An-Najah National University

Faculty of Engineering and Information Technology

Computer Engineering Department

Grip And Win

Shorooq Zaian Sousa

Dya'a Talal Derieh

Project supervisor: Dr. Sufyan Samra

Acknowledgement

We would like to express our heartfelt thanks to Dr. Sufyan Samra, our supervisor, for his incredible support throughout our project. We also appreciate our friends and family who have stood by us from the start, providing us with the encouragement and assistance we needed. We hope that our hard work and the knowledge we've acquired will benefit our community and make a positive impact on humanity.

Table of Contents

Table of Figures

Disclaimer

This report was written by Shorooq sousa and Dya'a derieh at the Computer Engineering Department, Faculty of Engineering, An-Najah National University. It has not been altered or corrected, other than editorial corrections, as a result of assessment and it may contain language as well as content errors. The views expressed in it together with any outcomes and recommendations are solely those of the authors. An-Najah National University accepts no responsibility or liability for the consequences of this report being used for a purpose other than the purpose for which it was commissioned.

Abstract

A Grip And Win machine is a popular vending machine commonly found in places like movie theaters, bowling alleys, shopping malls, and arcades. It offers entertainment and can help individuals stay focused and motivated. The machine consists of a large box filled with Toys and a claw that can be moved in three directions (x, y, z). To operate the machine, The player can insert coins of two, five, or ten shekels. The machine will provide change for ten or five shekels, but if two shekels are inserted, no change will be given since the game operates using two shekels, The machine operates for a set duration of fifty seconds. Once this time limit is reached, the player is unable to continue and must insert another coin to play again.

To win the game, the player must move the claw using the joystick to the appropriate location, then after making sure that the location has been determined, he presses the green button to lower the claw to the game and pick it up. The claw automatically returns to location (0, 0), then the claw opens and throws the game for the player to pick it up.

This machine is divided into four parts: The logic control consists of an Arduino Mega for motor control, an Arduino Uno for handling the LCD and coin acceptor, three TB6600 stepper motor drivers, an ESP8266, and a power supply for the entire system.

Control part consists of lcd for displaying game instructions and remaining play time, joystick to control the gripper position before gripping item, and a green button that lowers the claw to pick up the toy. After that, it automatically returns to the starting position, opens the claw, and releases the toy to the player.

The mechanics part consists of gripper that carried by motor and rope which this motor can be moved through (x, y) plane and the gripper that tied with rope is the z axis, one stepper motors for y movement, two stepper motors for x movement, one stepper for z movement and one servo motor for the gripper, The playing area contains the toys that the player can grip, and RGB led strips.

Introduction

Geneal background

The claw machine is a well-known concept, often found in arcades and shopping centers. However, these machines typically lack a change return option, requiring players to use only the specific currency they accept. To address this, we developed a change return feature, allowing players to use their own currency without needing to exchange it first.

Objectives

The project aims to provide the feature of returning money to the player without the need to exchange the appropriate currency before starting the game, in addition to providing the feature of knowing the amount of money the machine contains and the number of times it has been played, and controlling the opening of the money door and the game filling door for the machine owner.

Significance of The Work

This project is important because it enhances the area of arcade gaming machines. It involves the design and construction of a working claw machine that can return leftover money. Additionally, it highlights the use of various skills and knowledge gained by the students during their studies, including mechanical design, electronics, and programming. In the end, this project showcases the students' creativity, innovation, and problem-solving skills in creating an enjoyable and engaging gaming experience.

Organization of The Report

The report begins with the first chapter, Introduction, providing a comprehensive
background on the research topic. Chapter 2, Constraints and Earlier
Coursework, highlights the challenges faced during the project and outlines the
solutions and strategies employed to overcome them. It also acknowledges the contribution of previous courses that assisted in the development of the application.

Moving on to the third chapter, Literature Review, an in-depth examination is conducted to establish a thorough understanding of the current research landscape. This section also investigates any similar projects that have been previously undertaken, shedding light on their methodologies and findings.

The fourth chapter, Methodology, presents a systematic plan devised to address the problem at hand. It encompasses the detailed process involved in constructing the robot, including the utilization of specific software tools and hardware equipment. This chapter serves as a comprehensive guide for replicating the project.

Next, in the fifth chapter, Results and Discussion, the gathered data is summarized and subjected to statistical analysis. The findings are then compared and contrasted, facilitating a deeper understanding of the project's outcomes. This section encourages meaningful discussions and interpretations of the results.

Finally, the sixth chapter, Conclusion and Recommendation, encapsulates the final project summary, incorporating all the valuable lessons learned throughout the journey. Additionally, it offers recommendations for further improvement and enrichment, suggesting potential features and subsystems that could enhance the project's capabilities.

In essence, the report structure follows a logical progression, starting with an introduction and background, addressing constraints and earlier coursework, delving into a literature review, outlining the methodology, presenting results and facilitating discussions, and culminating in a conclusive summary and recommendations for future work.

These courses and practical experiences greatly enhanced our skills and apply theory in practical applications.

Literature review

Claw machines are widely popular due to their entertaining nature and can be found in various locations, as previously mentioned. This paper aims to explore the design of a claw machine that includes a feature for returning leftover coins, as well as the development of a dedicated application for the machine owner to access information about the machine.

Methodology

Overview

Initially, we created the mechanical design of the machine to enable the gripper to move along the x, y, and z axes. Next, we developed the Automated System Management (ASM) for the machine and identified the necessary components for its control, including inputs, microcontrollers, motors, and more. We will provide detailed explanations of each component later. After constructing the machine and assembling the mechanical parts, we will integrate the ASM-based control system and conduct testing.

Mechanical Components

- Four Stainless steel shaft rods measuring 60 cm and 53 cm in length with an 8 mm diameter provide numerous benefits for mechanical applications. Known for their outstanding resistance to corrosion, stainless steel is ideal for settings where moisture or chemicals may be present. The 8 mm diameter offers adequate strength and stability for a variety of uses while remaining relatively lightweight. These stainless steel shaft rods are frequently utilized across different sectors, such as robotics, automation, manufacturing, and machinery. They are typically used as linear motion guides, axles, support shafts, or components for rotation.

Figure 1. stainless steel shaft rods

- Linear Ball Bearing Block 8mm
  An 8mm inner diameter linear ball bearing block is a part utilized in linear motion systems. It features a housing or block that houses a linear ball bearing, enabling smooth and accurate linear movement along a shaft or rail.

Figure 2 Bearing Block

- Shaft Block Type SK

The Shaft Block Type SK is a particular kind of shaft support block utilized in linear motion systems. It is frequently employed in situations that demand smooth and accurate linear movement, including CNC machines, industrial automation systems, and robotics.

Figure 3 Shaft Block

- Bearing
  A bearing is a component that supports a rotating or moving part of a machine and minimizes friction. Bearings are commonly utilized in different applications, including motors, wheels, and gears, to enable smooth operation.

Figure 4 Bearing

- Bore
  A timing pulley is a specialized pulley made for use with a timing belt. It is frequently utilized in machines and mechanical systems that demand exact power transmission and synchronization. The timing belt links the pulley to another rotating part, like a camshaft or crankshaft, ensuring precise timing between the two.

Figure 5 Bore

- Timing Belt
  A timing belt, often referred to as a toothed belt or synchronous belt, is a flexible belt featuring teeth on its inner side. It is utilized in machinery and engines to transfer rotational motion and maintain accurate synchronization between the driving and driven parts.

Figure 6 Timing Belt

- Custom 3D Printed Parts

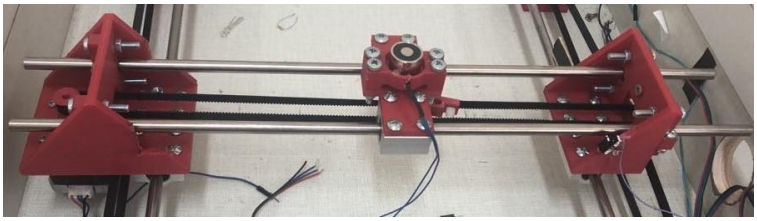

Figure 7 Custom Shaft 3D Printed Parts

Gripper Components

- Custom 3D Printed

Figure 8 Custom Gripper 3D Printed Parts

Hardware Components

- Arduino Mega 2560
  The Arduino Mega 2560 is a flexible microcontroller board that offers a remarkable range of input/output (I/O) features. It includes 54 digital I/O pins, 15 of which can serve as PWM outputs, providing plenty of options for connecting and managing various devices and sensors. Additionally, it has 16 analog inputs for accurate analog readings. The Mega 2560 is equipped with 4 UARTs (hardware serial ports) to facilitate smooth communication with other devices. Overall, the Mega 2560 is a dependable and well-equipped platform for experimenting with and creating electronics projects that have significant I/O needs.
- We used it to control the movement of the motors using the joystick.

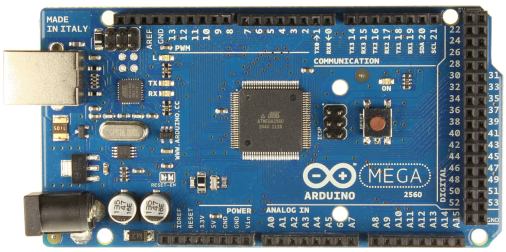

Figure 9 Arduino Mega

- Arduino Uno
  The Arduino Uno is a widely used microcontroller board for electronic projects. It is equipped with a 16 MHz ATmega328P microcontroller, 14 digital input/output pins, 6 analog input pins, and a USB connection for programming. We used it to control the lcd and coin acceptor.

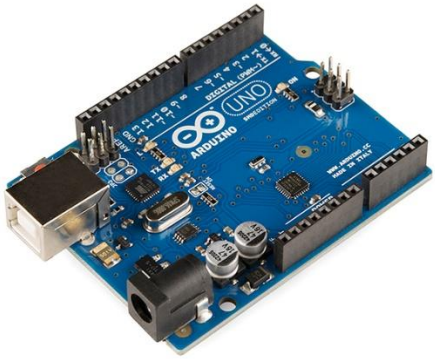

Figure 10 Arduino Uno

- ESP 8266
  The ESP8266 is a widely used and cost-effective Wi-Fi module that can operate as an independent microcontroller. It features integrated Wi-Fi connectivity, GPIO pins for connecting with other devices, and can be programmed using the Arduino IDE. We used it to upload data from arduino to thingspeak.

Figure 11 ESP 8266

- Stepper Nema 17
  The NEMA 17 stepper motor is commonly utilized in robotics, 3D printing, and automation systems. It features a standardized frame size of 1.7 inches and a step angle of 1.8 degrees, allowing for accurate positioning and control. These motors are available in various configurations, offering different holding torque ratings and wiring options. NEMA 17 motors are recognized for their compatibility, dependability, and versatility, which makes them a favored option for numerous applications. We used it for movements along x, y and z axes

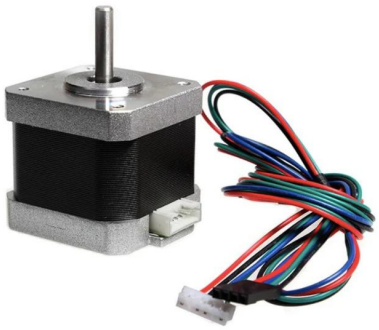

Figure 12 Nema 17

- servo motor
  A servo motor is a rotary actuator that allows for precise control of angular position. It consists of a motor coupled to a sensor for position feedback. It also

requires a servo drive to complete the system. The drive uses the feedback sensor to precisely control the rotary position of the motor.
We use it for opening and closing the gripper and for money and toys door.

Figure 13 Servo Motor

- Tb6600 driver
  The HY-DIV268N is a widely utilized stepper motor driver module. It is designed for bipolar stepper motors and can handle a maximum current of 5A. This module offers multiple microstepping options (such as full-step and half-step) and includes inputs for step and direction control to manage the motor.
  We used it to drive stepper motors.

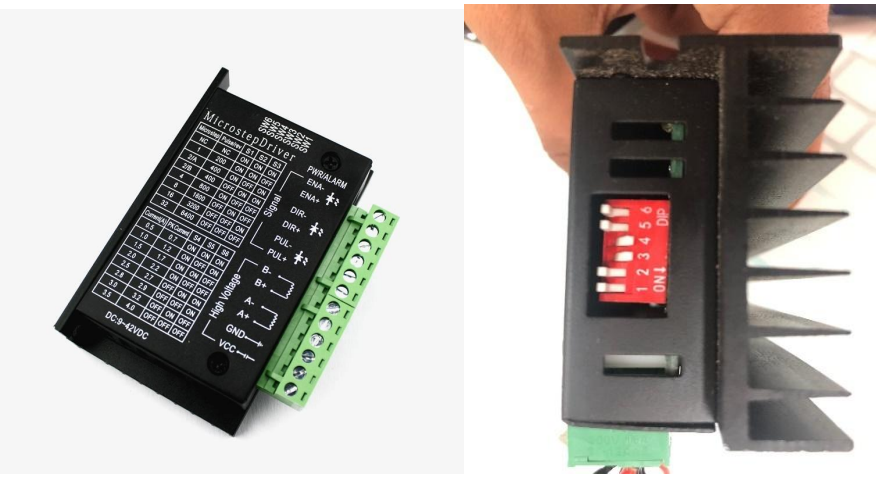

Figure 14 Tb6600 driver

- Coin acceptor
  A coin acceptor is a device used in vending machines, arcade machines, or similar systems to detect and validate coins. It can distinguish between different coin types, usually based on parameters like size, weight, and magnetic properties. Once validated, the coin acceptor sends signals to a connected control system, such as an Arduino or another microcontroller, to register the value of the coin and trigger corresponding actions.

Figure 15 coin acceptor

- Push Button
  A push button is a frequently utilized switch that closes an electrical circuit when pressed and opens it when released. It is typically used for temporary operations

and can be found in numerous electronic devices and systems for tasks like turning on/off or initiating actions.
We used it to claw the toy.

Figure 16 Push Button

- Joystick
  It is a device that enables users to manage and engage with Arduino projects through manual input. Usually, it features a movable stick or lever along with one or more buttons. The joystick employs potentiometers to track the position of the stick or lever, while button switches are used to sense button presses.
  We used it for joystick mood to control movement.

Figure 17 Joystick

- LCD 20*4
  The LCD 20x4 is a widely used alphanumeric display that features four lines, each able to display a maximum of 20 characters. It is frequently utilized for showing text, numbers, and symbols in various electronic projects and devices. We used it to display game setup instructions and time

*Figure 18 LCD 20*4*

- Breadboard
  A breadboard is a reusable platform for prototyping electronic circuits without soldering. It's commonly used for testing and building temporary circuits. The board consists of a grid of holes into which components such as resistors, capacitors, LEDs, ICs, and wires are inserted to form a circuit.

Figure 19 Breadboard

- Resistors
  We used resistors for voltage divider circuit in connection between coin acceptor and uno also for ESP and mega, to convert logic from 5V(mega) to 3.3V

Figure 20 resistors

- Power Supply
  To provide sufficient voltage and current with varying component values.

Figure 21 power supply

- Wires connector
  A wire connector is a device used to join two or more electrical wires together to ensure a stable and secure electrical connection. Wire connectors come in various types and sizes, and they are essential in both temporary prototyping and permanent electrical installations.

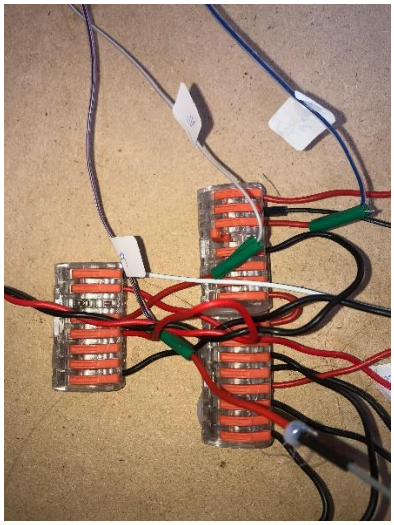

Figure 22 wire connector

- Switches

Figure 23 switch

- return the change
  It is made to return the remaining money to the user. It contains 3 servo motors that pushes the money out.

Figure 24 return the change

- RGB LED Stripe
  We used it for light effects.

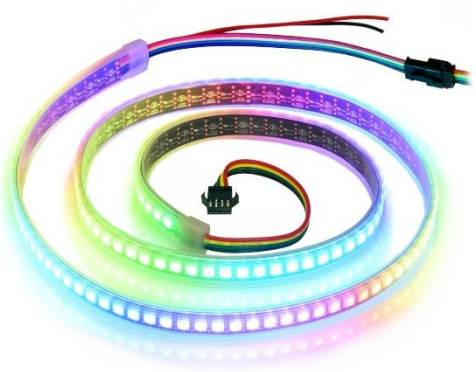

Figure 25 RGB LED Stripe

Process Of Work

ASM Design

- Initially, we established the required specifications and the machine's mechanisms. Next, we defined the machine's behavior and its interaction methods. After that, we developed the ASM, which allowed us to identify the necessary controller component.
- to start the game , the player enter the coin to coin acceptor then if there is a rest of money it will come out .
- When the game starts, the first thing we do is ensure that the gripper is in its starting position and is open.
- Once the game is set up and started, the player can use the joystick to maneuver the gripper to the toy they want.
- When you attempt to grasp with the gripper, it descends, closes, rises, returns to its starting position, and then opens on its own.
- **ASM Design Cont.**

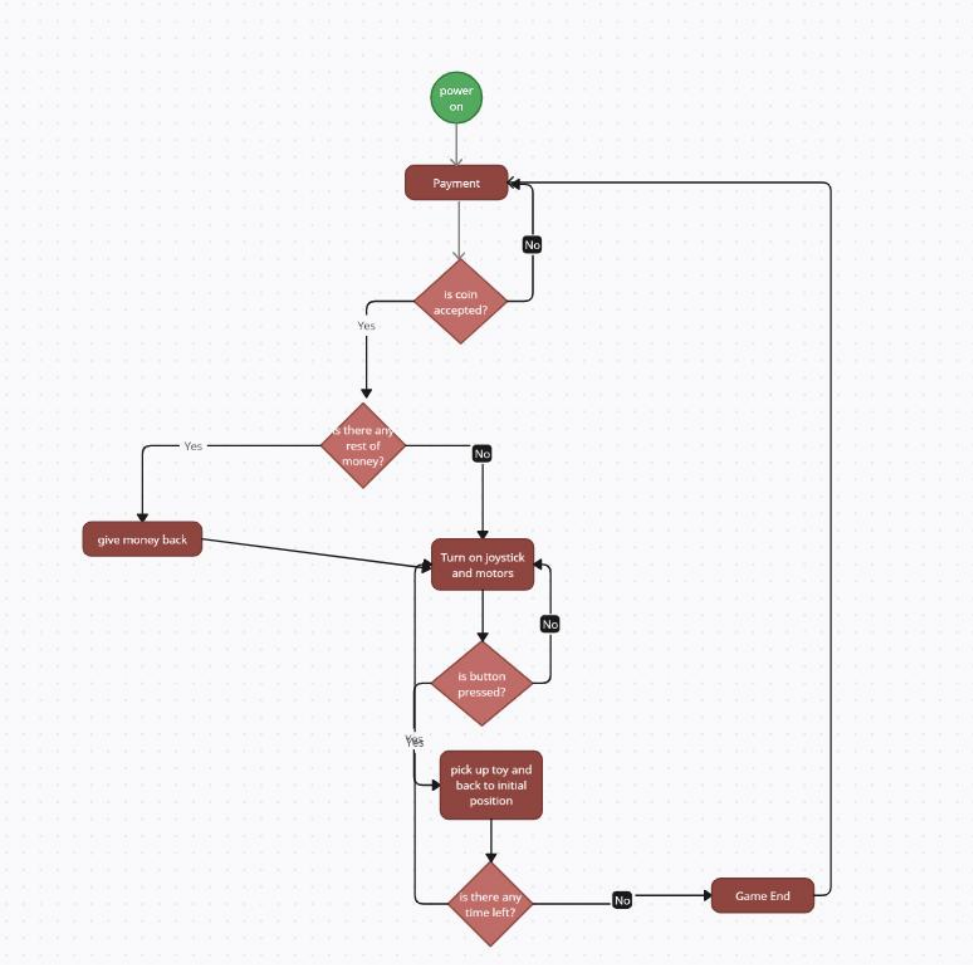

Figure 26 ASM Design

Controller Design

Following the earlier steps, we have made the decision to select the components illustrated in the figure below:

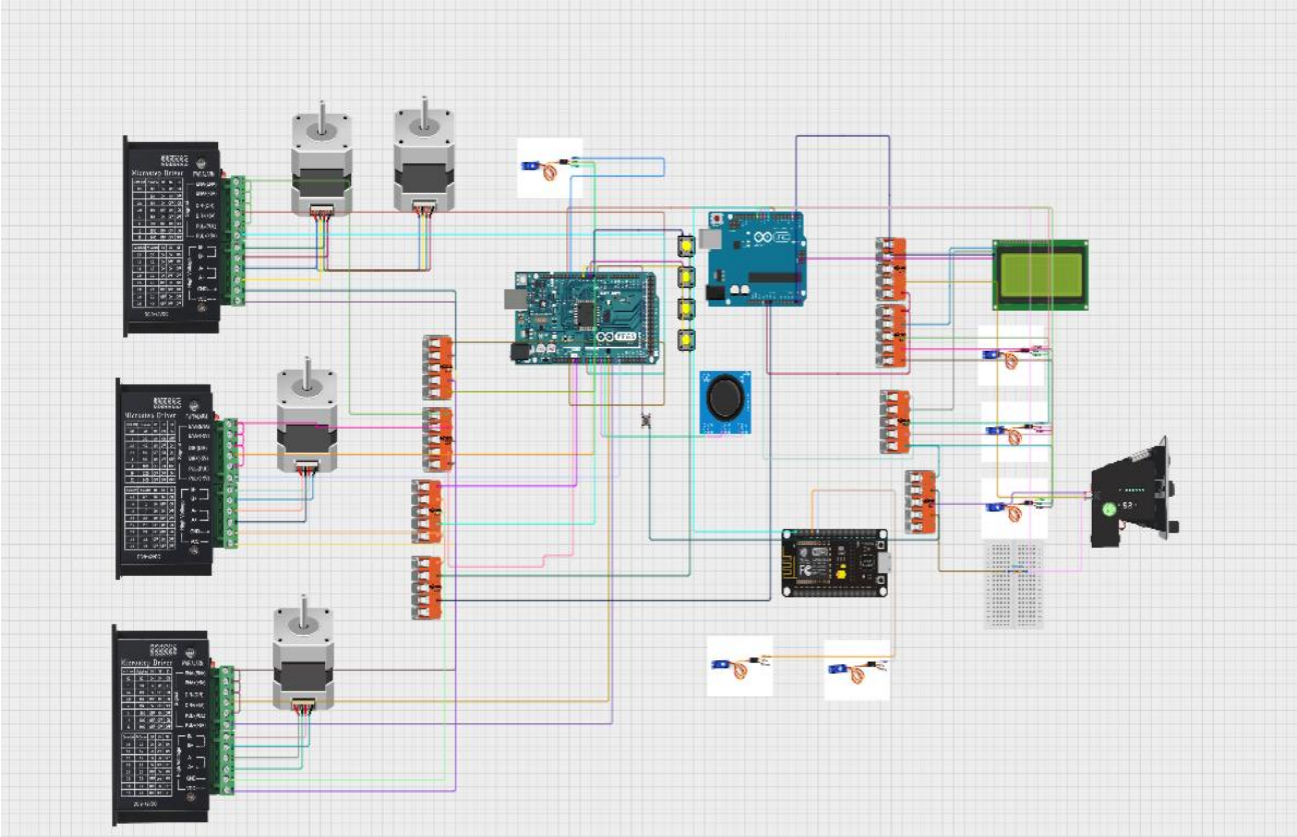

Figure 27 Controller Circuit

- The Arduino Uno is used for the LCD and coin acceptor, and it communicates with the Mega to signal when to activate the motors and joystick. It also sends data to the ESP regarding the number of plays and the amount of money, which is then transmitted to ThingSpeak. The Arduino Mega manages the joystick and motors, while the ESP8266 operates two servo motors that open and close the doors for money and toys.

- The ESP interacts with the Thingspeak server, which our mobile app is linked to, and transmits commands via the server to the ESP, which then sends them serially to the Arduino Uno.

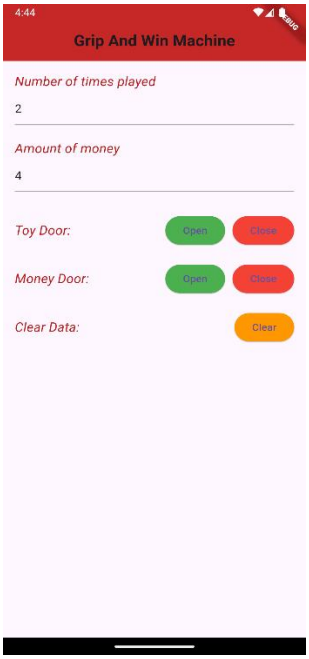

Figure 28 Mobile Application

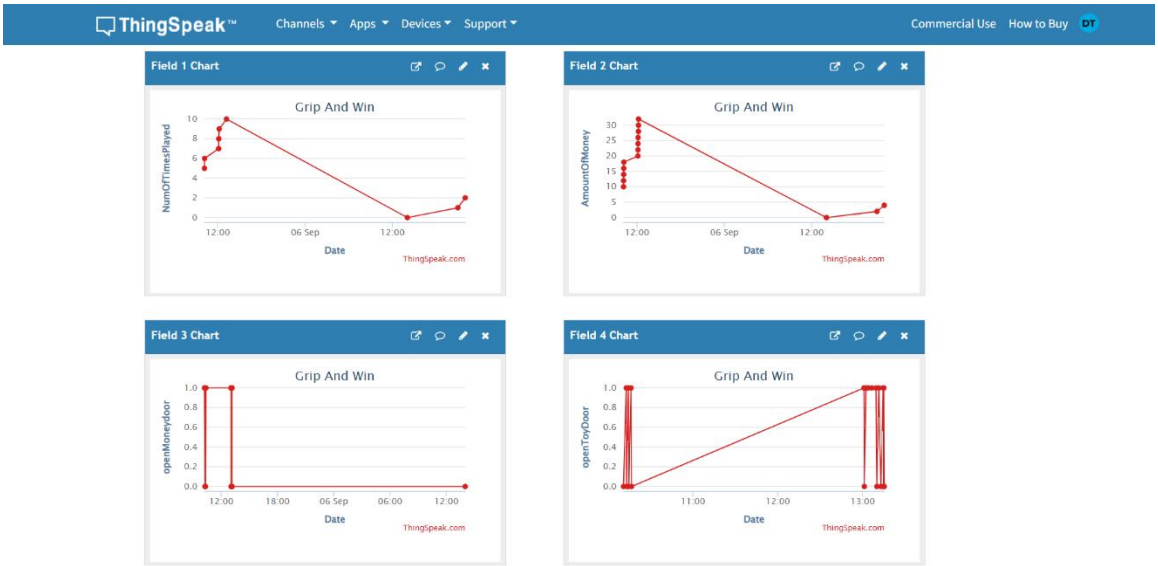

Figure 29 thingspeak

Mechanical Design

Initially, we put together the x-axis component, which is made up of two stainless steel rods, each equipped with a bearing block that supports a specially designed wooden piece for the x and z motors.
- At both ends of the x-axis component, we use custom 3D printed parts to attach a bearing block, allowing the entire axis to be mounted on the y-axis.
- Additionally, we have attached a stand and holder for the timing belt at each bearing at the endpoints, which is also made using a 3D printer.

- we use two stepper for x axis and one for y axis and one for z axis
  for the Gripper we use servo motor to open it

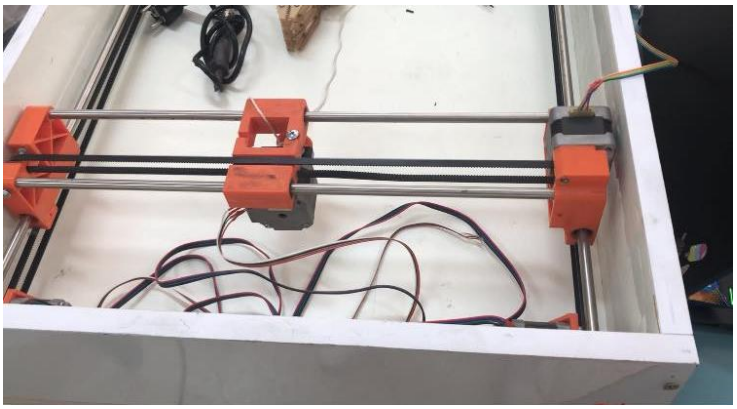

Figure 30 x-axis y-axis

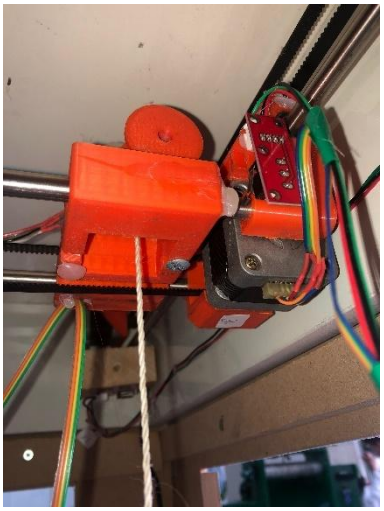

Figure 31 y-Axis

Figure 32 X -axis

- When Z motor rotates clock wise the gripper goes up and when rotates counter clock wise the gripper goes down.

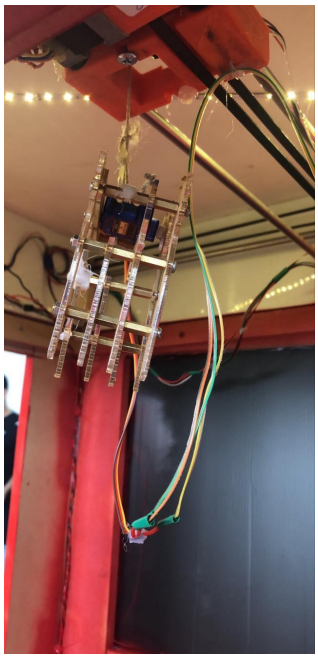

Figure 33 Gripper

Design

Figure 34 machine

Figure 35 inside machine

Figure 36 inside the box

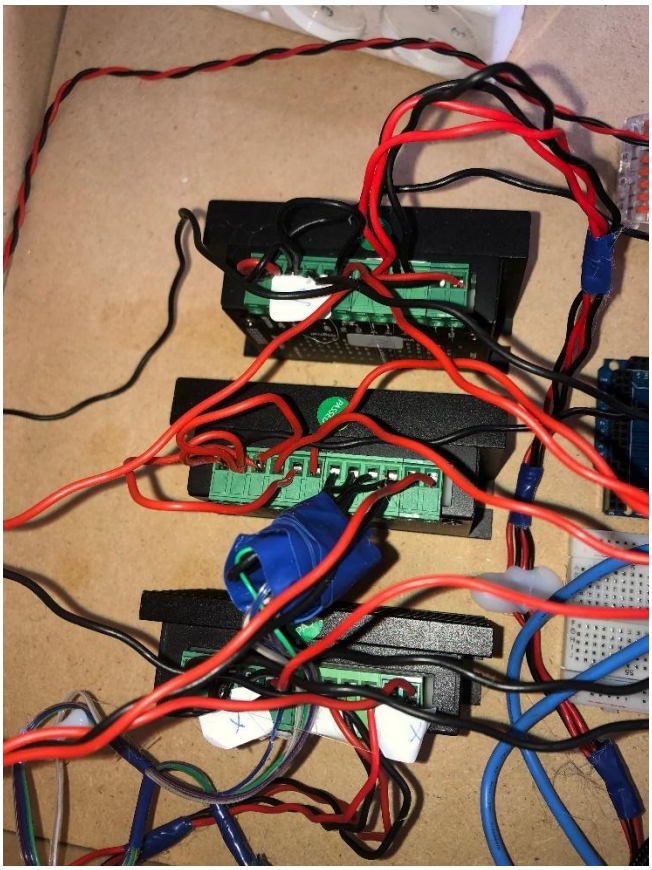

Figure 37 drivers

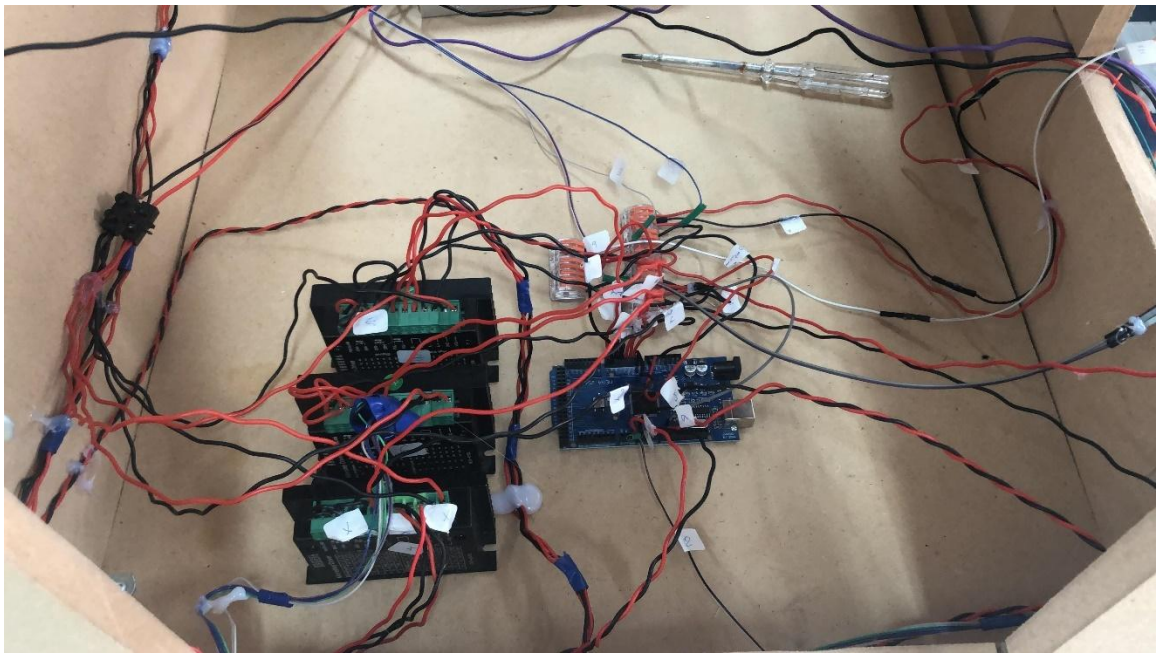

Figure 38 mega Arduino

Future Work

- Monitoring : make owner able to see and monitoring if there is anyone plays on the machine and if there is enough toys at the machine or not.
- Playiing By Mobile App: make user able to play and when by using mobile app with specific process interactions.
- Sounds and lights: adding sound and lights systems interact with what user enterd and the game conditions.

Conclusions and Recommendation

Conclusion

The project seeks to address a gap in common machines by incorporating a feature that returns change. It also includes an application for the owner to access essential information about the machine, while offering entertainment and enjoyment.

Recommendation

In this project, we dedicated significant effort to acquiring knowledge and worked diligently each day to complete it to the best of our abilities. Therefore, we strongly advise other students to focus on acquiring this knowledge before starting their own projects. We also urge students to engage in careful planning to enhance their likelihood of reaching their project objectives.

References

https://quartzcomponents.com/blogs/electronics-projects/how-to-interface-ch926-multi-coin-acceptor-with-arduino-uno?srsltid=AfmBOorAeIkVxGvnbNDUJFEQDb3RWvyMElBRwjkMJOnJ_nfDLxleY1wy

https://howtomechatronics.com/tutorials/arduino/stepper-motors-and-arduino-the-ultimate-guide/

https://docs.arduino.cc/tutorials/generic/basic-servo-control/

http://esp8266.net/

https://learn.sparkfun.com/tutorials/what-is-an-arduino/all