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كلية الهندسة و تكنولوجيا المعلومات

Graduation Project Report II

Pick at Locker

BY

Raghad Nedal Shehdeh-11924399

Zaina Rami Zaben-11923752

Supervisor: Dr. Aladdin Masri

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Contents

List of Tables

List of Figures

ABSTRACT

The delivery personnel usually face difficulties in finding customers' addresses accurately and correctly, resulting in time-consuming efforts for the deliveryman to find the right destination. Furthermore, recipients may not be available at home and they could not receive their parcel at the delivery time causing inconvenience for recipients and the delivery man. To try to solve those issues, this project aims to implement "Pick at Locker " where recipients could receive their parcels from public lockers at any time.

To manage all the project functionalities and properties; including holding and placing parcels into available lockers, verifying the correct PIN entry to open the locker, and processing payment. The Arduino Mega will be used as the main microcontroller.

In addition, this project aims to save both recipients and deliverymen time and reduce costs by optimizing routes, so recipients can collect their parcels from public lockers placed in a specific location by the delivery man. Furthermore, the project has positive environmental aspects by reducing carbon emissions.

The delivery personnel scan the barcode on the parcel, extracting the necessary information. Then send an SMS message to the customer, which includes the assigned PIN and locker number. Upon arrival, the customer enters their PIN and proceeds to make the payment for the parcel. If all details are correct and the payment is done, the locker will open, allowing the customer to retrieve their parcel. Afterward, the customer must ensure that the locker is securely closed.

After conducting research, it has been found that similar concepts have been implemented in various foreign countries. However, certain enhancements are required. In addition, since this idea has been executed previously, a novel of features and improvements will be incorporated to enhance its functionality.

1. INTRODUCTION

1.1. PROBLEM

Since the COVID-19 pandemic in 2020, retail e-commerce sales have grown 27.6% worldwide, and more and more parcels are being delivered to the doorsteps by deliverymen. However, a deliveryman delivers over 200 parcels per day, consumers expect fast and accurate delivery of the parcel. This challenge is faced by many factors such as time consumed and increased carbon emission while the delivery man hovers around the neighborhood to locate the customer's house, and since the street system in Palestine is unclear and undefined this could lead that the parcel being delivered to the wrong address. Moreover, in some instances, the customers are not present at the time of delivery at their homes.

In particular, the deliveryman is unable to navigate effectively due to unclear address systems and customer unavailability poses a substantial problem to timely deliveries. Despite efforts to contact customers via phone calls, the parcels may still be directed to incorrect addresses, leading to frustration for both the customer and the deliveryman.

Therefore, this project proposes the implementation of a public locker system. These lockers would serve as secure and accessible storage locations for the delivery process. By strategically placing public lockers in centralized locations, the aim is to eliminate the need for precise doorstep deliveries and circumvent the issues related to uncertain address systems and customer availability.

1.2. OBJECTIVE

This project introduces the public locker system in Palestine, to address the various challenges of the current delivery process, so There are many objectives to this project, which include:

- ACCURACY:

  Using the system of public locker, the deliveryman does not have to call the customers numerous times to find his place. Customers can easily pick up their parcels from the locker that has been allocated to their parcel.

- TIME SAVING:

  The deliveryman has to take the parcel from the retailer and place it in the public locker, which is in an easy and accessible location, and he does not need to spend excessive time searching for the right destination.

- ## 24/7 AVAILABILITY:

  The project aims to allow customers to collect their parcel from the public locker at their convenience time, which gives the customers flexibility unlike the conventional method, which require the customers to present at home during the specific delivery time.

- ## EFFICIENT ROUTE PLANNING:

  By implementing this system, the deliveryman can efficiently plan his route, leading to saving time, money, and environmental emissions.

- ## ENVIRONMENTAL IMPACT:

  When the deliveryman optimizes his route and drops the parcel at the public locker, this will contribute to the reduction in Carbon emissions and save the environment.

- ## ENHANCED FEATURE:

  While the idea of this project has been implemented in different countries around the world, it aims to introduce enhanced features and make improvements to the overall functionality of the system.

- ## USE OF PIN:

  In the system when the parcel is delivered to the lockers by the deliveryman an SMS message will be sent to the customer with assigned PINs and locker numbers. This will ensure that the customer has access to his parcel and secure the parcel in a safe place.

- ## SECURE STORAGE:

  The system will ensure the security of the parcel storage in the lockers. Customers use a PIN to access their parcels, and proper closure of the locker is highlighted to ensure the safety of retrieved parcels.

1.3. SCOPE OF THE WORK

The “Pick at Locker” project will design the whole system needed to operate the functionality of the project and help the deliveryman to safely deliver and secure the parcel at the public locker. For the customer, he will have the flexibility in receiving the parcel and getting his order safely as well. This includes the following steps:

1. Design the public lockers.
2. Integration of locking mechanisms that can be remotely controlled.
3. Programming the microcontroller system for managing the lockers.
4. Integration of hardware and software components to control locker access, PIN verification, and payment processing.
5. Implementation of a PIN verification system to ensure secure parcel retrieval.
6. Development of an automated SMS notification system.
7. Implement a mechanism to hold the locker and put it in the desired location.

1.4. IMPORTANCE

The "Pick at Locker" project aims to deliver parcels by offering customers a convenient and flexible way to receive their parcels from lockers, reducing time and cost expenses and increasing overall efficiency. This innovative approach not only saves time and costs for both deliveryman and customers but also contributes to environmental sustainability through optimized routes and reduced emissions. By enhancing security, improving customer experience, and showcasing technological advancement, the project stands to revolutionize traditional delivery methods while setting new standards for convenience and eco-conscious practices in the logistics industry.

1.5. REPORT AND ORGANIZATION

This report highlights the process of the research and the practical side of creating the public system of lockers “Pick at Lockers”. Therefore, the report will consist of the following parts which are:

- Chapter 1: is the introduction chapter It states the importance of the project, the objectives, the Scope of the project, and its importance.
- Chapter 2: is The literature review, projects, and articles from around the world will be further investigated to learn more about how this project was implemented what was their recommendations, and what enhancement features can be added.
- Chapter 3: is the methodology chapter, which outlines what was followed to create the system, and it discuss the constraints and limitation faced by the project.
- Chapter 4: is the result and discussion, it investigates the final result of the project and what was the outcome.

- Chapter 5: is the conclusion and recommendation, it highlight the conclusion of the project and suggest recommendation for any further research and projects.

2. LITERATURE REVIEW

Similar projects around the world have been studied and analyzed; this chapter investigates various literature reviews to study what mythology was followed, what was the final result, and what are the recommendations.

2.1. HYPERCONNECTED PICKUP & DELIVERY LOCKER NETWORKS (LOUIS FAUGERE,BENOIT MONTREUIL, 2017)

During the past decade, the market size has increased to the demand for the delivery. Traditional methods of home delivery often result in challenges such as delivering to the wrong destination, increased traffic congestion, and environmental pollution. To address these issues, the concept of hyper-connected pickup-and-delivery locker networks appears as a solution.

The paper explores the integration of two key concepts: the Physical Internet and hyper-connected Omni channel logistics. The objective is to achieve fast, convenient, and sustainable business-to-consumer pickups and deliveries. The proposed designs range from fixed locker banks to more advanced options inspired by the Physical Internet.

Different modules were analyzed in the research including modular towers, which allow dynamic adjustments to the network's capacity and configuration. Similarly, modular lockers offer adaptability to variations in demand and delivery patterns, though they present challenges in terms of inventory management and distribution. A significant advancement can be noticed in the use of Physical Internet handling containers (π-containers) as smart mobile modular lockers. This design demonstrates high flexibility, efficiency, and adaptability to real-time variations in demand and capacity, however the potential benefits of hyper-connected pickup-and-delivery locker networks, several challenges need to be addressed such as the engineering design methods, efficiency assessments, operating policies, and integration within broader logistics frameworks.

2.2. FLEXIBLE PARCEL DELIVERY TO AUTOMATED PARCEL LOCKERS: MODELS, SOLUTION METHODS, AND ANALYSIS (ORENSTEIN, RAVIV, & SADAN, 2019)

This study addresses the challenge of optimizing the delivery process to automated parcel lockers (APLs) when customers have the flexibility in choosing from multiple service points (SPs) such as home, office, or shopping malls. Unlike the traditional model where recipients specify a single delivery point.

The study introduces a model that can reduce costs and delivery times. The proposed solution methods draw from various heuristic techniques, including the savings heuristic, the petal method, and taboo search with a large neighborhood. Through extensive numerical

evaluations, the authors demonstrate the effectiveness of their model and solution methods in comparison to the conventional non-flexible approach. Furthermore, a simulation study showcases the model's adaptability to dynamic and stochastic environments, reinforcing the notion that exploiting recipient flexibility can enhance overall delivery efficiency.

The findings emphasize that the utilization of recipient flexibility yields substantial benefits in terms of cost reduction and delivery time optimization. The formulation of the problem as a mixed-integer linear programming (MILP) model, along with the application of heuristic approaches, provides a practical and efficient means of addressing the complexity of parcel delivery to APLs. The study also raises intriguing theoretical questions about the computational complexity of the loading problem and suggests avenues for further research, such as exploring more efficient solution methods and investigating multipored settings.

2.3. LAST MILE DELIVERY SOLUTIONS AND SMART LOCKER TERMINALS (FAUGERE & MONTREUIL, 2016)

According to this paper, the growth of e-commerce and the need for fast, reliable, and efficient last-mile delivery solutions have encouraged Smart Locker Terminals as a promising solution to enhance the efficiency of last-mile delivery.

Smart Locker Terminals is strategically located in public spaces, providing customers with a convenient pickup option for their parcels. The Smart Locker Terminals according to this literature can reduce delivery attempts, congestion, and emissions. Consumers can benefit from the flexibility and convenience of choosing when and where to pick up their packages. Logistics providers find value in reducing unsuccessful delivery attempts and optimizing route planning. Retailers are presented with opportunities to streamline their logistics operations and potentially lower shipping costs. Researchers have explored the integration of Smart Locker Terminals with Hyper-connected City Logistics to enhance efficiency and resource sharing. The use of Hyper-connected Modular Containers (PI Containers) adds another layer of efficiency by enabling real-time communication and tracking of goods.

The literature points out the gaps and opportunities for further investigation to understand the best place for the lockers to maximize accessibility and convenience for consumers. Future studies could explore the feasibility of incorporating emerging technologies such as blockchain for enhanced security and transparency within the Smart Locker Terminal ecosystem.

3. METHODOLOGY

In light of what has been discussed above, it is evident that the project has significance and advantages over traditional methods. In this project, both software and hardware methods were combined to control the whole project. This project has two states:

- Put Parcel.
- Take Parcel.

3.1. HARDWARE COMPONENT

3.1.1. Microcontrollers

- ARDUINO MEGA 2560:

  Arduino Mega has 54 digital input/output pins, 16 analog inputs, 4 hardware serial ports, a 16MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started (Arduino, Mega 2560 Rev3, 2023).

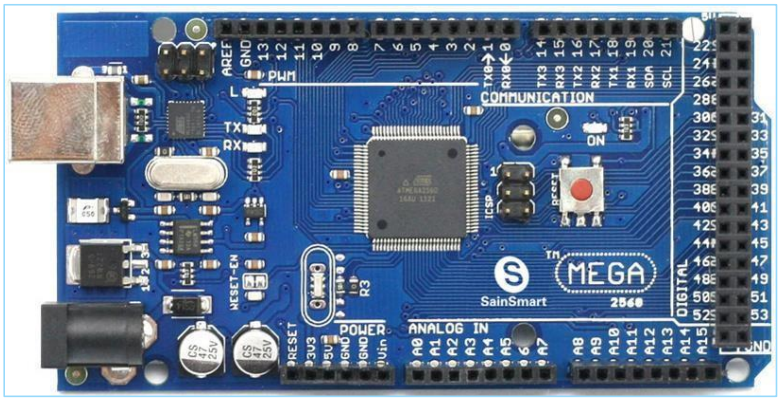


Figure 3.1:1 Arduino Mega 2560

- ESP32-WROOM-32:

  ESP32 microcontroller was used in the project to store and retrieve data from Firebase since Arduino Mega is not able to connect with the internet so a serial communication was established between ESP32 and Arduino Mega as shown in Figure 3.1:2 below.

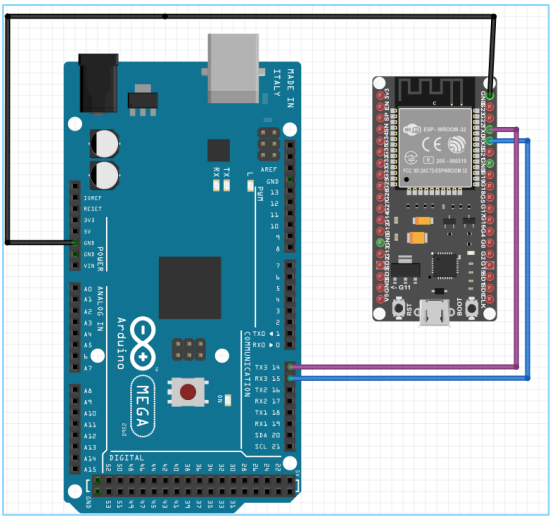
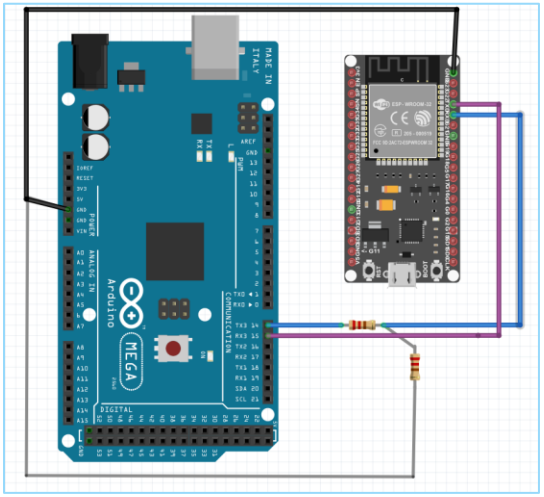


Figure 3.1:2 Serial Communication between ESP32 and Arduino Mega

However, the above connection could destroy ESP32 since Arduino Mega operates on 5 volts and ESP32 operates on 3.3 volts so to make it compatible with Arduino Mega a voltage divider was made to avoid any damage to ESP32 as shown in 3.1:3 below. (Hacker, 2021)



3.1:3 Serial Connection between ESP32 and Arduino Mega Using Voltage Division

In addition, ESP32 was used in this project as a web server combined with the mobile application, which was built using MIT APP Inventor[1].

[1] It is an intuitive, visual programming environment that allows everyone to build fully functional apps for Android phones, iPhones, and Android/iOS tablets.

3.1.2. Motors and Drivers

- STEPPER MOTORS:

Stepper motor is an electromechanical device that converts electrical power into mechanical power. Stepper motor use a cogged wheel and electromagnets to rotate the wheel one step at a time, each high pulse sent energizes the coil, attracting the teeth closest to the cogged wheel and driving the motor one step forward each time. The sequence of pulses determines the spinning direction of the motor, the frequency of the pulses determines the speed of the motor, and the number of pulses determines how far the motor will turn. Stepper motor was chosen due to its speed control, precise positioning, and repeatability of movement. To implement this project two-stepper motors needed one to control movement in the X-axis and the other to control movement in the Y-axis. (Earl, 2023)

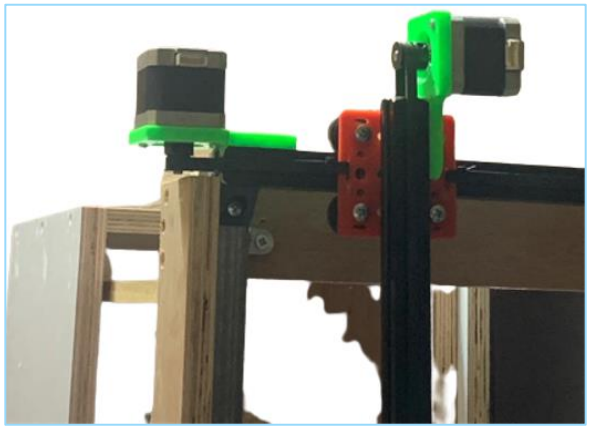


Figure 3.1:4 Stepper Motors

- YS-DIV268N DRIVER:

The YS-DIV268N driver is a specialized electronic component used to control and manage the operation of the stepper motor, since Arduino mega could provide up to 5 Volts only and the Stepper motor requires around 12 volts and at least 1.2A two drivers were used to accomplish this job since two stepper motors required in this project. (patrickNX9420)

Figure 3.1:5 YS-DIV268N-5A Driver

- DRIVER POWER CAPLE 12V:

As mentioned above stepper motors require 12V to operate so a driver power cable was used to make sure an appropriate voltage and current were provided to the motors to work correctly.

Figure 3.1:6 Driver Power Cable 12V

- CNC XY LINEAR MOTION:

As mentioned above two stepper motors were needed to take the parcel and place it in one of the empty lockers so a CNC XY linear motion was used and the two stepper motors were attached to it as shown in Figure 3.1:7.

Figure 3.1:7 CNC XY Linear Motion

- MICRO-SERVO MOTOR SG90:

Servomotors are widely used for their ability to provide precise control over position, speed, and torque, and are found in many types of machinery and devices that require accurate and controlled movement. A servomotor is typically made up of a small DC motor, a gearbox, and a control circuit that regulates the motor's movement. The control circuit provides feedback to ensure that the motor rotates to a precise position based on input signals, and then maintains that position with great accuracy, often within a few degrees. (Servo Motor SG-90, 2017)

Figure 3.1:8 Micro-Servo Motor SG90

In this project, six micro servomotors were used to close locker doors tightly. To achieve this job a curve stick was attached to each door as shown in Figure 3.1:9. Then

servomotor was controlled to go either to position zero to open the locker or to position 90 to close it.

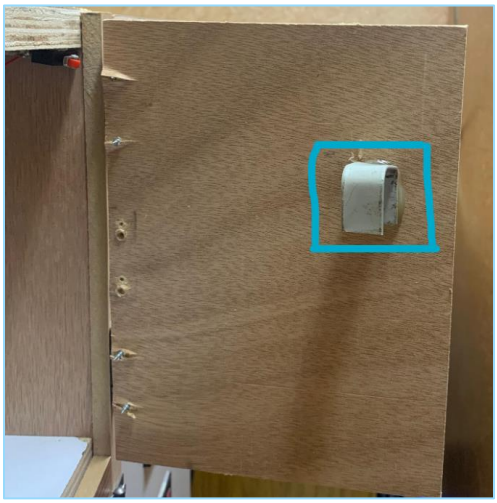


Figure 3.1:9 Curve Stick

- SERVO MOTOR MG996R:

This motor is very similar to the micro servo but they differ in terms of size and the operating voltage. This motor was used to push the parcel and place it in the desired locker it can be stated that it works in the z-axis.

Figure 3.1:10 Servo Motor MG996R

- 3D PRINTING MECHANISM:

To make linear motion in the Z-axis a 3D printing mechanism was used and a servo motor MG996R Figure 3.1:10 attached to it. The motor goes to position 180˚ to place the parcel then it returns to position 0˚.

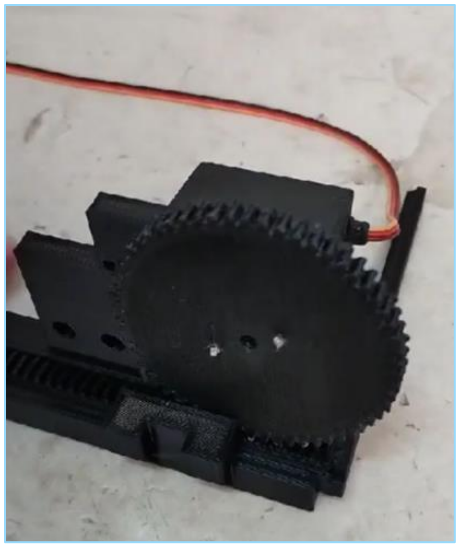


Figure 3.1:11 3D Printing Mechanism

3.1.3. Sensors

- INFRARED SENSOR (IR):

IR sensor is an electronic device that measures and detects infrared radiation in its surrounding environment with spectral sensitivity in the infrared wavelength range: 780 nm … 50 µm. (Jost, 2019)

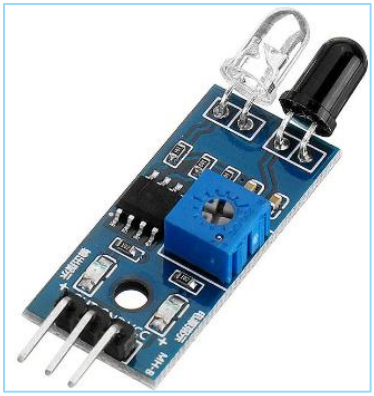


Figure 3.1:12 IR Sensor

Six IR sensors were used to detect if the lockers were empty or not. The following Figure 3.1:13 demonstrates the connection with Arduino:

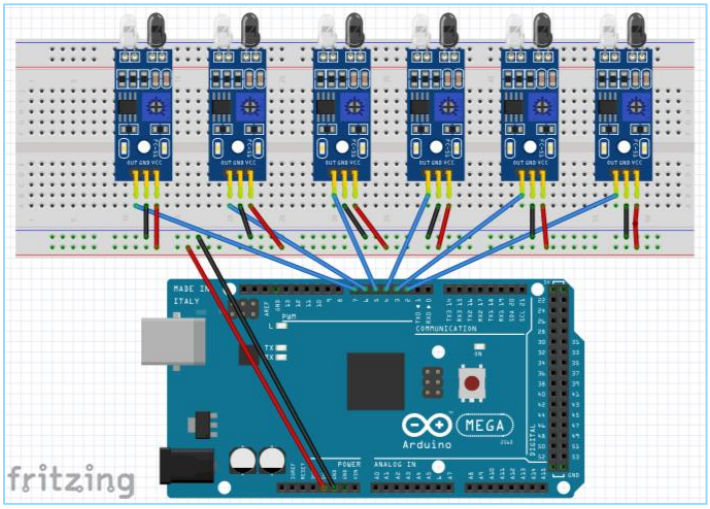


Figure 3.1:13 IR Sensors Connection

Another IR sensor was used to if the parcel arrived at the arm or not.

3.1.4. Input/Output Devices

- MICRO-SWITCH:

The microswitch has three pins (NO, NC, COM), it makes the circuit connected when pressed and breaks when released. (Push Button Switch, 2020)

Figure 3.1:14 Micro Switch

Six micro switches were used to detect if the lockers were open or not. In addition, two push buttons were used to detect if the arm was at its set point or not.

- ## STRIP LED:

12 volts strip LED was used in this project because it consumes significantly less power than other lighting options In addition, it does not get hot so it's safe to use. (BUCKLEY, 2019)

Six strip LEDs were used, when the door of the locker is open the strip LED is on, and when the door of the locker is closed the strip LED is off.

Figure 3.1:15 Strip Led

- ## 4-CHANNEL RELAY:

A compact and efficient device that empowers users to control and switch four separate electrical circuits using a single control signal. This makes it an ideal component for projects requiring versatile and centralized management of various high and low-voltage devices.

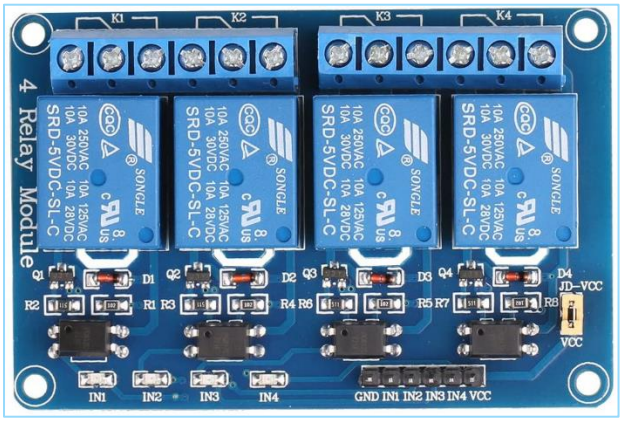


Figure 3.1:16 4-Channel Relay

Two four-channel relays were used each channel containing three pins (NO, NC, COM). The common pin connected to the positive terminal of the strip led and then it connected to the 12-volt power supply, the normally closed pin connected to the negative terminal of the strip led, and then to the ground. This module operates using 5 volts so Arduino Mega was used to operate it Figure 3.1:17 demonstrates the connection.

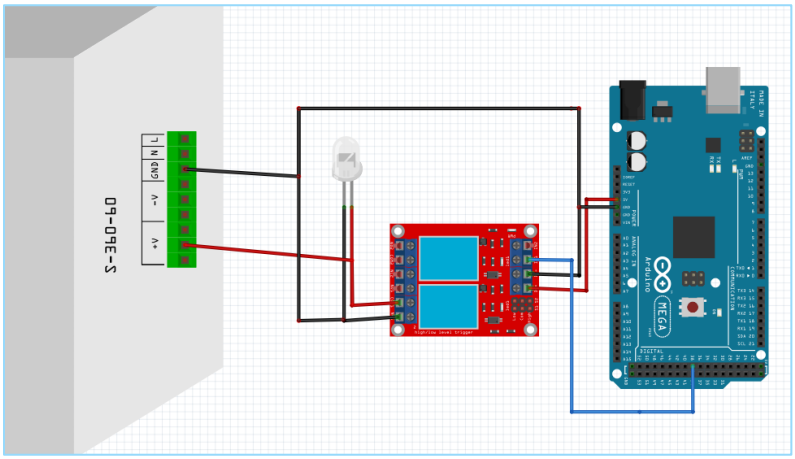


Figure 3.1:17 Strip Led connection with Arduino and Relay

- LIQUID CRYSTAL DISPLAY (LCD):

LCDs are used to display information from Arduino or keypad or any sensor connected to it. There are two different types of LCDs available: graphical and character LCDs. In this project, a 20×4 character LCD was used (20 columns and 4 rows). A potentiometer is also needed to adjust the contrast of the LCD Figure 3.1:18 shows the complete connection. (Sanjeev, 2018)

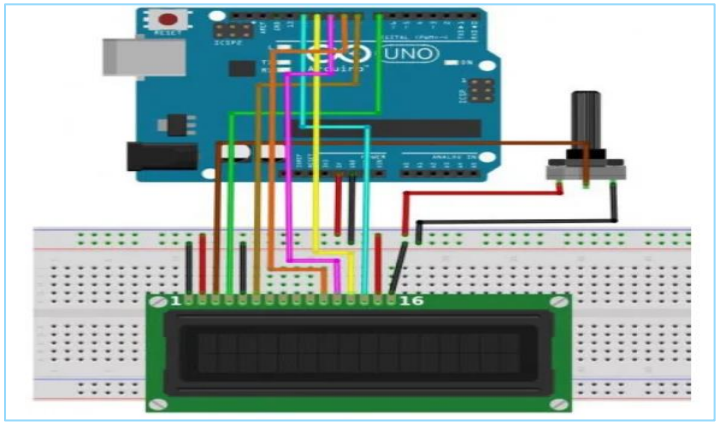


Figure 3.1:18 LCD Connection with Arduino Mega

- ## KEYPAD:

The 4×4 matrix keypad is an input device; it is usually used to provide input value in a project. It has 16 keys in total, which means it can provide 16 input values, and it uses 8 GPIO pins of a microcontroller. In this project, a keypad was used to allow users to enter their information Figure 3.1:19 shows a keypad connection with Arduino Mega.

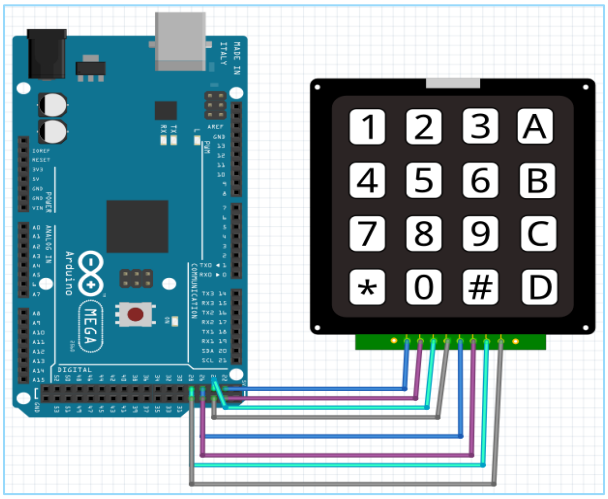


Figure 3.1:19 Keypad Connection with Arduino Mega

- ## RADIO FREQUENCY IDENTIFICATION (RFID):

In simple words, an RFID uses electromagnetic fields to transfer data over short distances. RFID is useful for identifying people and making transactions; the RC522 RFID reader module is designed to create a 13.56MHz electromagnetic field and communicate with RFID tags. (Arduino, What is RFID? How It Works? Interface RC522 RFID Module with Arduino)

Figure 3.1:20 RFID Module

RFID was used in this project to let users pay for their parcels when they receive them, Figure 3.1:21 shows a connection with Arduino Mega.

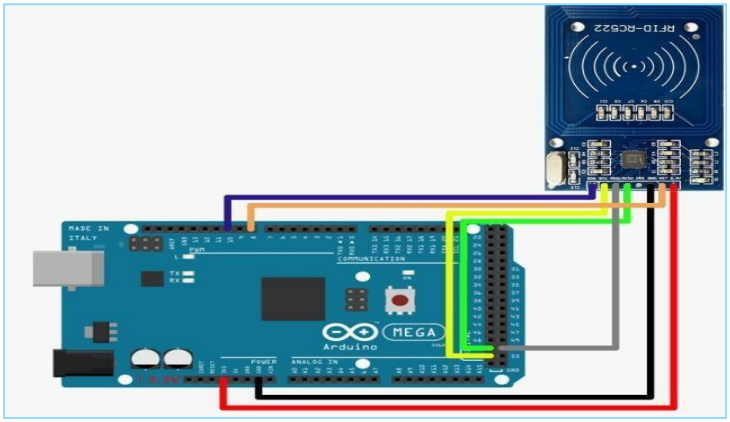


Figure 3.1:21 RFID Connection with Arduino Mega

- BARCODE SCANNER:

A Barcode scanner was used in this project to enable the deliveryman to scan parcels before placing them, so to connect it with Arduino Mega a software serial communication was done as described in Table 1.

Barcode Scanner Pins	Arduino Mega Pins
RX	10
TX	11
GND	GND

Table 1 Show Barcode Scanner Connection with Arduino Mega

In addition, the barcode scanner requires around 6 volts to operate correctly so a 12-volt power supply with a regulator was used for it.

Figure 3.1:22 Barcode Scanner

- ## DC-DC CONVERTER:

It converts one DC signal to another, As mentioned above barcode scanner requires around 6 volts to operate correctly so a 12-volt power supply was used to achieve this job Table 2 describes how the connection should done.

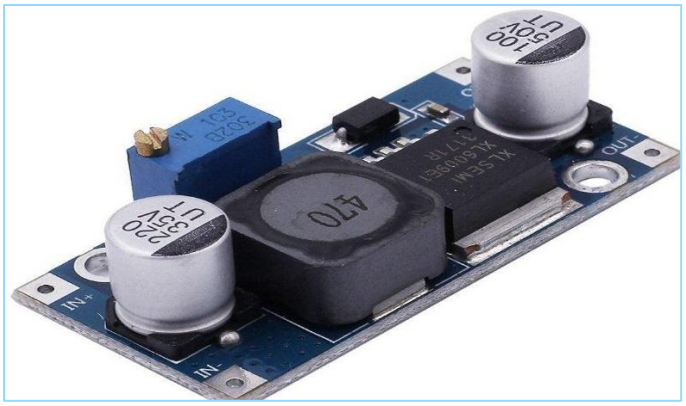


Figure 3.1:23 DC-DC Converter

DC-DC Converter Pins	Pins Connection
IN+	With 12-volt Power Supply
IN-	GND
OUT+	With Vcc of Barcode Scanner
OUT-	GND

Table 2 Shows the Convertor Connection with the Power Supply

- ## GSM MODULE SIM800L:

The SIM800L GSM module is a miniature GSM modem that can be used in a variety of IOT projects. This module can be used to make calls to phones or send SMS messages. In this project, this module was used to send SMS messages when a parcel was placed in one of the lockers. The operating voltage of the chip ranges from 3.4V to 4.4V so a DC-DC converter is also needed here you can see Table 2 for the connection map. (Arduino, Send Receive SMS & Call with SIM800L GSM Module & Arduino, 2020)

Figure 3.1:24 SIM800L GSM Module

3.1.5. Different Items

- BREADBOARD AND PCB BOARD:

To connect various components, such as the GND, 5-volt, and 12-volt power supplies, to devices that need these voltages, we used a breadboard.

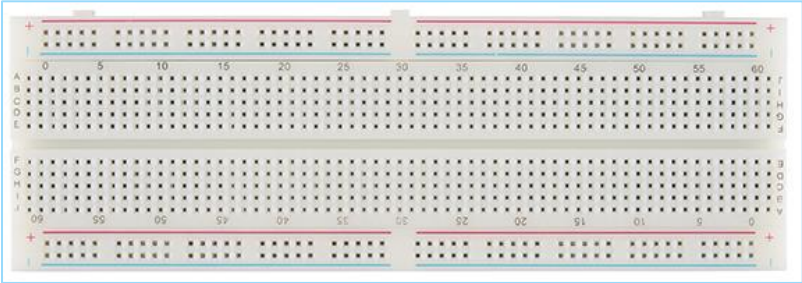


Figure 3.1:25 Breadboard

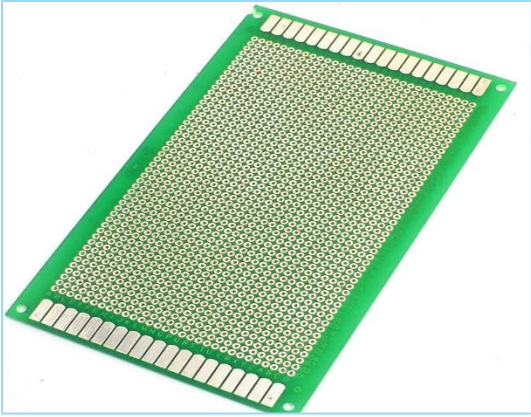


Figure 3.1:26 PCB Board

- WIRES:

A variety of connections was made using four types of wires: Electrical wire, male-to-male, female-to-female, and male-to-female.

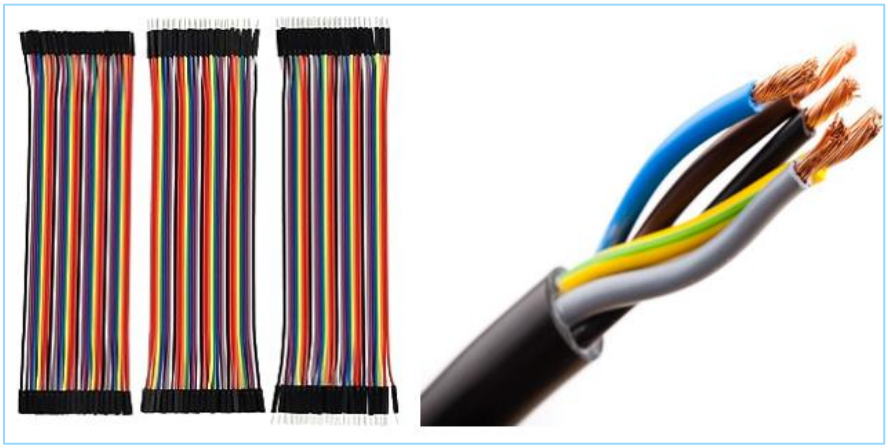


Figure 3.1:27 Different Types of Wires

- POWER SUPPLY:

Since multiple devices operate at 5 and 12 volts, a computer power supply was chosen to meet voltage requirements. The power supply also provides enough current to meet the needs of this project.

Figure 3.1:28 Power Supply

3.2. SOFTWARE IMPLEMENTATION

3.2.1. Libraries:

- Liquid Crystal Library: Used to allow Arduino Mega to control what to display on LCD.
- Keypad Library: Used to allow Arduino Mega to use matrix style using keypad.
- Serial Peripheral Interface (SPI) Library: used by Arduino Mega to communicate with Radio Frequency Identification (RFID).
- MFRC522 Library: used by Arduino Mega to read data from RFID devices.
- Servo Library: used to allow Arduino Mega to control multiple servomotors, this library can control up to 12 servomotors using only one timer.
- Software Serial Library: used by Barcode Scanner to make serial communication with Arduino Mega using digital pins, since Barcode Scanner requires a speed of 115200 bps.
- Firebase ESP32 Library: used by ESP32 to read, store, and update data on Firebase.
- Wi-Fi Library: used by ESP32 to connect it to the internet.

3.2.2. Flow Chart:

First, the user asked if he wanted to deposit a parcel or pick out a parcel. If he wants to put a parcel, he should select **"B".** After that, lockers are checked to make sure that at least one locker is empty, and then the arm is checked if it is in its set point, if not, the arm moves into its set point, and then the arm moves down to a particular location. Then the user is asked to scan the parcel, then he should put it in the preserved location, and then the arm should move to the first empty locker to place the parcel in it. Following that, an SMS message is sent to the user, which includes all of the information they need, and stored in the database.

If he wants to pick up a parcel, he should select **"A,"** then enter his phone number, and PIN code, and pay with his card, and all of the information is verified using data stored on Firebase. If all of the information is correct, the requested locker will be opened.

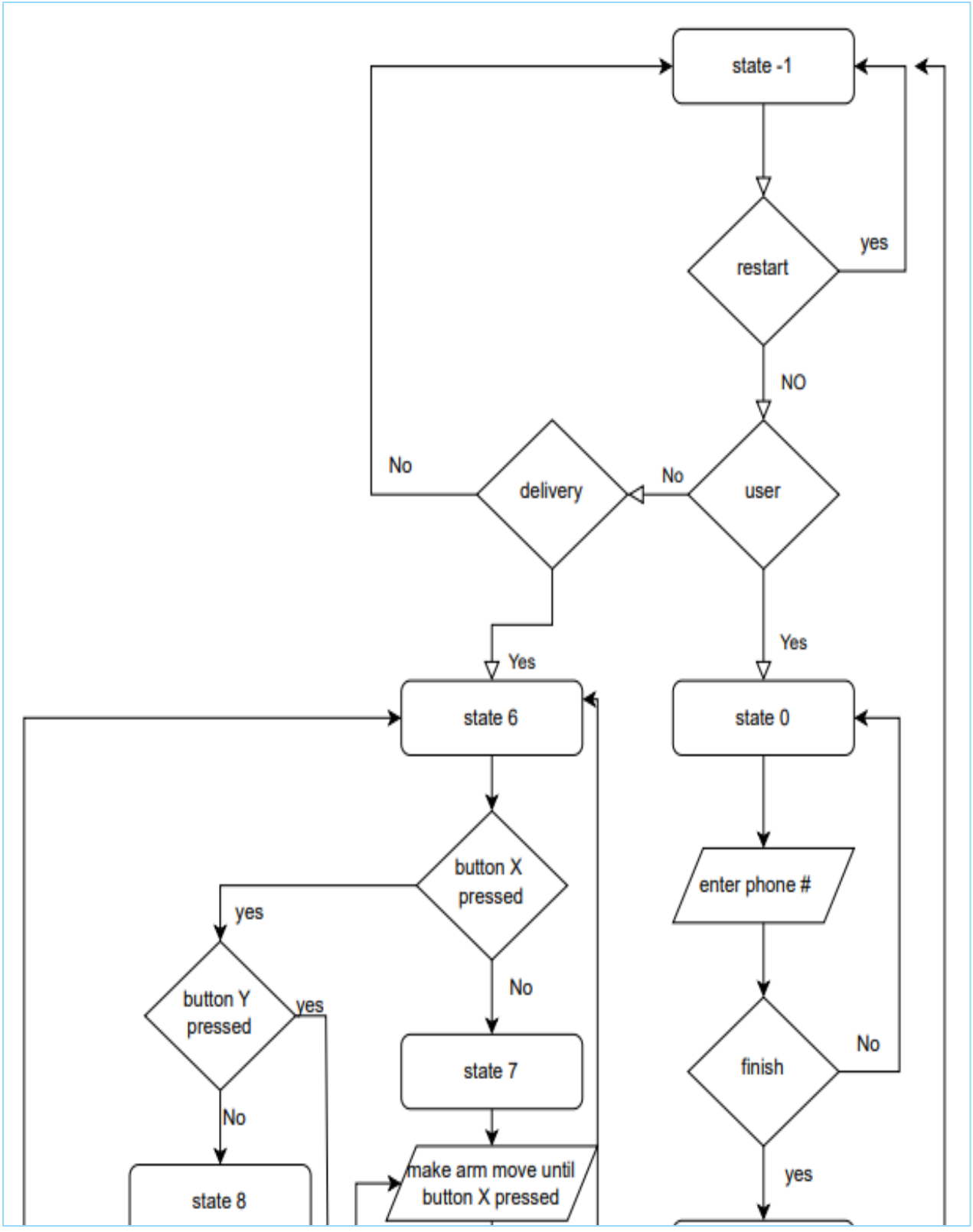


Figure 3.2:1 Flow Chart Part1

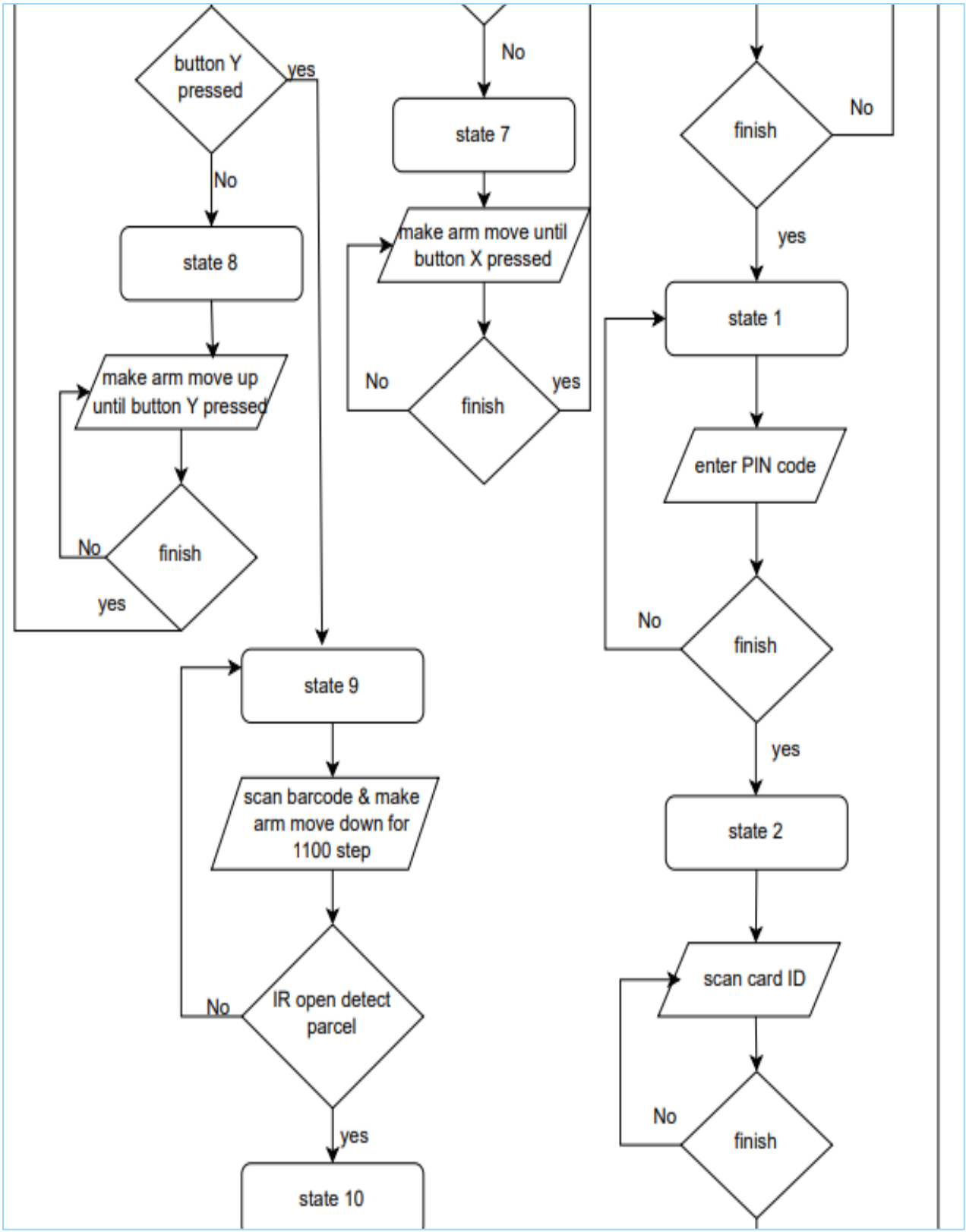


Figure 3.2:2 Flow Chart Part2

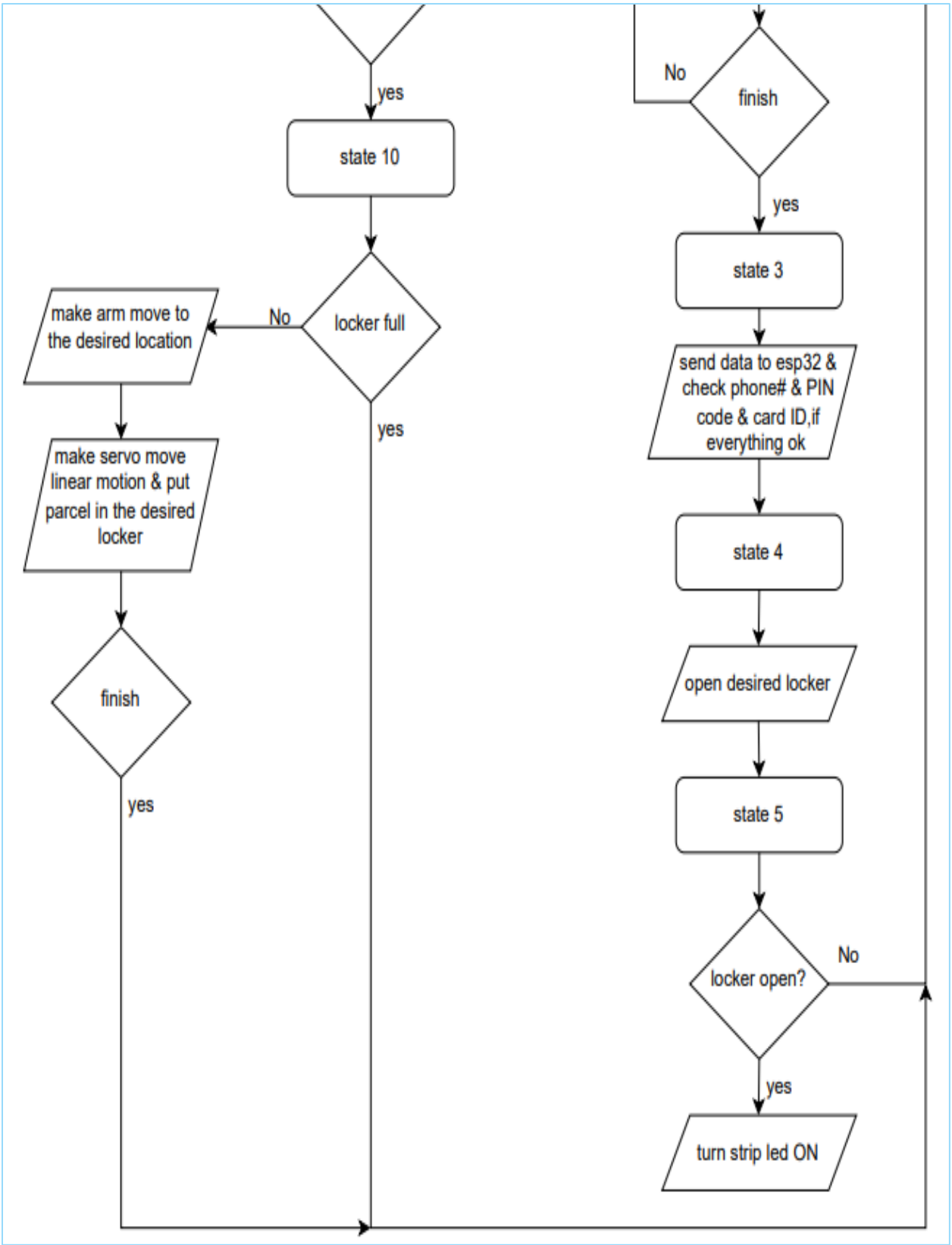


Figure 3.2:3 Flow Chart Part3

3.3. MOBILE APPLICATION

The mobile application was built using MIT APP Inventor, and ESP32 was used as a server for the application, also Firebase used for this application. The mobile application is divided into three sections:

- LOGIN/SIGNUP PAGE:

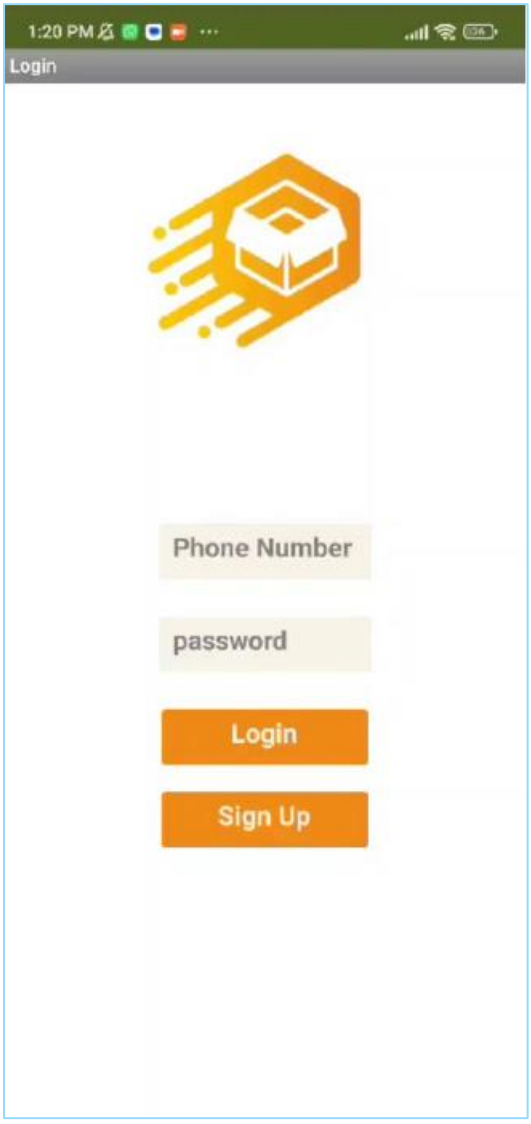


Figure 3.3:1 Login/Signup Page

- ADMIN PAGE:

On this page, the admin could open or close lockers by sending data to ESP32 then ESP32 will send this data to Arduino Mega. In addition, if the parcel has been in for more than 10 days in the locker, the admin will call the parcel's owner and if he does not answer, the admin can get it off the locker.

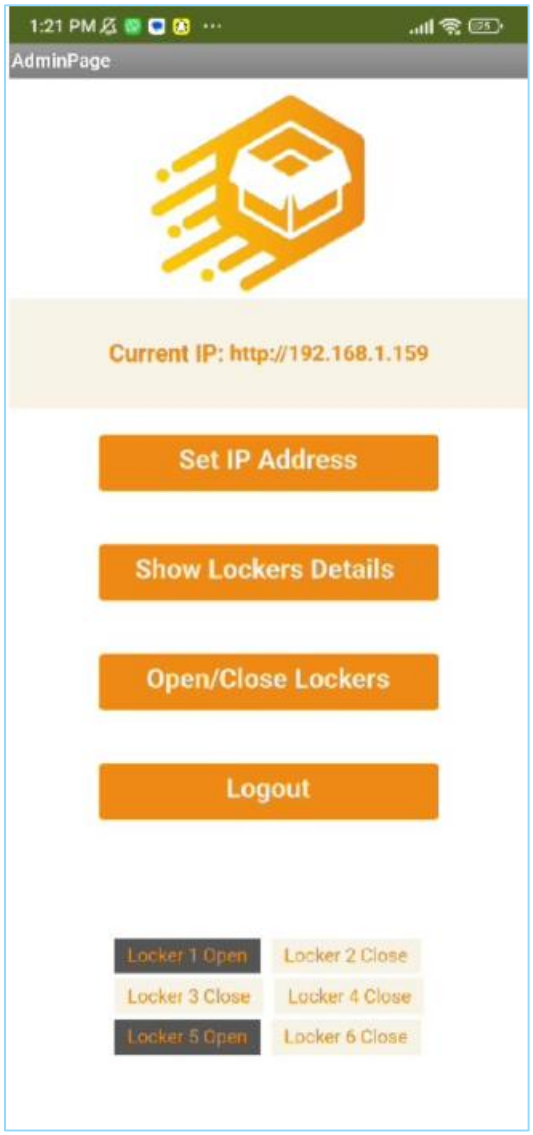


Figure 3.3:2 Admin Page Part1

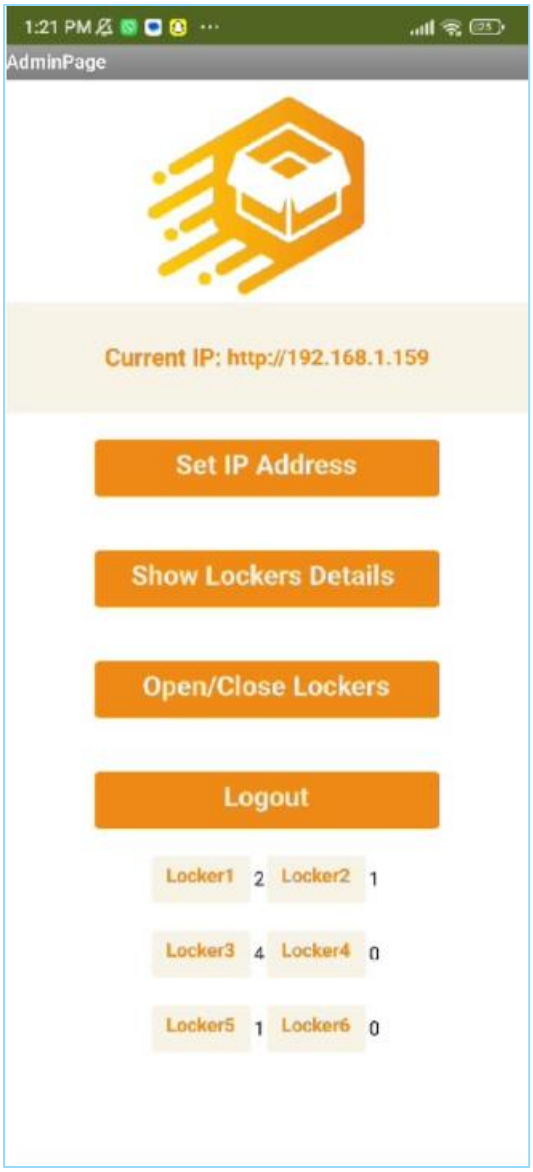


Figure 3.3:3 Admin Page Part2

- USER PAGE:

The user will log in if he has an account but if not he will have to sign up and then log in, the user will receive a PIN code and Information about his parcel.

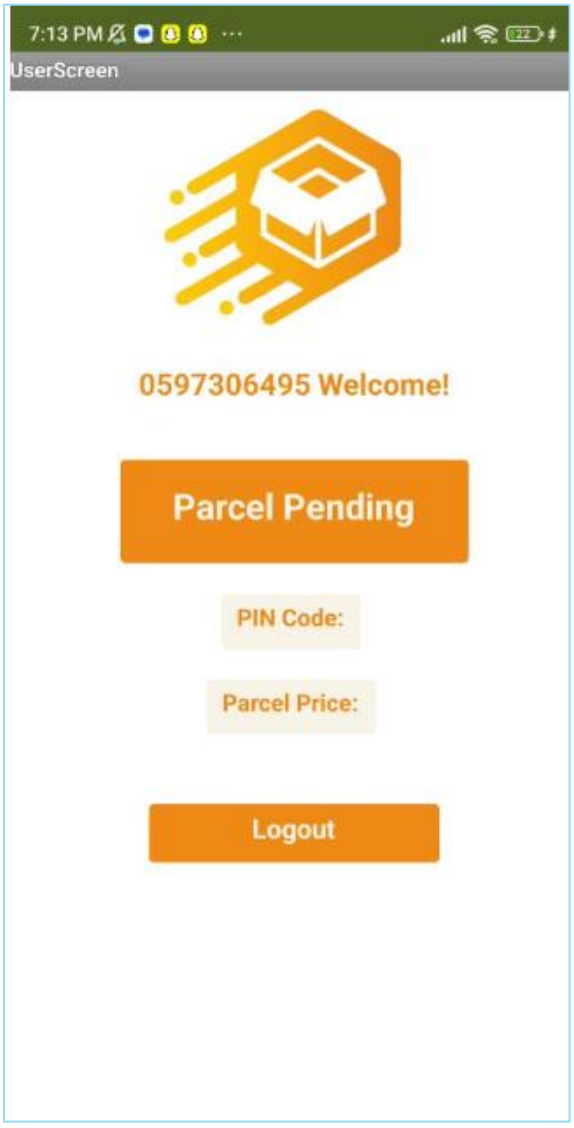


Figure 3.3:4 User Page Part1

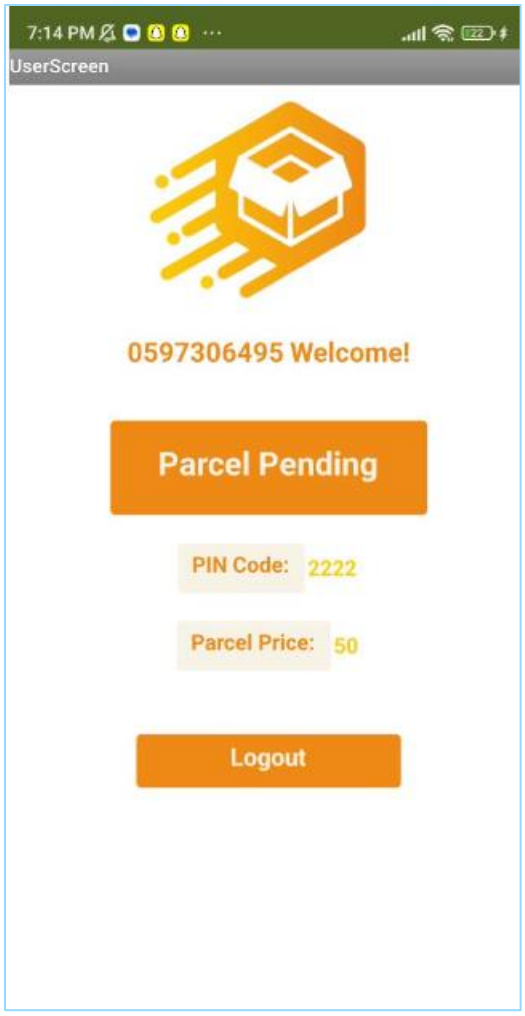


Figure 3.3:5 User Page Part2

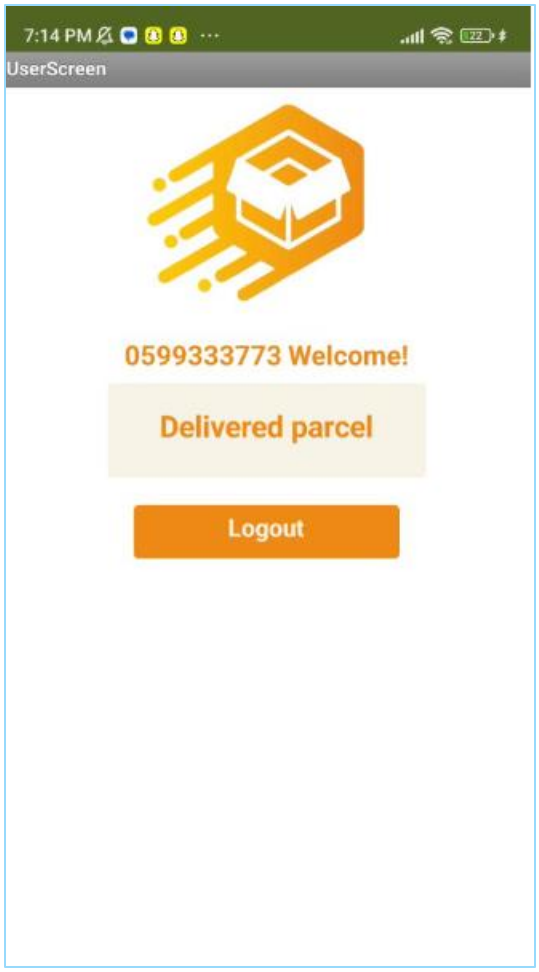


Figure 3.3:6 User Page Part3

4. RESULTS AND DISCUSSION:

At the end of this project, we successfully achieved the desired results by building a smart, automatic “Pick at Locker" with outstanding features such as easy and secure payment, saving both recipients and deliverymen time. The admin can also use the mobile application to close lockers remotely, and If the parcel has been for more than 10 days in the locker the admin will call the parcel's owner and if he does not answer the admin can get it off the locker.

Some Challenges and how they being solved:

1. At first, the ESP32 worked correctly for the uploaded code, but suddenly its temperature got very high so it was damaged, After careful consideration, we decided to use voltage division to avoid ESP32 damage.
2. Providing power to the various components of the machine. Some required 4 volts, others needed 5, some needed 6 volts while others needed 12 volts. We solved this by using a power supply from an old computer that provided both 5 volts and 12 volts and using the normal Electric converter and regulator.
3. Low signal problem with the GSM module SIM800L so we tried to change our location but that did not work.
4. Using app inventor because it is very restricted, and connecting app inventor with the Blynk.
5. Some of the components were working correctly but after adding another component they stopped working or worked in the wrong way, After careful consideration, we united the ground.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1. SUMMARY

Our team has designed and developed “Pick at Locker" where recipients can receive their parcels from public lockers at any time. The machine is equipped with an application and a keypad that can be controlled remotely by the admin for more security and efficiency.

Our locker has a very strong, user-friendly, and secure payment system since the user can not take his parcel if his money is not enough Also it is a secure and very strong locker because the parcel's owner can not open the locker if he did not enter the correct PIN code and the correct phone number moreover his card have enough money for paying.

During the development of the machine, we have also overcome several challenges. One of the challenges we faced was powering the different components within the machine. Some required 4 volts, others needed 5, some needed 6 volts while others needed 12 volts. We solved this by using a power supply from an old computer that provided both 5 volts and 12 volts and using the normal Electric converter and regulator. Additionally, we united the ground after carefully considering some of the components that worked correctly before and stopped working after adding another component.

In summary, our "Pick at Locker" Machine is a well-designed and efficient device that saves both recipients and deliverymen time and reduces costs by optimizing routes, so recipients can collect their parcels from public lockers placed in a specific location by the deliveryman. Furthermore, the project has positive environmental aspects by reducing carbon emissions. User-friendly features, customization options, and smooth automation make the machine unique and user-friendly.

5.2. RECOMMENDATIONS

1. Before connecting, read about each device to know more about it and to know how many volts each device needs.
2. Be careful when distributing currents and voltages.
3. Test each device separately and write its connection and its pins on the Arduino board to make sure that all of them working correctly.
4. Never just, connect wires, as they can easily break. Solder them instead.

5.3. WHAT WE HAVE LEARNED

1. How to work with sensors like IR, and motors like servomotors, and stepper motors.
2. How to connect and use various types of high-voltage devices and how to distribute currents and voltages.
3. How to connect Arduino to ESP32 and use its Wi-Fi features.
4. How to use ESP32 as a server for mobile applications and use MIT App Inventor to build quick mobile applications.
5. How to work with GSM module SIM800L.

5.4. FUTURE WORK

1. Improve the mobile application by adding notifications to it not just using the GSM module.
2. Add a door on the parcel entry section, If all lockers are full the door will still close, instead of just printing to the user “The lockers are full, try again later" on the screen.
3. Use material stronger than wood for more security.
4. If the parcel did not reach to the desired locker after specific time a notification will sent to the admin.

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