Technological Institute of the Philippines - Quezon City

2nd Semester SY 2023-2024

ThermoDeliver: Temperature-Regulated Food Delivery Box

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Abstract- The present invention introduces a temperature-regulated food delivery box designed to ensure precise temperature control and optimal food preservation during transit. The housing comprises insulated compartments for storing food items, each equipped with temperature sensors. Unique to this invention is the utilization of Thermoelectric Peltier Cooler technology, employed in one compartment to achieve and sustain low temperatures and in another to maintain high temperatures. Safety and reliability features, including fail-safe mechanisms, redundant sensors, self-diagnostic capabilities, and protective measures, designed to ensure safe and reliable operation in various environmental conditions. A dedicated smartphone application allows users to remotely control temperature settings, receive real-time temperature updates, and get alerts in case of deviations. By enabling precise temperature regulation and monitoring, this innovative food delivery solution revolutionizes the preservation of food quality throughout the delivery process.

I. Introduction

In the Philippines, food delivery is so common that the majority of the citizens use this system. Food delivery management often experiences bad food quality during the delivery process. Resulting in bad reviews and dissatisfaction of the customers.

Project Overview- The intention of the project is to create a new food delivery box that has a temperature regulation and monitoring system to ensure the food quality doesn't drop during the delivery process, and gives satisfaction to the customers.

Objectives:

- Create temperature regulating system
- Application of hot and cold system
- Making a box / container as its body.
- Casing for Components
- Actual Progress Done:
- Used a built / already manufactured container.
- Casing of components.

II. Methodology

Hardware Design:

The hardware design of the system encompasses both electronic and physical components to ensure a proper functioning temperature control and monitoring system.

A. Electronics Systems

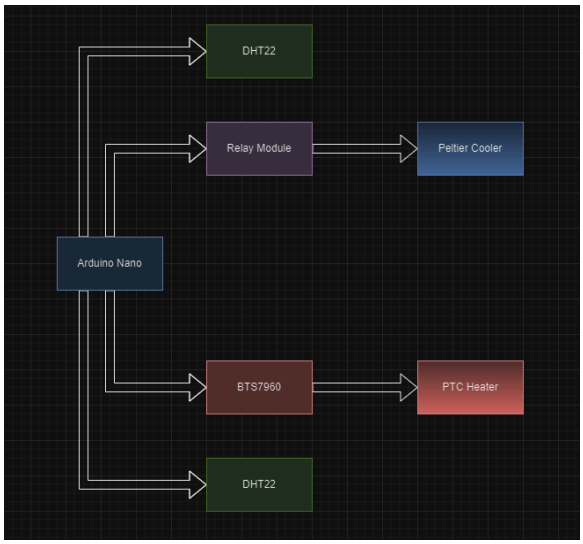

Figure 1. System Architecture

- The electronic system consists of several key components that enable the functionality of the temperature regulated box..

B. Physical Systems

The physical system of the temperature regulated box ensures that the proper circulation of the temperature inside the box is maintained and ensures its durability.

- Cooling and Heating System: This is how the temperature inside the box is maintained.
- Electronic Components: The microcontrollers, sensors, actuators, and power management systems work as intended when electronic components are tested so they perform seamlessly as a single entity.

Components	Quantity
MicroController (Arduino)	1
BTS7960	3
Relay Module	1
Peltier Module	1
PTC Heating	1
Battery	1
12V Power Supply	1

Figure 2. Prototype

- The temperature regulated box has two separate compartments to accommodate hot and cold temperature and the Electronic system behind it.

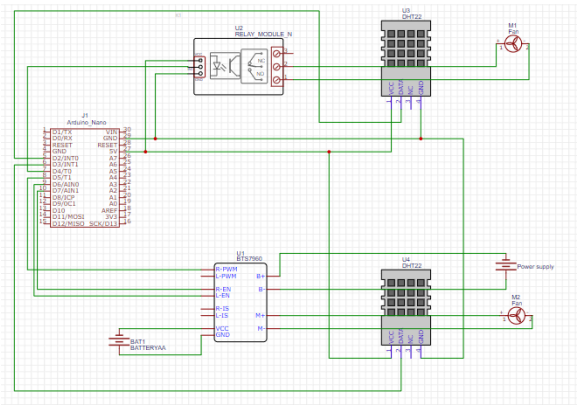

Figure 3. Schematic Diagram

- This is the schematic design which represents the prototype model and the interconnection of all its components.

C. Power Management

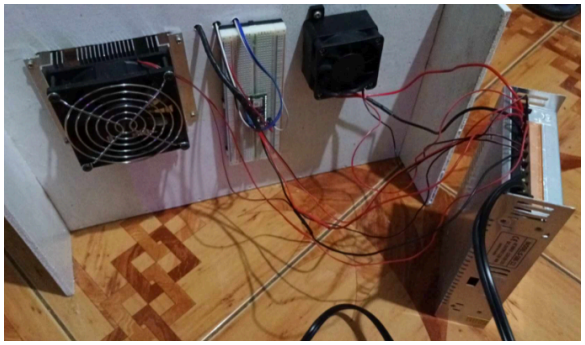

Figure 4. Power Supply

D. Software Design

a. Embedded Software

- The embedded software is responsible for managing the heating and cooling of the box.

E. Data Engineering

b. Data Description

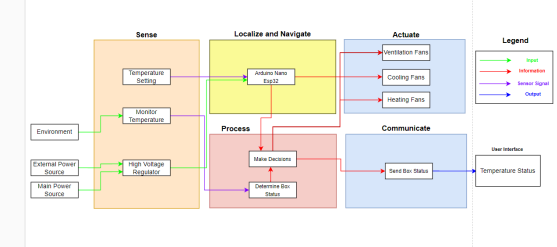

Figure 5. Functional Architecture

- The data flow diagram involves collecting temperature data from the environment for example inside the box. To update the microcontroller whether the motor speed increases or decreases.

d. Algorithms Used

- Algorithm for arduino ide is used to make the entire circuit work in harmony making sure to get the desired output.

II. Testing Procedures and Results

a. Testing Configuration / Setup

The testing setup includes simulation of the functionality of the box in the outside environment; this is also to ensure that the sensors are working properly and no other external factors are affecting the data reading of the sensor.

Figure 6. Testing Procedures and Results Overview

- This figure shows a detailed look the test processes that are conducted in the evaluation stage of the automated parcel locker system. It displays all components of the system with its working mechanisms and brings out major points when it comes to testing and outcomes.

b. Testing Results

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Temperature: 27.50°C 81.50°F
Temperature: 27.80°C 82.04°F
Temperature: 27.50°C 81.50°F
Temperature: 27.80°C 82.04°F
Temperature: 27.50°C 81.50°F
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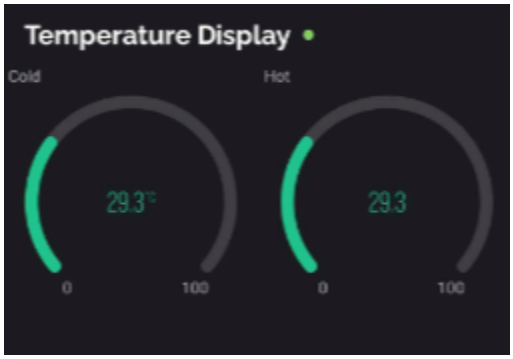

Figure 7. Result of the sensors

- This figure shows the readings of the two sensors for the heating and cooling compartment.

the relay to turn on and off the peltier cooler mechanisms,

III. Analysis of Testing Results

The ways that tests were carried out on the thermodeliver system supplied important information which is connected with its performance, functionality and user interaction. They are the most important data and test results analysis:

1. Hardware Testing Analysis:
    - Casing: The stress testing of the casing which is reinforced with plywood enhancing the durability and resilience Electronic Components: Testing the electronic components such as microcontrollers, sensors,, and power management systems validated their seamless integration and reliable performance as a cohesive system.
2. Software Testing Analysis:
    - Embedded Software: Meeting the operational requirements, the system was successfully operated with an embedded software capable of properly reading the temperature and sending the appropriate measurement to the motor driver to adjust the speed and
3. Quality Assurance and Reliability:
    - Issue Identification: Identified issues during testing were addressed promptly, such as the malfunctioning of the arduino uno due to improper wiring, proper power distribution. ensuring the system's reliability and adherence to quality standards.
    - Recommendations for Improvement: Based on testing results, recommendations were made for further enhancements, such as better power system, use of PID(Proportional Integral Derivative) for better fan speed control, better sensor, and scalability for future expansion, addition of application that can monitor the temperature.

IV. Conclusions

The efficiency, reliability, and usability of the Temperature controlled delivery box ensures that The food quality that the customers served is at its optimal level so that it can give satisfaction for both the customer, rider, and the food services that are being used. The rise of the food

delivery system occurs during the pandemic wherein the majority of the population of the philippines started using food delivery services to mitigate much contact during the pandemic. Many problems were faced during that time because it is brand new to the common folks and the commonly used isolation are foil which did not help to maintain the food quality resulting in bad reviews and dissatisfaction.

In the advancement of technology these features hopefully got implemented because it is already common for the people that provide food delivery services to have it as their source of income future upgrades or additional functions can be applied to the system as technology advances.

V. References

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