Multidisciplinary Applied Research and Innovation Vol. 4 No. 3 (2023) 275-280

MARI

Homepage: http://publisher.uthm.edu.my/periodicals/index.php/mari
e-ISSN :2773-4773

Portable Heating Lunchbox

Nor Faezah Adan*, Melvin Brian Anak Michael, Lubna Nazihah Md Lajis, Nurmaizatul Qibria Abd Maulud

Department of Electrical Enginering, Centre for Diploma Studies,
Universiti Tun Hussein Onn Malaysia, Pagoh Higher Education Hub,
84600 Pagoh, Johor, MALAYSIA.

DOI: https://doi.org/10.30880/mari.2023.04.03.038
Received 01 March 2023; Accepted 01 May 2023; Available online 30 June 2023

Abstract : Nowadays, there are still a small number of individuals who carry packed lunches for the lunch break. It's strongly recommended to do this because there are a number of benefits to packing your own lunch from home that we are ignorant of. In comparison to food stands, home-cooked meals are of higher quality. However, most people who bring meals from home will face the problem of the food becoming cold at lunchtime. The major goal of this project is to design a portable lunch box that works to heat food based on a set temperature and time anywhere with a power supply and also to develop a food heating system with a notification to users. This paper proposes a lunch box that can be reheated where the PTC heating element [1][2] in this lunch box is used to heat foods. The lunch box can be operated manually by using buttons or via Bluetooth to the handphone for selections of time and temperature. The Bluetooth is connected to the handphone through the operation of Arduino Uno and HC-05. Users are able to set and monitor the time to heat the lunchbox on their smartphone when it is connected to the lunch box through bluetooth. By this, it eases user to heat their food and keeps them reminded. The temperature readings displayed on the LCD for each one-minute interval were recorded as the PTC heating element of the food container was heated from 0 to 11 minutes. According to the observations, the lowest temperature recorded was 27°C and the highest temperature reached 34°C.

Keywords: Portable Heating Lunchbox, Bluetooth, Arduino, PTC heating element

1. Introduction

Nowadays, regardless of age, whether young or adult, school students or those who are already working still bring packed meals for the lunch break. This is a highly advised practice since bringing your own lunch from home has several advantages that we are unaware of. Home-prepared food is of better quality than in food stalls. Food stalls frequently provide far more food than you need. Many restaurants provide quantities that are two to three times the recommended daily allowance. Besides, one can have more control over the ingredients when making their own meals. We can ensure that the food is nutritious and made from fresh, high-quality ingredients. In addition, we can also ensure health through food preparation and ensure that the food is safe to be consumed. The human body and mind

*Corresponding author: norfaezah@uthm.edu.my

require a range of minerals and vitamins to stay energized throughout the day, increase productivity, and boost their ability to develop ideas, in addition to having an educated mind. Aside from that, cooking nutritious meals at home can help to boost your immune system and lower your risk of diseases including heart disease, cancer, high blood pressure, and diabetes [3].

However, most people who bring meals from home will face the problem of the food becoming cold at lunchtime. The food provided is not fresh, stale and not as tasty as when it was first served. The heat stored in the food is lost due to evaporation in the form of vapor. As a result, many prefer to dine outside at booths or canteens as they can get freshly cooked foods and better taste as it is still warm. According to certain research, food tastes better when it is warm. Studies have linked this to a taste receptor that detects sweet and bitter tastes. This receptor gives a greater signal to the brain when food is heated. Regardless of the research, hot food can sometimes satisfy hunger that cold food can't. Besides, hot foods are easier to digest. Our digestive system is sensitive to varying temperatures, according to researchers looking into how to help food break down faster. Warmer meals are easier to digest since the digestive system does not have to work as hard [4].

The idea chosen to innovate the present lunch box is food containers that can be reheated [5]. It is possible to assist the community in dealing with these issues through this project. This lunch box can make it easier for people to retain quality food in their daily life for their own well-being. Furthermore, the lunch boxes are light and portable, making them ideal for use at school, work, picnics, or in the vehicle. It is effortless to use and appropriate for all members of the community, regardless of age. The ability of this food containers to heat dependent rechargeable lunch boxes. Users are able to reheat their lunch by plugging in the lunchbox to any power outlet such as the wall socket plug or power bank via a USB cable.

2. Materials and Methods

2.1 Materials

Table 1 lists down all the components needed for this project.

Table 1: List of components

No.	Component	Qty	Function
1	Arduino Uno Rev 3	1	As the main controller.
2	HC-05	1	To receive and transmit data through Bluetooth.
3	DHT11	1	A temperature sensor to detect the heat produced by the PTC heating element.
4	Relay	2	Switch that is electrically operated that can be turned on or off and let the current flow in the circuit.
5	PTC heating element	1	A self-regulating heater is used to produce heat in the lunch box.
6	LCD	1	To display information of the time on the lunch box.
7	USB relay module	1	Connect the USB port to the power outlet for the power supply through a USB cable male to a USB cable female.

2.1 Methods

Figure 1 shows a block diagram of the components used in this project which are Arduino UNO, temperature sensor DHT11, Bluetooth module HC-05, PTC heating element [1][2], pushbuttons and relay.

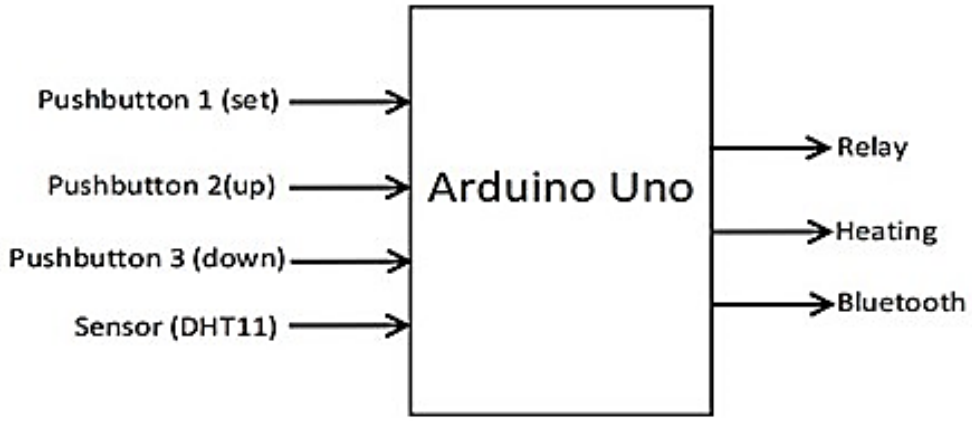

Figure 1: Block diagram

Figure 2 shows a flow chart of the entire process in the development of the product. The start process begins when the lunch box is connected to the power outlet by the USB relay module through a USB male cable to a USB female cable, and the relay that acts as a switch is turned on. This lunch box is used when users connect their smartphones to the Bluetooth of the HC05. Users are able to set the time of the heating of the lunch box from 1 minute up to 40 minutes. When the time of the heating is done, a notification will be sent to the user's smartphone through the Blynk application. The heating of the PTC is the output of this lunch box. When the food is heated, the user can switch off the lunch box manually.

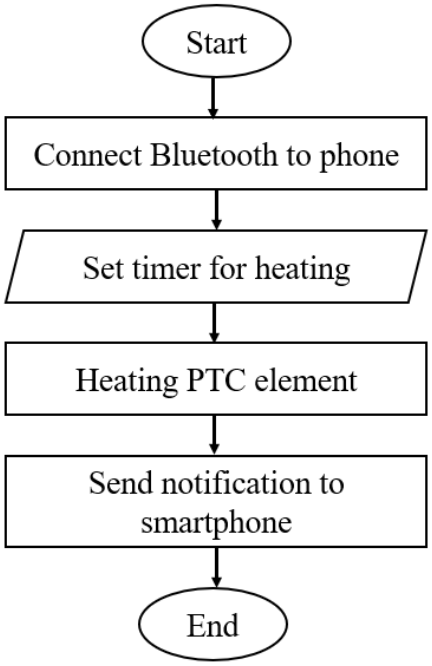

Figure 2: Flowchart of the system

Figure 3 below shows the connection of the prototype components to test the function of push-button start/set time and temperature display on LCD. The components shown in the figure consist of an Arduino Uno, 4 pushbuttons, LCD, relay module, DHT11 temperature sensor and also a potentiometer to control the berightness of LCD display. The lunch box can be operated and monitored by the user with these 4 pushbuttons functions as shown in **Figure 4**. Pushbutton 1 to start/stop (Long Press for Stop), pushbutton 2 to increase the timer value, pushbutton 3 to decrease the timer value and the last one is to set the timer value. A timer of one minute was set during the testing process to record temperature changes for heating food.

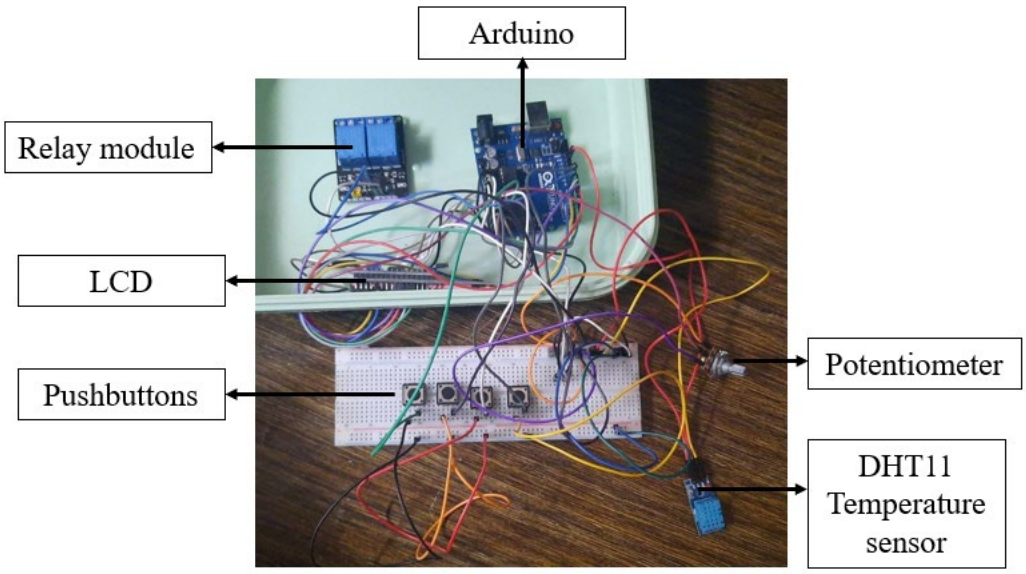

Figure 3: Electrical connection of the system

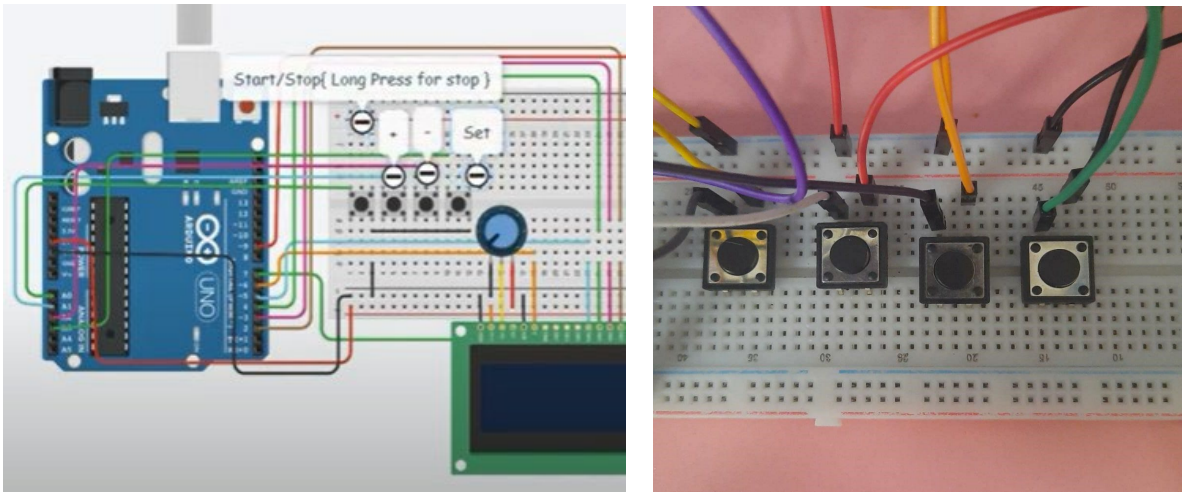

Figure 4: Pushbuttons connection and function

2.2 Prototype Design

Figure 5 shows the 3D design of the prototype. LCD, pushbutton, and USB relay modules are on the food container's outlet, while PTC heating element, relay, Bluetooth HC-05 and temperature sensor DHT11 are on the inside of the container. It's portable, rectangular in shape and the size is suitable for lunch-type of foods. The food section is made of stainless steel, which can retain the heat generated by the PTC heating element and keep the food warm. The ability of this food container is to heat a

dependent rechargeable lunch box. Users can reheat their lunch by connecting the lunchbox via a USB cable to any power outlet, such as a wall socket plug or a power bank [6]. There are 4 push buttons, to start/stop, set the temperature value and also increase and decrease the value of temperature.

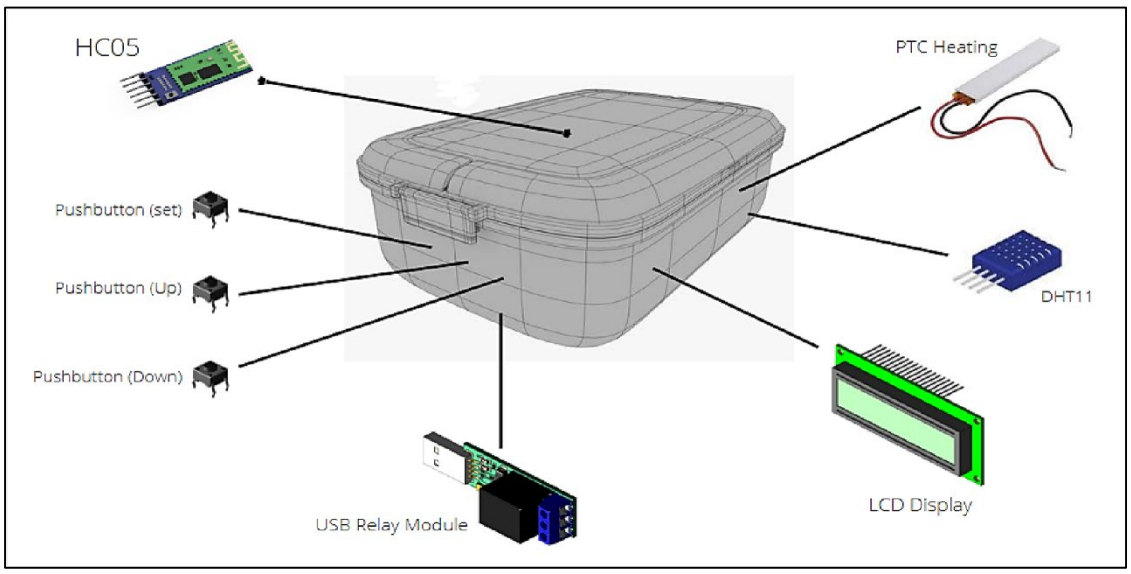

Figure 5: 3D design of the prototype

3. Results and Discussion

The results of the portable heating lunch box project can be seen in **Figure 6** which shows the pushbutton 1 function to start/set time appears on the screen of the LCD. The LCD also displays the temperature inside the lunch box. When the lunch box is connected to the power supply, the temperature inside the lunchbox which is measured by DHT11 temperature sensor will be shown on the LCD display.

Figure 6: LCD to display the start or time setting for heating process and temperature inside lunchbox

The result for the heating process is shown in **Table 2**. The temperature starts at room temperature and continue to increase to a maximum temperature of 34°C within 11 minutes.

Table 2: Result of heating process

Time (minutes)	Temperature (°C)
0	27
1	31
2	33
3	34
4	34
5	34
6	32
7	32
8	31
9	31
10	31
11	32

4. Conclusion

In conclusion, the user can use the food container heater according to the time that the user has specified. The PTC heating element will increase its temperature gradually. The timer will be counted on a countdown basis and when the timer has run out of count it will trigger bluetooth to send a notification to the user's phone to notify the food is ready.

An improvement that can be done to current system is to set the appropriate temperature setting for different types of food so that the heating process runs smoothly.

Acknowledgement

The authors would also like to thank the Centre for Diploma Studies, Universiti Tun Hussein Onn Malaysia for its support.

References

[1] H. Becker and H. Ohnmacht, "PTC Heating Elements - Background Analysis and Design Attributes," in IEEE Transactions on Industry Applications, vol. IA-21, no. 4, pp. 896-898, July 1985, doi: 10.1109/TIA.1985.349538.

[2] "PTC Thermistor, Chapter 3 – Resistor types." https://eepower.com/resistor-guide/resistor-types/ptc-thermistor

[3] Toe, Jue Jue Myint, et al. "The Study To Investigate The Need Of Lunch Box For The Young And Active Employees In Myanmar." International Journal on Recent Trends in Business and Tourism (IJRTBT), vol. 3, no. 3, 1 July 2019, pp. 8–11.

[4] L.Ye and Y. Jing, "Modular electric lunchbox design in the context of "post-epidemic era", 2021 International Conference on Computer Technology and Media Convergence Design(CTMCD), 2021, pp. 209-212, doi: 10.1109/CTMCD53128.2021.00051.

[5] Lü Xinxin and Luo Jia, "Design of New Thermal Lunch Box Based on Humanization Design," 2017 7th International Conference on Manufacturing Science and Engineering (ICMSE 2017).

[6] S. Thakare and P. H. Bhagat, "Arduino-Based Smart Irrigation Using Sensors and ESP8266 WiFi Module," 2018 Second International Conference on Intelligent Computing and Control Systems (ICICCS), 2018, pp. 1-5, doi:10.1109/ICCONS.2018.8663041.