather conditions and events such as hurricanes, tornadoes, flood, and drought has a huge impact on human civilization. An example of this is hurricane Katrina, which took place on the Gulf of the US killing nearly two thousand people and displacing almost one million people. Air transportation also depends on Weather as temperature and humidity can determine the behaviour of a plane in the air. It also plays an important role in the shipping industry because they can be used to predict hurricanes and other storms, although ship construction has become more advanced to terrible weather conditions, hurricanes can still damage or even capsize some ships.

Weather is varied by the difference in air pressure in different locations. This difference depends on the direction of the sun at a specific spot. This spot is determined by latitude from tropics in pressure and temperature. Weather helps in keeping track of different climate patterns which include temperature,
humidity, rainfall, wind speed, wind direction. Weather forecasts is predicted by collecting quality data about the state of the atmosphere in a given place using sensors to obtain values or data and trying to manipulate a deep understanding of how the atmosphere would evolve on that day. These temperature and humidity device would be carried out by using an Arduino microcontroller. Weather forecasting performed manually has turned out to be a major problem as inaccurate data is generated and it leaves a negative impact. The construction of an Arduino based weather station will help in predicting weather conditions accurately for farmers, weather based industries and so on. With this monitoring system, data about their field would be readily available with them. These would not only save time but also labour.

In weather monitoring, conditions such as temperature, humidity and rainfall or precipitation can be measured using sensors [1]. The advancement of technology has helped in making small and reliable electronic sensors capable of monitoring environmental conditions efficiently [2] [3]. [4] developed a monitoring system where sensors are used in measuring indoor weather and environment based on the conditions mentioned. Combination of these sensors with data acquisition system has proved to be a better approach for temperature and relative humidity monitoring [5]. [1] [6] introduced wireless sensing micro system for environmental monitoring, using capacitive-based sensors. [7] [8] introduced the usage of surface acoustic waves (SAW) devices as temperature sensor and pressure sensor respectively. These systems, however, are quite expensive and complex in nature as some of them require the use of on-chip transmitter circuit and involve fabrication processes. The aim of this research is to construct a portable, light weight, cost effective and low power consumption device for measuring temperature and humidity. The essence is to develop a device that is capable of providing in real-time temperature and humidity data at maximum speed without delay.

2. Methodology
The methodology adopted in this project involves the construction of a device for measuring temperature and humidity using a DHT22 sensor. The data observed or measured by the sensor is transmitted to a computer by an Arduino. The values are then displayed on a Liquid Crystal Display (LCD) for human interface [9]. The flow chart of the device is shown in Figure 1a. The principle (mode of operation) of this device explains the function of each component and their outputs. The circuit diagram is presented in Figure 1b. It was constructed using DHT22 which is a temperature and humidity sensor. The sensor was initialized by supplying +5 V. A program code in the Arduino IDE (sketch book) was created to enable the DHT22 sensor, liquid crystal display and Arduino works. The readings are gathered serially into a computer which communicates with the Arduino and displays the values on a Liquid Crystal Display (LCD) for human interface.

![Figure 1: (a) Flow chart for the construction of the device and (b) Circuit diagram used to implement humidity and temperature device.](image-url)
3. Results and Discussion

Multiple tests were carried out to check the performance of the hardware and software of the device. The tests were carried out at different stages during the development of the device in order to determine the efficiency of each segment of the device. These include the circuit for the temperature and humidity device and the results when tested in selected environments. The readings obtained are stored in files (Microsoft word). The files containing the readings were copied in Microsoft word Excel, where graphs are plotted to give a perfect view of the temperature and humidity for each specified location. The circuit of the temperature and humidity device consists of liquid crystal display, DHT22, Arduino Uno and potentiometer. The device was first implemented on a bread board as shown in Figure 2(a) to detect the working state. This allows us to know if the Dht22 sensor is reading values; it is first cross checked on the serial monitor of the Arduino IDE as shown in Figure 2(b). When it was confirmed that the DHT22 sensor is reading values, the Arduino Uno was then plugged into the computer before being transferred to a Vero board where it was soldered in order to reduce the size of the circuit as shown in Figure 2(c). Since portability is the main objective of this research, the final prototype of this device was constructed to fit within a small plastic enclosure as shown in Figure 3. The device was tested at different locations within the Covenant University campus and data acquired involving both temperature and humidity are presented in Table 1-5.

![Figure 2: (a) Implementation of temperature and humidity values on the serial monitor of the Arduino IDE, (b) Temperature and humidity test circuit on breadboard and (c) Temperature and humidity test circuit on Vero board.](image-url)
Figure 3: Temperature and humidity device in operation.

Table 1: Table of temperature and humidity in the Chapel

| Date      | Time(m) | Temperature(°C) | Humidity (%) |
|-----------|---------|-----------------|--------------|
| 02/04/2018| 9:00am  | 30.00           | 1.60         |
| 02/04/2018| 9:10am  | 32.60           | 2.10         |
| 02/04/2018| 9:20am  | 33.00           | 3.50         |
| 02/04/2018| 9:30am  | 35.10           | 5.60         |
| 02/04/2018| 9:40am  | 35.60           | 5.80         |
| 02/04/2018| 9:50am  | 37.60           | 7.30         |

Table 2: Table of temperature and humidity in Physics Laboratory

| Date      | Time(m) | Temperature(°C) | Humidity (%) |
|-----------|---------|-----------------|--------------|
| 02/04/2018| 8:00am  | 30.40           | 4.10         |
| 02/04/2018| 8:10am  | 35.00           | 6.60         |
| 02/04/2018| 8:20am  | 37.50           | 8.50         |
| 02/04/2018| 8:30am  | 37.60           | 9.60         |
| 02/04/2018| 8:40am  | 38.00           | 9.90         |
| 02/04/2018| 8:50am  | 42.30           | 8.10         |

Table 3: Table of temperature and humidity in Basket Ball Court

| Date      | Time(m) | Temperature(°C) | Humidity (%) |
|-----------|---------|-----------------|--------------|
| 02/04/2018| 10:05am | 32.70           | 1.40         |
| 02/04/2018| 10:10am | 30.50           | 1.80         |
| 02/04/2018| 10:15am | 29.50           | 2.70         |
| 02/04/2018| 10:20am | 35.40           | 3.70         |
| 02/04/2018| 10:25am | 35.90           | 3.80         |
| 02/04/2018| 10:30am | 36.40           | 4.90         |
Table 4: Table of temperature and humidity in Lecture Theatre 1

| Date       | Time(m) | Temperature(℃) | Humidity (%) |
|------------|---------|----------------|--------------|
| 02/04/2018 | 10:45am | 30.70          | 4.60         |
| 02/04/2018 | 10:50am | 31.60          | 1.90         |
| 02/04/2018 | 10:55am | 31.70          | 2.20         |
| 02/04/2018 | 11:00am | 32.50          | 2.40         |
| 02/04/2018 | 11:05am | 33.70          | 4.80         |
| 02/04/2018 | 11:10am | 32.59          | 5.80         |

Table 5: Table of temperature and humidity in Cafeteria 1

| Date       | Time(m) | Temperature(℃) | Humidity (%) |
|------------|---------|----------------|--------------|
| 03/04/2018 | 3:00pm  | 30.00          | 1.20         |
| 03/04/2018 | 3:05pm  | 32.90          | 1.30         |
| 03/04/2018 | 3:10pm  | 32.80          | 2.00         |
| 03/04/2018 | 3:15pm  | 37.80          | 5.00         |
| 03/04/2018 | 3:20pm  | 38.80          | 4.00         |
| 03/04/2018 | 3:25pm  | 32.80          | 5.10         |

4. Conclusion
The construction of the temperature and humidity device was successfully implemented using cheap components. These components include: Arduino Uno, DHT22 and potentiometer. The sensor transmits temperature and humidity wirelessly to the Arduino which then displays them on the Liquid Crystal Display. The characteristics of the device after testing include low power consumption, small size, cheap cost, efficiency and high accuracy. The materials used for the project can be acquired locally. The device is suitable for all kinds of short distance conditions of wireless data acquisition and transmission.

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References
[1] Ong K G Grimes C A Robbins C L and Singh R S 2001 Design and application of a wireless, passive, resonant-circuit environmental monitoring sensor. Sensors and Actuators 93 pp 33–43.
[2] Ayara W A Omotosho T V Usikalu M R Singh M S J and Suparta W 2017 Development of a solar charged laboratory bench power supply. Journal of Physics: Conference Series 852(1) pp 012044.
[3] Falayi E O Usikalu M R Omotosho TV Ojoniyi O S and Akinwumi S A 2017 Impact of meteorological parameters over Covenant University, Ota. Journal of Physics: Conference Series 852(1) pp 012012
[4] Odlyha M Foster G M Cohen N S Sitwell C and Bullock L 2000. Microclimate monitoring of indoor environments using piezoelectric quartz crystal humidity sensors. Environmental Monitoring 2 pp 127–131.
[5] Moghavvemi M Ng K E Soo C Y and Tan S Y 2005 A reliable and economically feasible remote sensing system for temperature and relative humidity measurements. Sensors and Actuators 117 pp 181–185.
[6] DeHennis A D and Wise K D 2005 A wireless micro system for the remote sensing of pressure, temperature and relative humidity. *Journal of Micro Electromechanical Systems* **14**(1) pp 12-22.

[7] Buff W Plath F Schmeckebier O Rusko M Vandahl T Luck H and Muller F (1994) Remote sensor system using passive SAW sensors. In Proceedings of IEEE Ultrasonic Symposium. Cannes, 585p.

[8] Roneel V S 2014 Development of a remote automatic weather station with a pc-based data logger. *International Journal of Hybrid Information Technology* **7**(1) pp 233-240.

[9] Nagendra D 2017 Monitoring environmental parameters. Humidity and temperature using Arduino based microcontroller and sensors. 2p.