Evolution in Electrical and Electronic Engineering Vol. 2 No. 2 (2021) 568-576

EEEE

Homepage: http://publisher.uthm.edu.my/periodicals/index.php/eeee
e-ISSN : 2756-8458

Environmental Data Reader Bag for Hikers

Iffah Izati Halid[1], Jameel Abdulla Ahmed Mukred[1]*

[1]Faculty of Electrical and Electronic Engineering,
Universiti Tun Hussein Onn Malaysia, Batu Pahat, 86400, MALAYSIA

*Corresponding Author Designation

DOI: https://doi.org/10.30880/eeee.2021.02.02.068
Received 18 July 2021; Accepted 05 August 2021; Available online 30 October 2021

Abstract: Hiking is walking in nature and it is a natural exercise that promotes physical fitness that is economical and convenient since it requires no special equipment. Although hiking is a fun thing to do and becoming popular, but to be in a place that has a high altitude with a low temperature, pressure and high humidity still have a risk. In order to help the hikers know their limit when they go for hiking, the multisensory hiking bag for hiker is proposed. This hiking bag will be installed with the multisensory device which consists of two sensors, bmp180 and am2320 with the help of microcontroller board that have been programmed by Arduino Ide software. The multisensory device will show the reading of altitude, pressure, temperature and humidity on that place. Thus, this proposed multisensory hiking bag for hikers is believed to help the hiker know the environment around them to know their limit when go for hiking.

Keywords: Data Reader, Hiking Bag, Multisensory Device

1. Introduction

Although hiking is a fun task to do and becoming popular but to be in place that has high altitude with a low temperature, low in pressure and humidity still have a risks. Some hikers may face with decreased partial pressure of oxygen along with decreased barometric pressure or known as high-altitude illness [1]. Therefore, multisensory hiking bag for hiker is required for the people that interested in hiking know their limits when they go for hiking and it is easy to carry. This hiking bag will let hikers know at what altitude they have climbed, the pressure, temperature and humidity around it so they can know what height they feel altitude sickness, what humidity level makes their skin dry and stuff like that.

The aim of this project is to modify and design the hiking bag that have multisensory device installed in it for the hiker to monitor the environment around them so they can know their limit when they go for hiking. In this project, the multisensory hiking bag that can detect altitude, temperature, pressure and humidity will be design, the various component will be integrate using Arduino Ide Software and the performance of different sensor functionality will be evaluate and analyze.

Corresponding author: jameel@uthm.edu.my

1.1 Related work of bag with sensor.

The researcher used ultrasonic receiver sensor and ultrasonic transmitter sensor in the obstacle detection system of the bag "Smart Backpack" [2]. When the ultrasound receiver reaches the object, signal is senses from the ultrasonic transmitter. The researcher used RFID sensor together with Apriori Algorithms, android application and microcontrollers to detect and notifies the user whatever items that they carried in the bag "Smart Bag Prototype with Apriori Algorithm" [3]. It helps to minimize the human error that always forgetting to carry their items.

The researcher also used RFID to track the booked parcel bag "Smart Bag Tracking and Alert System using RFID" [4]. Other than RFID sensor used for luggage tracking, altitude sensors also used to propose smart tag "Towards Smart Wearable Real-Time Airport Luggage Tracking" **[**5]. In this system modes of operation, the Wi-Fi modules wakes up and gets altitude sensor readings.

2. Materials and Methods

The design of the multisensory hiking bag for hiker is a simple bag design that installed with a multisensory device. The multisensory device in the bag is equipped with a several sensors that can observe the ambient temperature, humidity, atmospheric pressure and altitude. The system will be constructed and programmed using Arduino microcontroller board and Arduino IDE software. The data collected at the output of the system will be displayed in LCD.

2.1 Materials

(i) Pressure sensor

Pressure sensor used in the project is BMP180. BMP180 Pressure Sensor used to measure absolute pressure around and varies according to the weather and altitude [6]. BMP180 sensor have 5 pins VCC, GND, SCL, SDA and 3.3V and the pressure range is 300hPa-1100hPa with the accuracy rate ±0,12hPa [7]. The pressure sensor also used to measure the altitude in the project. The altitude can be calculated using the international Barometric Pressure formula.

(ii) Humidity sensor

Humidity sensor used in the project is AM2320 temperature & humidity sensor. AM2320 temperature & humidity sensor used to sense, measure and monitor the amount of water that present in the surrounding air or amount of water present in pure gas or mixture. This humidity sensing related to the process of water desorption and water adsorption [8]. In this project, AM2320 temperature & humidity sensor used to detect ambient temperature and humidity.

(iii) Arduino board

Arduino board used in the project is Arduino Uno Board. Arduino is an open source platform that can simplifies the amount of the hardware and software development and let it run independency without interfacing other external software [9]-[10]. The Arduino board provides 14 digital inputs and output pins and 6 analogue inputs that can be powered using a USB connection with computer or power supply [11]. Arduino board can be programmed by Integrated Development Environment (IDE) software which is an independent base for Arduino platform that on multiple operating system [12].

(iv) I2C LCD Display

The 16x2 LCD display screen with I2C interface is able to display 16x2 characters in 2 lines. It is using an I2C communication interface that's only needs 4 pins for the LCD display which is GND, VCC, SDA, SCL.

2.2 Block diagram

Figure 1 shows the block diagram of multisensory system device. The sensor will detect and collect the information of the environment around them and send the data to the microprocessor card "Arduino". The card Arduino will process the data by using the Arduino IDE Software and the output will be displaying.

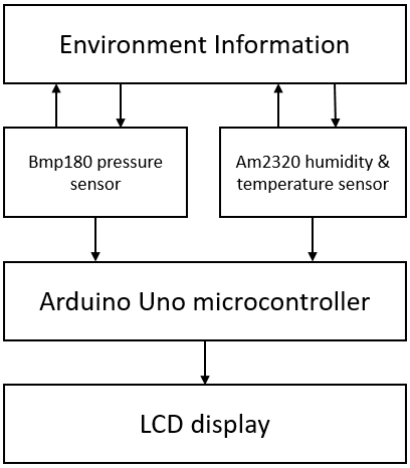

Figure 1: Block Diagram of Multi-Sensory Device

2.3 Circuit design

Figure 2 shows the circuit design for multisensory device. For the BMP180 pressure sensor, VCC pin will be connected to the power supply 3.3v on the Arduino and GND pin should be connected to the ground of Arduino. SCL (serial clock pin for I2C interface) pin pressure sensor connected to the pin SCL of Arduino and SDA (serial data pin for I2C interface) pin connect to the pin SDA of Arduino.

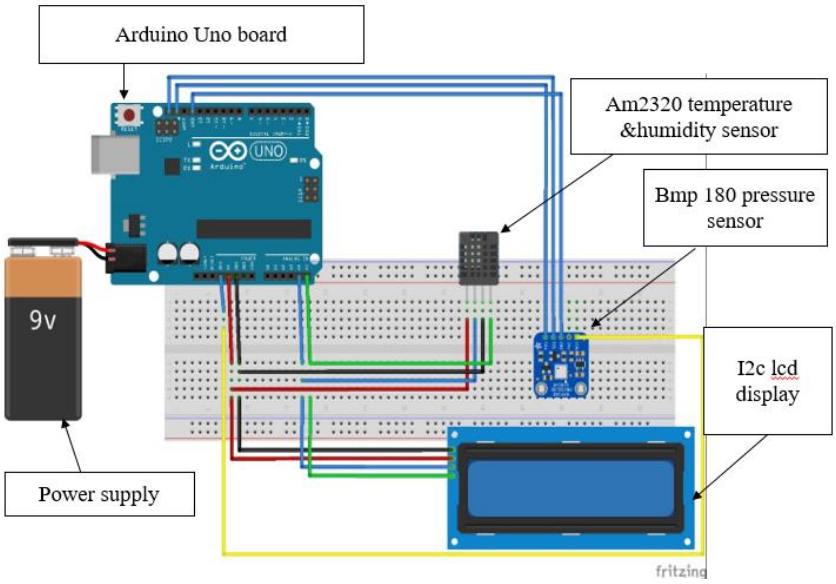

Figure 2: Circuit Diagram for Multisensory Device

For AM2320 humidity sensor, Vin pin will connect to power supply 3.3v on the Arduino and GND pin connected to the ground of Arduino. SCL (serial clock pin for I2C interface) pin pressure sensor connected to the A5(SCL) of Arduino and SDA (serial data pin for I2C interface) pin connect to the A4 (SDA) of Arduino.

2.4 Equation

$$P = P_b \cdot \left[\left[1 + \frac{L_b}{T_b} \cdot (A - h_b)\right]^{\frac{-g_\circ \cdot M}{R \cdot L_b}}\right] \qquad Eq.1$$

The pressure at a given altitude can be calculated using Equation 1 shown above [13]. In this calculation, the temperature and pressure at sea level must be known. According to the ISA standard, the pressure at sea level is 101325 Pa and the temperature at sea level is 15˚C/288K [13].

3. Results and Discussion

The result that have been obtained will be analyzed and explain in this section. The multisensory hiking bag is design with two sensors in it which is Bmp180 and am2320 sensor. Bmp180 is to measure the pressure and altitude while am2320 is to measure the temperature and humidity. Multisensory device that consists with this two sensor will be programming using the Arduino Ide Software through the Arduino Uno board.

3.1 Multisensory hiking bag design

Figure 3 shows the hiking bag that have been modify by installing the multisensory device in it. This multisensory device circuit will be put inside the bag. The LCD display will be put on top of the bag, the two sensor bmp180 pressure sensor and am2320 temperature and humidity sensor will be place outside the bag so as not to affect the readings of pressure, altitude, temperature and humidity.

Figure 4 shows the reading display from two sensors on LCD display. P is stand for the reading of pressure in hPa, A is stand for the reading of altitude in meter, T is stand for the reading of temperature in degree Celsius and Hum is stand for humidity in %.

Figure 3: Hiking bag modifying

Figure 4: Multisensory device installation

3.2 Sensor functionality and analysis

To satisfy the objective of this project which is to evaluate and analyze the performance of different sensor functionality, the reading of pressure, altitude, temperature and humidity is collected from the

multisensory device. The reading of pressure and altitude is calculated using the equation 1 and shown in Table 1 (see Appendix). The reading of pressure and altitude also can be observing in the LCD display based on the reading from bmp180 sensor. The reading of temperature and humidity is based on the reading from am2320 temperature and humidity sensor that were collected for 6 days as shown in Table 2 to Table 7 in appendix located at the village of Parit Maimon, Batu Pahat, Johor Malaysia.

Figures 5 shows the graph of relationship of pressure and altitude from the reading calculated from the equation. The data of this pressure and altitude is based on reading of pressure and altitude in Table 1 in appendix. From the Figure 5, it shows that the relationship of pressure and altitude is inversely proportional as altitude increase, the pressure will decrease.

Figures 6 shows the graph of relationship between temperature and humidity from the table. The data of this temperature and humidity is based on reading of temperature and humidity in Table 5 in appendix. From the graph, it can conclude that relation between temperature and humidity is inversely proportional. If the temperature increase, the humidity will decrease and vice versa.

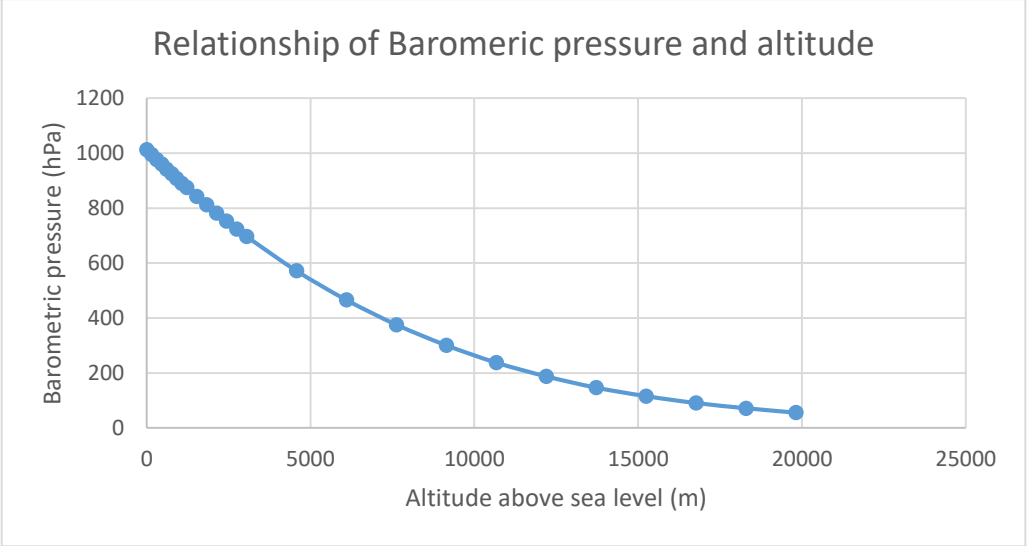

Figure 5: Relationship of pressure and altitude

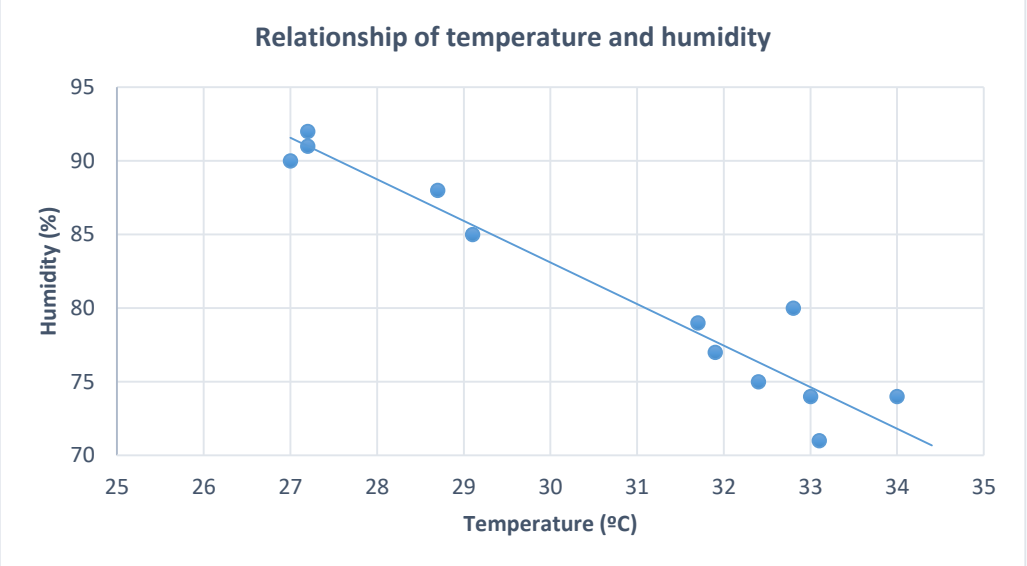

Figure 6: Relationship of humidity and temperature

4. Conclusion

Overall, in this project, the multisensory hiking bag for hiker is successfully developed. The multisensory device installed in this bag was able to show the reading of altitude, pressure, temperature and humidity. Based on the result analysis of the reading in multisensory device, it can conclude that relation between temperature and humidity is inversely proportional while and also the relation between altitude and pressure is also inversely proportional. With future modern technologies, the design of the multisensory hiking bag can be further improving in order to protect the sensor. A single board compact PCB for multisensory device circuit also can be used for more portability.

Acknowledgement

The authors would like to thank the Faculty of Electrical and Electronic Engineering, Universiti Tun Hussein Onn Malaysia for its support.

Appendix A

Table 1: Reading of pressure and altitude

Altitude		Pressure	
feet	m	kPa	hPa
0	0	101.3	1013
500	152	99.5	995
1000	305	97.7	977
1500	457	96	960
2000	610	94.2	942
2500	762	92.5	925
3000	914	90.8	908
3500	1067	89.1	891
4000	1219	87.5	875
5000	1524	84.3	843
6000	1829	81.2	812
7000	2134	78.2	782
8000	2438	75.3	753
9000	2743	72.4	724
10000	3048	69.7	697
15000	4572	57.2	572
20000	6096	46.6	466
25000	7620	37.6	376
30000	9144	30.1	301
35000	10668	23.8	238
40000	12192	18.8	188
45000	13716	14.7	147
50000	15240	11.6	116
55000	16764	9.1	91
60000	18288	7.2	72
65000	19812	5.6	56

Table 2: Reading of temperature & humidity Day 1

Time	Temperature(˚C)	Humidity(%)

7:00 AM	29	80
8:00 AM	28	86
9:00 AM	28.7	84
10:00 AM	29.9	87
11:00 AM	30.8	83
12:00 PM	28.2	89
1:00 PM	28.4	87
2:00 PM	29.1	90
3:00 PM	31.5	83
4:00 PM	30.7	87
5:00 PM	30.5	87
6:00 PM	30.3	89
7:00 PM	30.1	90

Table 3 : Reading of temperature & humidity Day 2

Time	Temperature(˚C)	Humidity(%)
7:00 AM	27.1	90
8:00 AM	27.2	92
9:00 AM	28.6	91
10:00 AM	29.9	88
11:00 AM	30.5	85
12:00 PM	32.7	77
1:00 PM	33	75
2:00 PM	34	69
3:00 PM	34	70
4:00 PM	34.1	70
5:00 PM	32.7	74
6:00 PM	32.2	78
7:00 PM	32.1	79

Table 4: : Reading of temperature & humidity Day 4

Time	Temperature(˚C)	Humidity(%)
7:00 AM	27.2	88
8:00 AM	27.5	88
9:00 AM	27.4	90
10:00 AM	28.2	90
11:00 AM	29.9	90
12:00 PM	30	88
1:00 PM	30.4	86
2:00 PM	33	74
3:00 PM	34	74
4:00 PM	32	78
5:00 PM	31	78

6:00 PM	30	86
7:00 PM	30.4	90

Table 5: Reading of temperature & humidity Day 4

Time	Temperature(˚C)	Humidity(%)
7:00 AM	27	90
8:00 AM	27.2	91
9:00 AM	27.2	92
10:00 AM	28.7	88
11:00 AM	29.1	85
12:00 PM	32.8	80
1:00 PM	33	74
2:00 PM	34	74
3:00 PM	34.4	69
4:00 PM	33.1	71
5:00 PM	32.4	75
6:00 PM	31.9	77
7:00 PM	31.7	79

Table 6:Reading of temperature & humidity Day 4

Time	Temperature(˚C)	Humidity(%)
7:00 AM	26.9	90
8:00 AM	27.5	89
9:00 AM	28.5	89
10:00 AM	30.2	88
11:00 AM	31.6	88
12:00 PM	31.9	79
1:00 PM	31.7	79
2:00 PM	33.4	72
3:00 PM	32.2	75
4:00 PM	32	75
5:00 PM	31.8	77
6:00 PM	31.4	80
7:00 PM	31.3	80

Table 7 : Reading of temperature & humidity Day 4

Time	Temperature(˚C)	Humidity(%)
7:00 AM	26.7	89
8:00 AM	27.3	91
9:00 AM	28.4	91
10:00 AM	30.2	88
11:00 AM	31.4	91

12:00 PM	31.4	86
1:00 PM	32.2	78
2:00 PM	33.4	70
3:00 PM	33	72
4:00 PM	32	75
5:00 PM	31.7	77
6:00 PM	31.4	88
7:00 PM	31.2	88

References

[1] G. Aksel, Ş. K. Çorbacıoğlu, and C. Özen, "High-altitude illness: Management approach," Turkish J. Emerg. Med., vol. 19, no. 4, pp. 121–126, 2019, doi: 10.1016/j.tjem.2019.09.002

[2] P. Sankhe and E. Rodrigues, "Smart Backpack," 2018 3rd Int. Conf. Converg. Technol. I2CT 2018, pp. 1–4, 2018, doi: 10.1109/I2CT.2018.8529333

[3] T. S. Akbar, M. Abdurohman, and A. G. Putrada, "Smart Bag Prototype with Apriori Algorithm," Proceeding - 2019 Int. Symp. Electron. Smart Devices, ISESD 2019, pp. 1–5, 2019, doi: 10.1109/ISESD.2019.8909490

[4] J. U. Duncombe, "Infrared navigation - Part I: An assessment of feasibility," IEEE Trans. Electron. Devices, vol. ED-11, pp. 34-39, Jan. 1959 (Example for a journal article)

[5] M. Ghazal, S. Ali, F. Haneefa, and A. Sweleh, "Towards smart wearable real-time airport luggage tracking," 2016 Int. Conf. Ind. Informatics Comput. Syst. CIICS 2016, pp. 9–14, 2016, doi: 10.1109/ICCSII.2016.7462422

[6] M. Kusriyanto and A. A. Putra, "Weather Station Design Using IoT Platform Based On Arduino Mega," ISESD 2018 - Int. Symp. Electron. Smart Devices Smart Devices Big Data Anal. Mach. Learn., pp. 1–4, 2019, doi: 10.1109/ISESD.2018.8605456

[7] M. T. I. Juel, M. S. Ahmed, and T. Islam, "Design of IoT Based Multiple Hazards Detection and Alarming System," 2019 4th Int. Conf. Electr. Inf. Commun. Technol. EICT 2019, pp. 1–5, 2019, doi: 10.1109/EICT48899.2019.9068782

[8] B. N. Shivananju, H. Y. Hoh, W. Yu, and Q. Bao, Optical biochemical sensors based on 2D materials, no. January. Elsevier Ltd, 2019

[9] . D'Ausilio, "Arduino: A low-cost multipurpose lab equipment," Behav. Res. Methods, vol. 44, no. 2, pp. 305–313, 2012, doi: 10.3758/s13428-011-0163-z

[10] H. Hamiche, S. Guermah, R. Saddaoui, K. Hannoun, M. Laghrouche, and S. Djennoune, "Analysis and implementation of a novel robust transmission scheme for private digital communications using Arduino Uno board," Nonlinear Dyn., vol. 81, no. 4, pp. 1921–1932, 2015, doi: 10.1007/s11071-015-2116-z

[11] A. El Hammoumi, S. Motahhir, A. Chalh, A. El Ghzizal, and A. Derouich, "Low-cost virtual instrumentation of PV panel characteristics using Excel and Arduino in comparison with traditional instrumentation," Renewables Wind. Water, Sol., vol. 5, no. 1, 2018, doi: 10.1186/s40807-018-0049-0

[12] "Air Pressure at Altitude Calculator." https://www.mide.com/air-pressure-at-altitude-calculator (accessed Jul. 02, 2021)