Smart Ping Pong Machine

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INTRODUCTION

Our project involves creating a Smart Ping-Pong machine that includes a wide array of play options that provides a wide range of playing styles. This allows for players of different skillsets to improve on their Ping-Pong abilities in a fun and varied manner that can be altered and controlled by a mobile application. In the play application, the user can select their ideal play preferences to give them a comfortable play experience or to ease them into using the machine. We would like to thank our mentor Sebastian Dwornik from PDA for supporting this project.

Background:
Our idea was based on reviewing the designs and features of some of the available machines in the market. These devices proved to be either too costly or provide minimal features and are all controlled by some form of bulky remote with buttons and dials. Moreover, cost-effective machines intended for rookie Ping-Pong players lose their effectiveness after a brief time span as they are constrained by the level of difficulty they can offer. As a result, the player needs to continually spend more money to buy more costly machines to keep up with their improving skill levels.

Idea:
To solve the issues mentioned above, a machine was designed that uses basic and cheaper components to suit a wide array of play styles. This is achieved while the machine is controlled by the application that keeps track of the user's growth over the period of their machine use.

TOOLS,PARTS AND FACILITIES

Tools
Equipment like multi-meters, oscilloscopes and function generators accessed from the Humber lab rooms were used to perform the testing required to calibrate outputs needed from the firmware. Software tools like Android Studio for application development, ThonnyPython for firmware development and Firebase to host the databases and act as the connection between the application and the machine were used as well.

Parts
A Raspberry Pi 4 Model B running on RaspianOS was used as the development platform. We used a TB6621FNG Dual Motor driver to control 2 6-9V DC motors to launch Ping-Pong balls, a Push-Pull Solenoid to control launch interval and an ANNIMOS Digital High Torque Servo Motor to control the launcher's horizontal aim.

Facilities
We used the PCB printing facilities, soldering stations and prototype lab at Humber College to design and create our printed circuit board that contained all mounted components. We also accessed the colleges laser-cutting and 3D printing machines that helped design and create various mechanical components for the machine.

ELECTRONICS/PCB, FIRMWARE

Electronics
We initially designed all our components individually, then tested them on the breadboard. When the breadboarded circuits worked with the basic prototype firmware, we advanced to preparing our PCBs. We used female header sockets to mount the devices to solder and connect all components. This measure was taken to prevent wasting any components on the PCB with errors. This proved to be beneficial as it took a few attempts to fix our component issues. We then advanced to building our Integrated circuit, which has all three components working together to accomplish our machine objectives. The integrated design has the firmware using 2 PWMs to control the speed of the DC motors separately using the Dual motor driver. This can also control the direction the motors rotate horizontally, which gives the user opportunity to rotate the machine both clockwise and counter-clockwise. Another PWM output is used to control the Servo Motor which can rotate in a 270-degree range but only needs to rotate in a 50-degree range. The Servo Motor we use can handle the torque of a 20Kg mass on the axle so it can easily and quickly aim as soon as it receives its instructions. The solenoid uses a basic ON/OFF switch to pull back the flap that stops the ball to let it go and quickly reverse to stop the next ball(s).

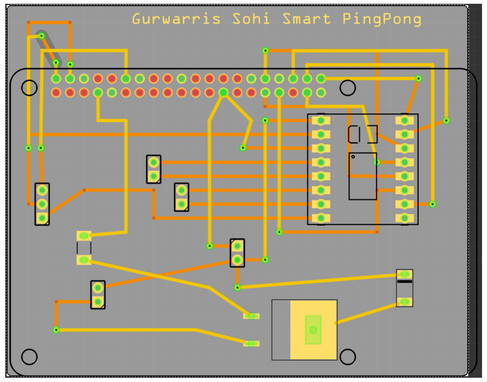


Figure 1: Diagram of Finalized Fritzing PCB Design

Figure 2: Servo Motor used for Horizontal Launch functionality

Figure 3: Raspberry Pi 4 – Main Project Development Platform

MOBILE APPLICATION, DATABASE

Mobile Application
The mobile application allows the user to log in if they already have an account. If not, they can access the Sign-Up page to create a new account. The user must fill in data fields such as First Name, Last Name, Email Address, Password, and Password Confirmation. They can then sign in using their Email and Password. Offline verifications are performed to prevent users from having predictable passwords or entering fake email ID's. The sign up and sign in backend are performed through the Firebase Authentication module. The application recognizes the user and keeps them signed in unless they sign out. After the login, users can select *Difficulty, Launch Interval of Balls and Horizontal Angle Range for Launched Shots*. They can then access the Launch Page to start their play session after examining their chosen play settings and clicking the play button.

Database
The selected fields are sent to the Realtime Database and the Cloud Firestore. The Realtime Database is used to send information to the Ping-Pong machine to start the play session. The Cloud Firsetore saves information so that the user can view their old settings to observe their growth as it is easy and quick to read large amounts of information in one session.

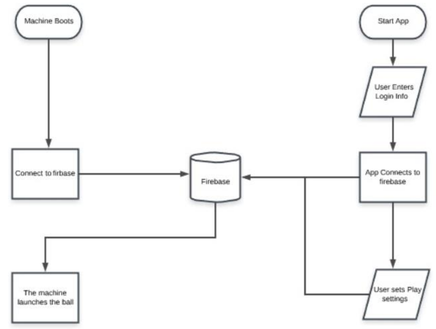


Figure 4: System Diagram – How Application, Machine and Databases interact with one another

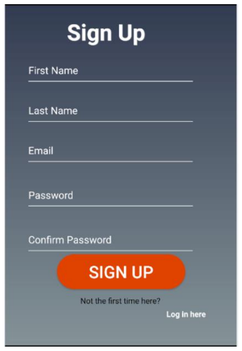
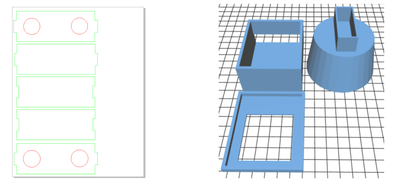


Figure 5: Sign Up Screen with Required User Credentials

ENCLOSURE

We designed an enclosure for the machine launcher that contains the DC motors and the launched ball area. This is basic design fit together using friction fitting after it was laser cut on a 6mm acrylic that provide it with stability and strength to hold the fast and vibrating motors. We also designed a 3D printable case for the Raspberry Pi and the PCB with its mounted components to secure it from harm. We designed a holder on a heightened cylindrical base for the Servo Motor that acts as the base for the launcher; the base is connected to the Raspberry Pi using screws. An old vacuum pipe was going to be used as it was hollow enough to allow the ball pass through. In addition, it would've been easy to cut a flap into it to allow the solenoid to control launch intervals.



Figures 6 and 7: Corell Design and stl designs used model enclosures for both machine casing and launcher

CONCLUSIONS

With all these features that we have worked towards during our path of designing and completing this project, we believe that we have created an machine that accomplishes the objective we had in mind. The machine is cheaper, but offers competitive play styles and is connected to and controlled by a mobile app. So after this, our next goal could be to add more functionality to the app like, user's sharing their stats to their friends to show them their progress or adding horizontal spin mode to the machine to make it even more hard to play against to give the users their money's worth.

ACKNOWLEDGEMENTS

- *13 Best Ping Pong Robots That Will Improve Your Game Instantly*. (2020, January 11).
- Cheng, F. (2018). *Build Mobile Apps with Ionic 4 and Firebase: Hybrid Mobile App Development*.
- OACETT. (2017, March). *I need to Complete a Technology Report*.
- Robuck, M. (2018, 11). AWS goes deep and wide with machine learning services and capabilities. *Fierceinstaller*.