

PingPong Ball Launch System Proposal

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Introduction

1.Objective:

A highly efficient daily practice is essential for people who want to improve their skill. For those who like Ping Pong ball, swing is one of the most fundamental and important training items. Sometimes when we want to practice Ping Pong ball, we need to find a partner to practice with us. But what if our friends are busy? In this case, we designed a Ping Pong Ball launch system which can launch the ball automatically and we can use a remote controller to easily control the launch system to choose which practice mode we want.

2.Background:

According to the author of the website [1]“newgy”, finding a proper training partner is one of the most efficient methods to improve our skills and if we have to work alone, the training robot is also an alternative. The existing Ping Pong Ball launcher robots are stationary and can only be controlled manually. If a player wants to change the launch direction, he or she has to walk to the robot and turn the machine to a different direction. Obviously, it is not efficient when we move frequently and when we want to practice swinging in different positions. In our Ping Pong Ball launch system, the player can hold a remote controller and change the launch direction and launch speed by pressing the button. Besides, with the different speed and direction, we can simulate how to stroke the ball in different positions and different angles. Since we can control the launch system conveniently, we do not need to waste time to manipulate the machine and our efficiency improves significantly when we practice alone.

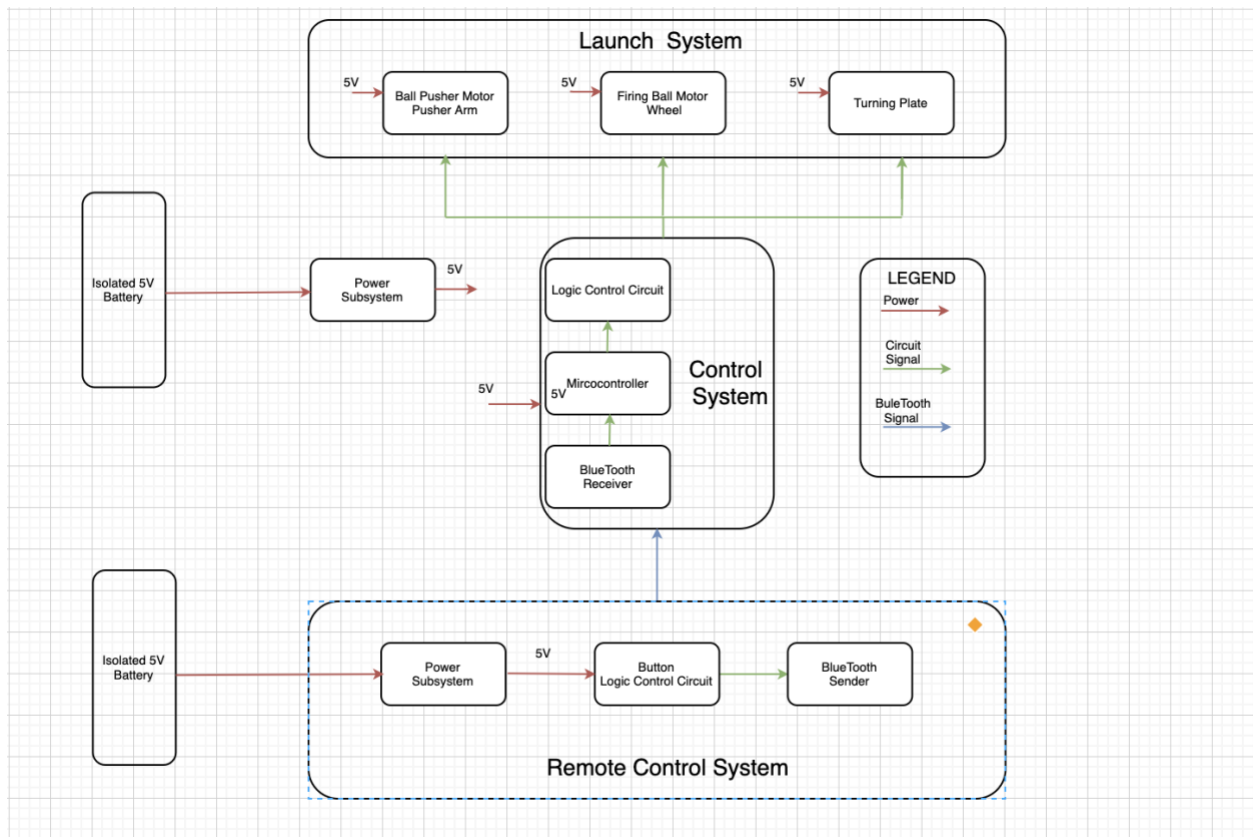
3.High-Level Requirement

1. The Ping Pong Ball launch system can use Bluetooth to connect with our control unit and receive the signal correctly when we click different buttons on the controller.
- 2.The launch system can modify the speed and frequency of the ball. Also, the launch system will support three different modes: stable mode, acceleration mode and random mode. In stable mode, the launcher will launch the ball at a fixed frequency and direction. In acceleration mode, the speed of the Ping Pong ball will increase gradually. In random mode, the launcher will launch the ball in a random direction.
3. We will design a remote controller including the button logic circuit and it will signal with different frequency as we press different buttons and these signals can be received by the control unit in a short time.

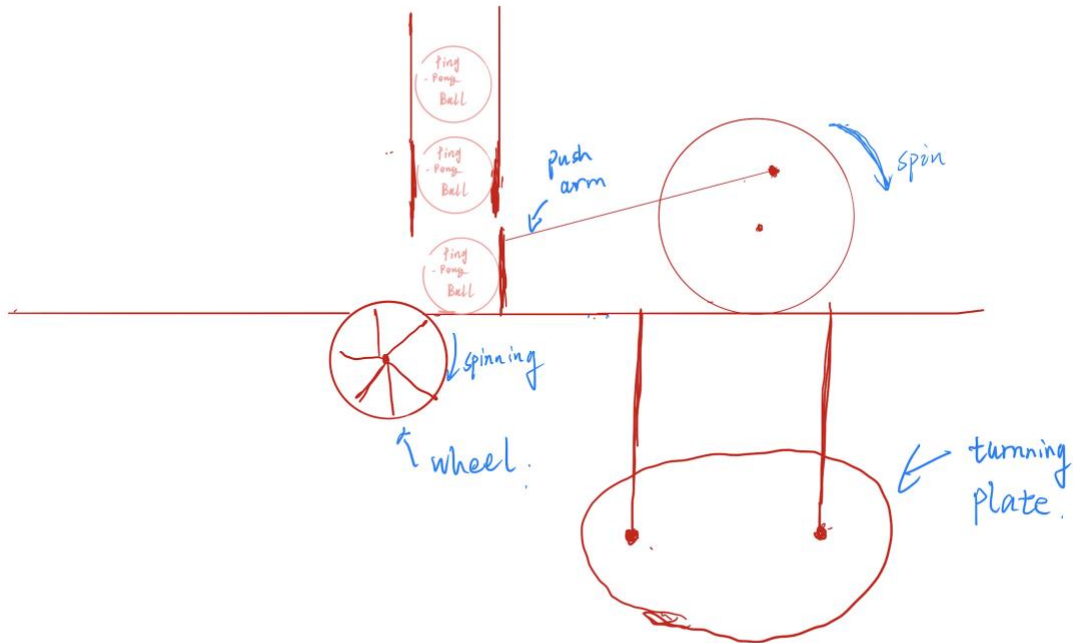
Design

1. Block Diagram

Notice: Please read the block descriptions for the launch system, since it is hard to clarify all details in the block diagram.



2. Physical Diagram:



3. Block Descriptions (Function Overview and Requirement)

(a) Launch System

- I. The ball pusher will push the ball to the firing ball subsystem. The fundamental component will be a motor and a mechanic arm. The motor will move the mechanic arm backward and frontward and the ball will be pushed forward when the arm hits it.

Requirement 1:

Pusher can have frequency range from shooting 1 ball per second to 5 balls per second. This may change based on our experience. And most small motor can at least 60 - 120 rpm which is more than enough for our purpose.

- II. A circuit, which can manipulate the spin speed of the motor, will be constructed and connect to the Ball Pusher system so that we can change the frequency of launch system
- III. The firing ball subsystem will accelerate the ping-pong ball. The fundamental component will be a motor and wheel. The spinning wheel will speed up the ping-pong ball and fire it. Similar to the ball pusher system, we will have a circuit to change the speed of the motor.

Requirement 1:

Firing ball subsystems should be able to accelerate the ball to at least 20 mph and up to 45 mph. This may change based on our experience, since 45 mph may be too dangerous for practicing.

- IV. The turning subsystem will move the direction of the ball. The fundamental component will be a motor and a plate. The launch system

will be attached to the plate. When the motor rotates the plate, the direction of the ball will be changed.

Requirement 1:

When the user presses the turning button, the turning subsystem should rotate the direction by 5 degrees.

- V. All subsystem of Launch system will power by 5V voltage
- VI. All the frequency and direction of motor will be control by the control system

(b) Control System

- I. The logic control circuit will give the signal to change the frequency of motor in the launch system. This is most likely to be done by changing the value of resistance.

- II. A Bluetooth receiver will be used to receive the signal from the remote controller system and the Bluetooth signal will be passed to the microcontroller.

Requirement 1:

The latency of Bluetooth receiver should be no more than 1 second. Low Latency is an important requirement for our project, since

when an emergency happens, the machine has to be stopped as soon as possible.

- III. The microcontroller will process the Bluetooth signal and give the control signal to the logic control circuit, which controls the frequency of motor in the launch system.
- IV. All components in the control system will run on 5V.

(C) Remote Control System

- I. The button logic circuit will generate different signals for different buttons to the Bluetooth circuit.
- II. The Bluetooth circuit will send the Bluetooth signal to the control system
- III. Remote Control System will run on a separate power supply. Basically, we will put a small battery packet on it, so that the Remote-Control System can be portable.

Requirement 1:

The size of remote controller should be small so that the user can hold it on hand and can practice ping-pong without any inference on movement

3. Risk Analysis

The control system is the key component for this project. The functionality of the launch system is largely dependent on it. Without a sound control system, the launch system can only fire the ping-pong ball with the same speed, which is not the purpose of this project. To ensure the functionality of the control system, we would carefully design the circuit, which controls the power of motors. And we may also consider different methods to control the frequency of the launch system, such as lowering the voltage by increasing the resistance or by changing the physical design.

Moreover, the Bluetooth receiver and sender are also important for this project. Remote control is one of the essential functions of our ping-pong machine. We want Bluetooth to be fast and stable. The noise around the receiver and sender. Bluetooth communication is relatively stable once it matches up with the corresponding devices, but the match process may be affected by other devices. Therefore, when we choose or design the Bluetooth device, we want to ensure that in short distance like 5 - 10cm, the receiver and sender can match up with each other correctly.

Lastly, for the remote controller, the only potential risk is its size. The remote controller should be small enough so that the user can practice and control the machine at same time. To meet the size requirement, we have carefully designed our PCB so that it would get too big. And we need to carefully choose the power system for the remote controller. A coin battery will be the best choice, so we would likely develop the remote controller to support a coin shape battery.

Ethics and Safety

There are several safety concerns involved in our system. The user of our device will be involved with the operation through a remote-control system and the ping pong balls that our system launches. So, it is crucial that we ensure the safety of both the user and our system.

The first potential hazard is our launching system. It is possible that high speed ping pong ball could injure our user and others around. In this case we need to limit the launch speed of the ping pong ball when we build our pushing motor so that it won't hurt our users or any others.

Moreover, according to the [2] IEEE code of ethics term No. 1, we must hold paramount the safety, health, and welfare of the public. Our system will be using some rechargeable or lithium battery for power source of launching and controlling system. Thus, we must prevent batteries from being exposed to dangerous conditions like overcharging by monitoring the temperature of the battery and warn our users of the potential hazards the batteries can do.

Citations and References

[1] “10 Key Tips to Advance Your Table Tennis Game” <https://www.newgy.com/pages/10-tips-to-advance-your-table-tennis-game>

[2] “IEEE Code of Ethics.” IEEE. Accessed February 13, 2020.
<https://www.ieee.org/about/corporate/governance/p7-8.html>.