T^3PR(Table Tennis Training Partner Robot) Proposal

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Executive Summary

Introduction

Table tennis has long been well known as a party or basement sport, especially in the United States. Traditionally, it has only been played competitively in Asia and Europe; however, recent booms in table tennis in the United States have led to more and more competitive training and play. Unfortunately, the scene is still relatively small, and as such, it is difficult to improve without having other people to play with. Being able to train on one's own would significantly boost one's improvement and the table tennis competitive scene.

Purpose

The robot being built will help people train in table tennis on their own with much greater efficiency and effectiveness.

Problem Statement

Table tennis is a sport that cannot be played alone. As such, training and improving can be difficult without access to other players. Methods such as hitting against a wall, practicing serves, and working on footwork are helpful, but also limited to certain facets of the game. The issue is that none of the aforementioned methods work on returning the ball, a crucial aspect of table tennis. The robot being designed will be much more effective in helping players improve than the current methods, by enabling a player to practice returning a ping pong ball.

Solution Statement

The robot will be able to solve this problem by shooting ping pong balls from the other side of the table to the player's side so they will be able to practice returning. To make this training effective, the robot will have to be able to do several things:

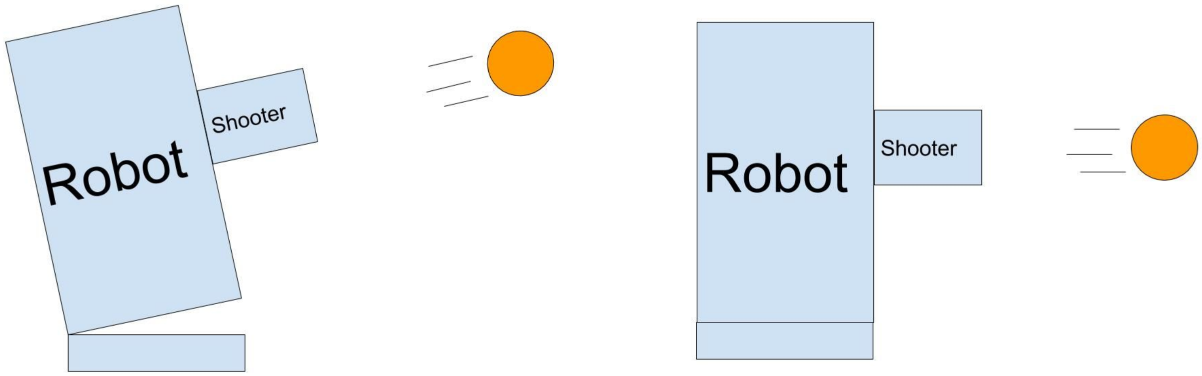
1. Be able to hold and shoot many ping pong balls for repetitive practice
2. Shoot at various angles to allow the player to practice against a variety of in game situations
3. Put a variety of spins on the ping pong ball for the player to practice against

For traditional practice, the Chinese have come up with a training method called multiball, in which one person (usually a coach) will feed balls from one side to the practicing player who will return the ball. The cycle will continue until the coach uses up all of the balls. Multiball is very effective for improving in table tennis, even at the top level. Because of the sheer quantity of balls the player has to return, this repeated practice is very effective in terms of improvement. It is also very fast, because the coach does not worry about returning or picking up the balls, allowing for a lot of practice in a short amount of time. Furthermore, multiball has the added benefits of improving one's footwork, power, speed, reaction time, fitness, endurance and anticipation. With one person, this type of practice is impossible, but with a robot constantly feeding balls in a multiball fashion, it will be extremely effective practice without needing a coach or another player.

To simulate multiball practice, the robot will be able to shoot a substantial amount of balls at varying speeds and distances for effective practice. Furthermore, these shots will have to be extremely consistent. To accomplish this, the robot can either recycle the balls being used or just hold an adequate amount of balls. This is discussed more in the research and technical aspect sections below.

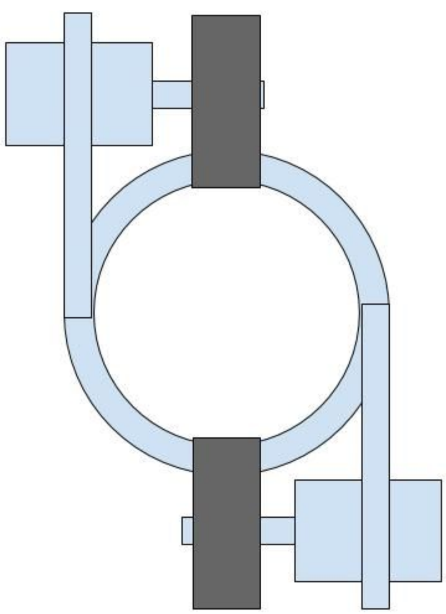
For effective practice, the robot will have to be able to shoot the ping pong ball at different locations on the other side of the table. To accomplish this, the robot will be able to swivel at varying angles, allowing it to cover and aim across the entire table. Furthermore, the shooter on the robot will be able to swivel up and down so the robot can shoot at varying angles. This will give the player more options for training and practicing against certain shots.

By swiveling from side to side, the robot will be able to shoot ping pong balls to all parts of the table



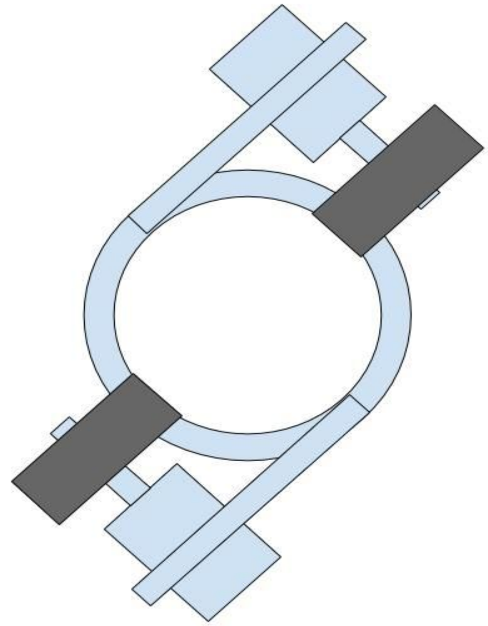
By changing the shooting angle, the robot can simulate a much larger variety of shots

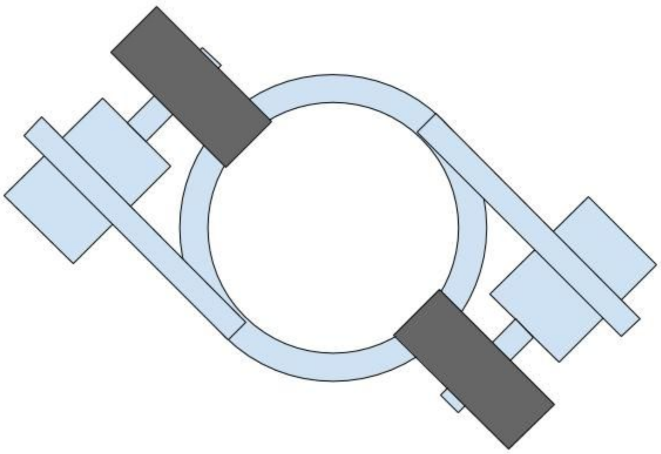
Putting spin on the ping pong ball is common practice in a table tennis match.. In order to effectively convey the feeling of returning a ball from a human player, the robot shooter will be able to put both topspin, backspin, sidespin, and no spin on the ball. To accomplish this, the shooter will consist of a dual flywheel system that are each powered individually by a motor. Furthermore, the shooter will be able to spin using a servo and gears. This will allow the player to reposition the flywheels in varying orientations. By having them in varying orientations and varying speeds, different spins will be generated. For example, having the flywheels oriented top-bottom and having the bottom motor spin faster will result in backspin. Having them move at the same velocity will result in no spin.



Top-Bottom Orientation
If :
-the motors spin at the same rate: *No spin*
-the top spins faster than the bottom: *Topspin*
-the bottom spins faster than the top: *Backspin*

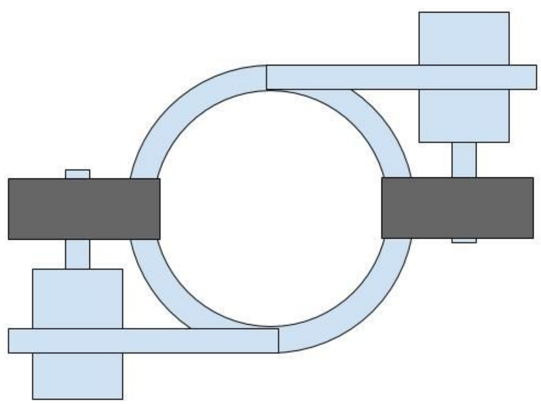
45-Degrees Right Side Orientation
If:
-the top spins faster than the bottom:
Top-right side spin
-the bottom spins faster than the top:
Bottom-right side spin





45-Degrees Left Side Orientation
If:
-the top spins faster than the bottom:
Top-left side spin
-the bottom spins faster than the top:
Bottom-left side spin

Side-Side Orientation
If:
-the left spins faster than the right: *Left side spin*
-the right spins faster than the left: *Right side spin*



Current State of the Industry

Research

There is no shortage of table tennis robots on the market. Each of these robots come with their own perks and flaws. While the robot that is being designed will be different from each of the following robots, research on each of the current robots on the market will help with design ideas and necessary features. The robot that I design will then combine the majority of the best features of the current robots on the market.

iPong

- Can hold 110 balls
- Remote controlled power, shot frequency, spin
- Easy to assemble
- Inexpensive
- Inconsistent shooting
- No net, so can't recollect balls

Throw 2

- 3 different modes, very adaptable to training
- 17 lbs, relatively lightweight
- Remote controlled
- Hopper jamming
- No side/combination spin
- Expensive

Robo-pong

- All types of spins/shots
- Easy digital interface
- Net to collect balls
- Programs weren't realistic for real life matches
- PS2 connection instead of USB, can't connect to many computers
- Oscillation feature needed frequent recalibration

Smartpong

- Variety of shots and modes
- Remote-Controlled
- Net to collect balls
- Good for advanced players
- Comes with back up parts
- Expensive

Amicus Advance

- Highly sophisticated programming for shot variation
- Expensive
- Better suited for professionals

H2W Touch Pro

- ❖ Details to emulate human player
- ❖ Wheels that allow it to move from table to table
- ❖ LCD touch screen and spin indicator, like a person
- ❖ Sophisticated programs and own program creator
- ❖ Expensive, more than average player needs

V-988

- ❖ Also geared towards school and club setting vs. individual user
- ❖ Has wheels to make it easy to move around
- ❖ Half price to that of H2W
- ❖ Consistent shot, good for drills
- ❖ Relatively basic

Trainerbot

- ❖ Consistent shooting with all spins
- ❖ Controlled with phone app
- ❖ Small and easy to transport
- ❖ Only holds 30 balls
- ❖ Expensive
- ❖ No net to collect balls

Based on the features of the robots researched above, the following aspects of the robot I am designing must be considered:

- ❖ Transportability
  - ➢ The robot is best if it is easily transportable. This is helpful with being easy to train with, on varying tables. This is best demonstrated with Trainerbot, which is the only robot that can fit in a backpack. It can also be done with the robot having wheels, like the H2W Touch Pro. Being easily transportable will encourage people to bring the robot along with them. This is huge for making the robot be both practical and effective.
- ❖ Power Source
  - ➢ Preferably, the robot is powered internally and does not need to be plugged in. Having an external wire can be inconvenient if there is no outlet nearby. It also can be tripped over, hurting the robot and players. However, it might be unavoidable.
- ❖ Shooter Features
  - ➢ In order for the robot to be viable in the market, it will have to incorporate all types of spin (backspin, topspin, sidespin, no spin). This is necessary to make it useful for all levels of players, especially those at the strong amateur to professional level.

- Programming For Training
  - The robot should be able to be controlled remotely, either through a phone app or a separate remote. This makes training a lot easier and convenient for the player. It also gives them the ability to make their own training exercises, without having the go to the other side of the table and physically adjusting the robot.
- Budget
  - It would be best if the robot is cheap and affordable. This way it will be more enticing for beginner level players.
- Player target(beginner, intermediate, advanced, professional)
  - It is almost near impossible to design a robot that will appeal to all levels of players. For example, having a shooter that has a high variety of shots and features would appeal to an advanced player, but to have those features would require an expensive budget, making it unappealing to beginners. The robot I am designing will have to be affordable and effective.
- Collection of balls
  - The robot will be most effective if it has a way to collect balls on its own. This usually is done using a net. Being able to recycle the balls without having to refill the robot's hopper is essential for effective training. This is difficult to accomplish if one wants a robot that is small and transportable.
- Number of Balls
  - For effective training, it is necessary to have the ball hopper to have a large number of balls, or be able to recycle balls on their own.
- Product Worthy
  - The robot that I design will have to look aesthetically pleasing for it to be effective. Without a clean look, the robot would not be appealing towards any type of player. The form of the robot is just as important as the function.
- Shot Frequency
  - The robot should be able to control the amount of shots it shoots during a certain time frame. As such the robot will have to be able to control when it shoots. This ties in with the programming of the robot.
- Human Emulation
  - Robots are typically unappealing to play against is because playing against a robot is nothing like playing like a person. With a person, you can predict where they will hit based on where they stand and their form. In contrast, the vast majority of table tennis robots are just static shooters. The robot that I am designing will somehow have to emulate how a person plays in order to make it appealing to play against.
- Shot Consistency

- ➢ The most critical part of the robot will be its quality. The robot will must be able to shoot ping pong balls in a variety of spins to a variety of locations on the other side of the table on command and without fail. As such the shooter design will be crucial; while all the other features are important, without the main feature of the robot working well it would all be for naught.

Research Findings

Taking into account the various robots on the market, a table tennis robot needs a variety of features to be viable and additional features to flourish. The bare minimum for being successful is being:

- ❖ Consistent shots
- ❖ Able to shoot a lot of balls without having to refill

If these requirements are not fulfilled, the robot just ends up being more work. There are a number of other features that make a table tennis robot excel. Through this research, I believe the most important ones are:

- ❖ Transportability
- ❖ Programming
- ❖ Human emulation

Transportability is key for encouraging users to use this robot frequently and make it simple and easy to use wherever, be it at a table tennis club or home. Programming also is crucial to an effective robot. Being able to create practice plans and control the robot remotely will make practice a lot more efficient and player friendly. Lastly, human emulation is also important, something that I believe many current robots lack. The feel of playing a person is simply vastly different from practicing against a static shooter. Encapsulating these features will be important when robot design is considered.

Design

General Description

Based on the findings of the research above, the robot will have to be consistent, adaptable, and human-like. To accomplish this, the robot will be divided into different subsystems that will enable it to be an effective table tennis training bot.

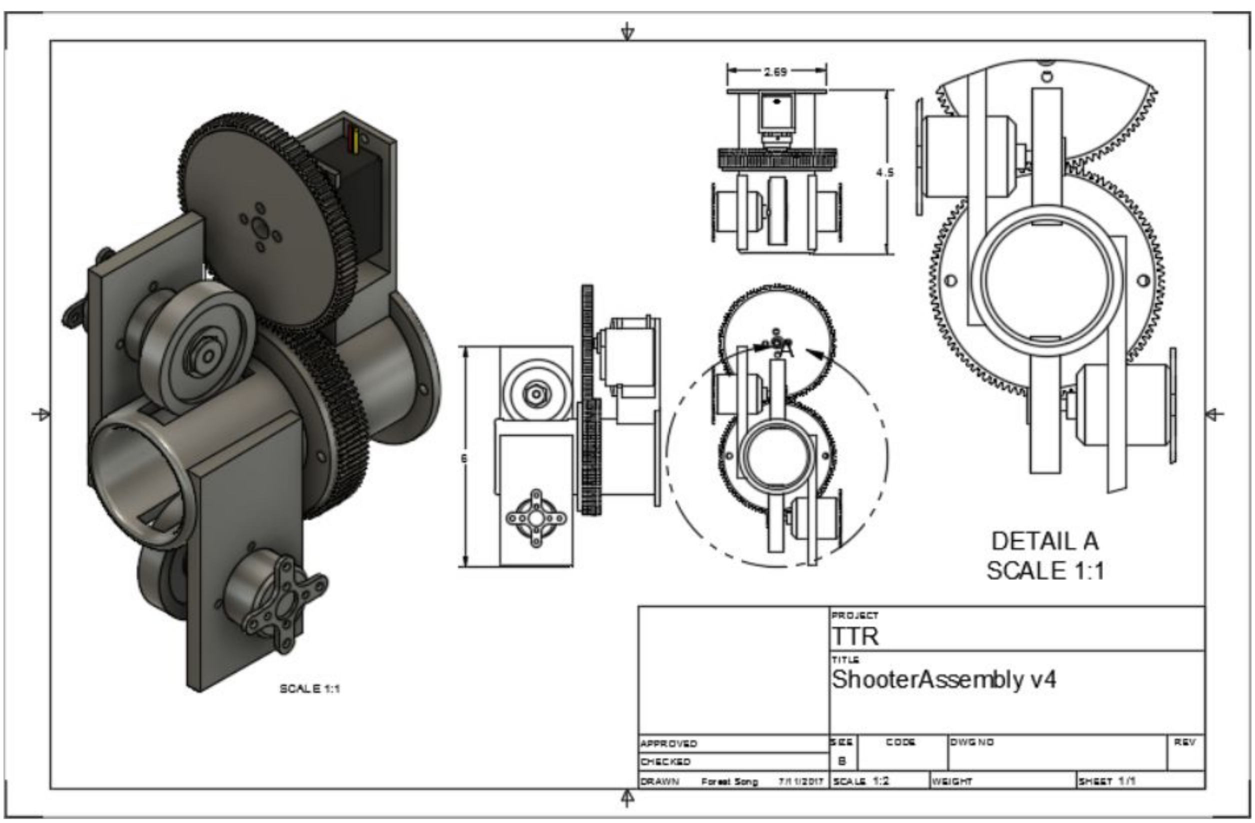
Shooter

The ball shooter is the most critical part of the robot. In order to accomplish all the tasks detailed in the solution, the shooter will have to be very consistent.

The solution to shooting a ping pong ball is using a dual flywheel system. It consists of two wheels powered by two separate motors. This allows for more control, more consistency, and less friction in comparison to just using a single wheel. It is also a lot more consistent over the long run and more compact than other shooting designs, such as a spring or rubber band loaded system.

Furthermore, the dual flywheel system allows for a critical feature of the robot: the ability to generate spin. Depending on the speeds and orientations of motors, the ping pong ball can travel at a variety of velocities and spins. This is discussed in greater detail in the solution statement above.

This is the design for the shooter. The motors are mounted on opposing sides for an even weight distribution. The non-moving part of the system will be 3-D printed, because it is cheap, lightweight, and can accurate.



Picking the correct motor is an important point. One thing that was considered was if the motor should be brushed or brushless. Brushed motors have communicator contacts which conduct current, while a brushless motor does not. Instead, a brushless motor requires a separate commutating device to control it.

	Pros	Cons
Brushless	❖ Long lifespan, because no communicators(brushes) to wear out ❖ For the same reason, it's low maintenance ❖ Higher efficiency, 85-90%	❖ More expensive because it needs a separate communicator device
Brushed	❖ Simple wiring, no need for separate controller ❖ Low cost	❖ Lower efficiency, 75-80% ❖ Needs to be replaced more often ❖ Noisy

Based on each motor's characteristics, it becomes clear the motor should be brushless. The higher cost is worth the higher efficiency and longer lifespan.

The motors must spin at an adequate velocity for the wheels to be able to shoot the balls at a fast enough speed. According to the Guinness World Records, the fastest ever recorded ping pong ball velocity hit by a player was Łukasz Budner in Częstochowa, Poland, on June 4, 2016. He hit the ball at a velocity of 72.08 mph, or 32.22 m/s. Therefore, the ping pong ball robot should be able to shoot a ball at least that fast.

The physics of a ball powered by a flywheel are as such:

- Wheel's tangential speed = (RPM/60)*2*π*(WheelRadius)
- For this design, the diameter of the wheel is 1.875", so the radius is .9375"
- The ball rotates to match the tangential velocity; since it's rolling, the center of mass of the ball has half the tangential velocity.
- To achieve the necessary 32.22m/s, the wheel needs to spin at:
  - $\frac{(32.22*2)*60}{2*\pi*.9375} \approx 656.7\,\text{RPM}$
- Because most brushless motors run at about 85% efficiency, the motor should have an RPM of about
  - $656.7 \div .85 \approx 772.588$ RPM
- Most brushless motors are measured by kv, or RPM/volt. Using an 11.1V battery, the necessary kv for a motor is roughly 69.6 kv.
- Because the vast majority of motors exceed this rating, finding a motor with sufficient velocity should be relatively easy.

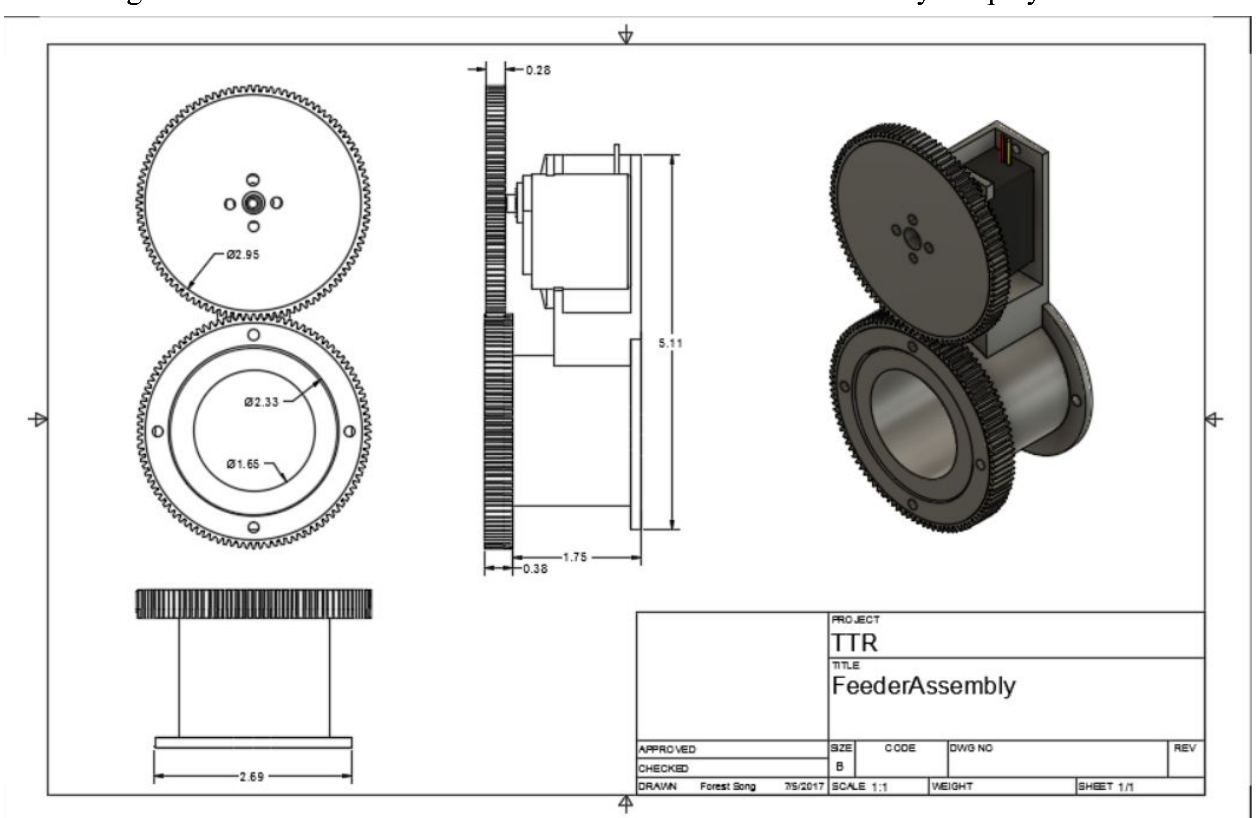
The motors chosen in the design are both cheap, efficient and long lasting. They are rated at 880 kv, which is plenty for the task needed.

Similarly, the wheels chosen have to be acceptable for a flywheel design. This means that they will have to be compressible. This is important because the ping pong ball will want to sink into the wheel a bit to gain sufficient friction. This will enable the wheel to grip the ball. For the same reason, the wheel should be made from grippy material, such as rubber, to generate spin. This will also make the shooter more consistent. This design is consistent with spins created by players when playing.

The wheel that I chose is the Banebots 1 ⅞” T40 wheels with 30A Green Shore Tread. This wheel has a very soft tread which makes it compressible. It’s also very lightweight and durable, but will still provide sufficient traction.

Shooter Swivel

In order to generate various spins, the shooter needs to be able to swivel. To accomplish this, a 180 degree servo is needed to rotate the shooter to 4 different positions stated in the solution above. The servo powers a gear, which in turn rotates the the shooter. The angle to which the shooter rotates will be able to be controlled by the player.



Ball Hopper

The ball hopper has to hold enough balls for adequate practice. Based on the various robots on the current market, the robot should be able to hold 50 balls. To figure out the necessary dimensions, the volume and packing efficiency of ping pong balls must be considered.

- The diameter of a ping pong ball is 40mm(1.57”) or a radius of 20mm(.787”).
- The volume of a sphere is $\frac{4}{3}\pi r^3$, which gives us a volume of 2.04 in^3 for a single ping pong ball. For 50 ping pong balls, it will give us a volume of 102 in^3
- The packing efficiency of spheres is about 74% optimally, or 64% randomly.
- 102 in^3 $\div$ 64% $\approx$ 159.4 in^3
- Therefore, the volume of the hopper needs to be at least 159.4 in^3 in order to fit all of the balls

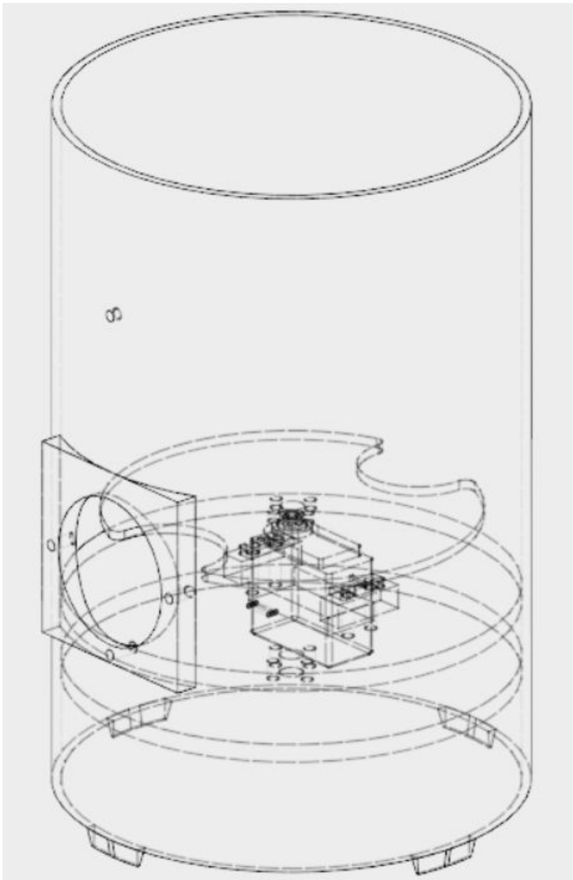
In order to make the balls easy to sort, the hopper will be a cylinder of diameter of 6”.

- The volume of a cylinder is $\pi r^2 h$, where r is the radius and h is the height
- With radius of 3, the necessary height of the hopper is $\frac{159.4}{\pi * 3^2} \approx 5.64$ ”
- Therefore, the height of the hopper must be at least 5.64 inches tall

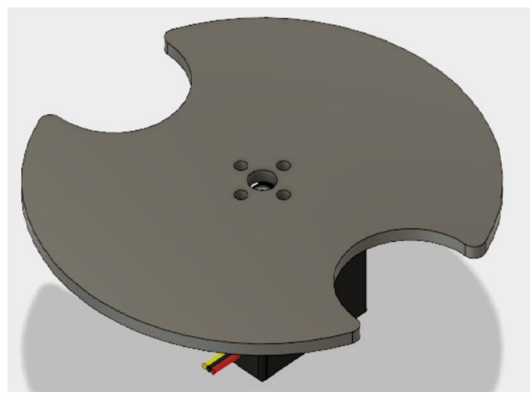
- The hopper will have a height of 6 inches for balls to fit in, which should allow for 50 balls with plenty of leeway.
- It will be connected to the shooting assembly through one end and the balls will be fed through.
- The entire thing will be 3-D printed; this allows it to be lightweight, precise, and cheap.

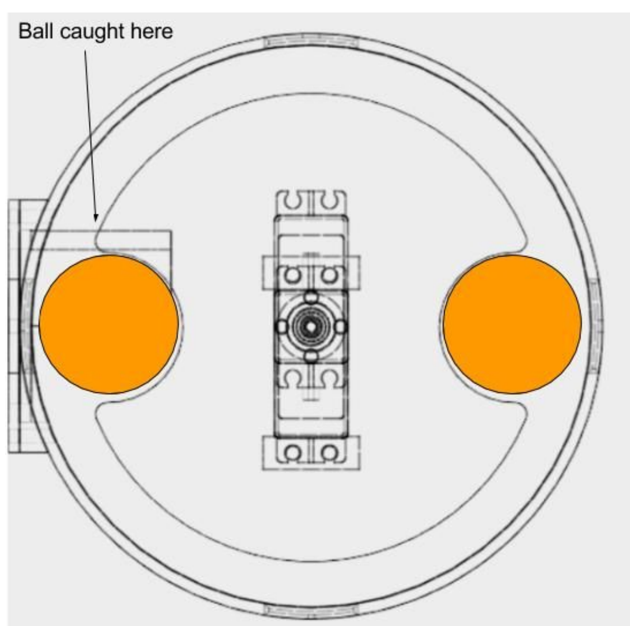
Feeder

Because the shooter will often be inclined upwards, gravity is not a great solution towards feeding ping pong balls to the shooter.



To fix this, an agitator of sorts will be placed in the hopper. The piece rotates on a continuous servo, and shifts around the balls. In doing so, the balls will fall into the two circular "slots", which will then feed directly to the shooter.

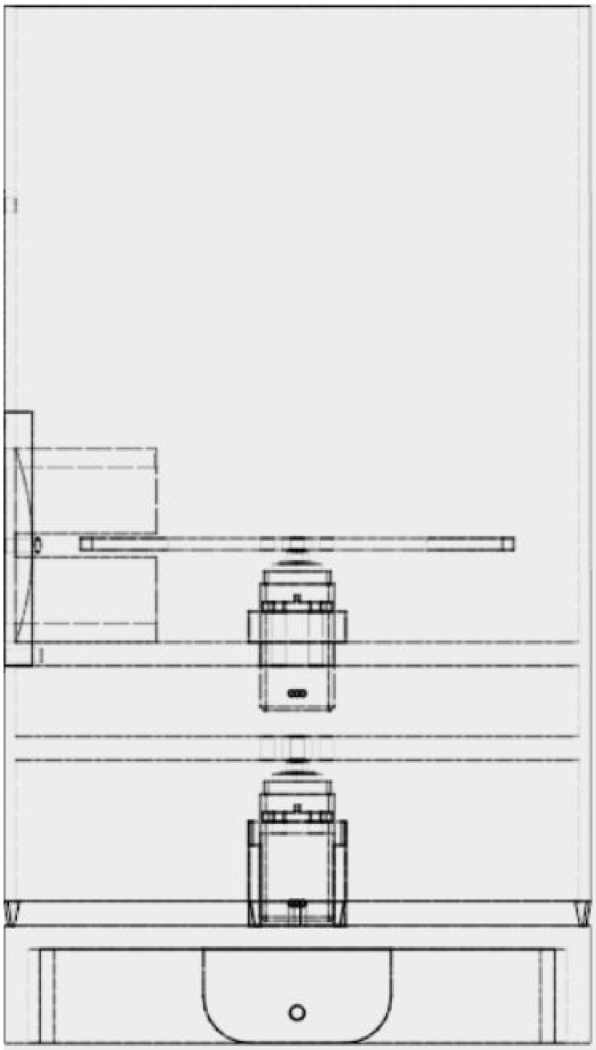




- ❖ The balls rotate around and fall into the circular "slots".
- ❖ Once they reach the part with the shooter, the ball will get "caught" by part of the shooting chamber.
- ❖ This part has a slot that allows the thinner agitator to pass through but catches the ping pong balls.

Base Swivel

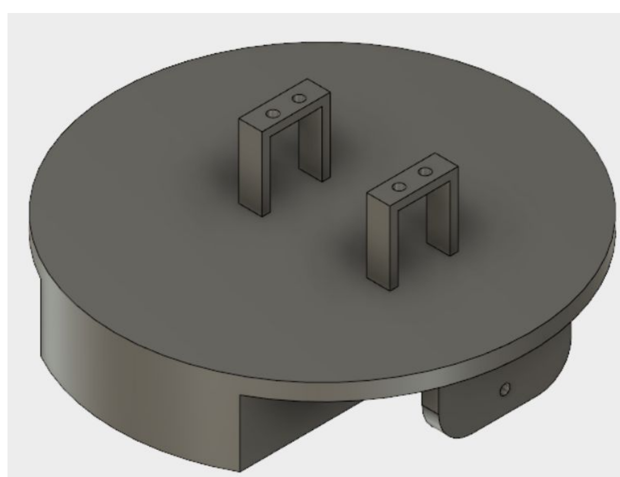
The robot needs to be able to turn from side to side in order to aim for varying parts of the table.



To accomplish this, a separate assembly from the hopper will be attached using a servo.

- ❖ The servo rotates, which in turn rotates the entire system, allowing the robot to adjust where it shoots.
- ❖ The hopper also touches the base of the piece that holds the swivler. This only occurs at very few points, to allow for:
    - ➢ Minimal friction while rotating
    - ➢ Adequate structural support
- ❖ Even so, a lot more torque is required to rotate the system, so a higher torque servo should be used.

- ❖ One point of solid connection at the servo allows the hopper to spin freely.
- ❖ 3-D printed so it is lightweight and accurate.
- ❖ Same diameter as the hopper but they share the same center, meaning it will rotate nicely on the same axis.

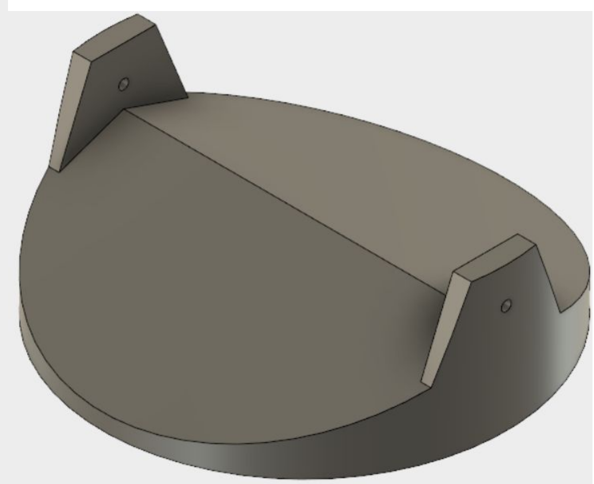


Angler

The robot should be able to be angled up and down, in order to simulate different types of shots.

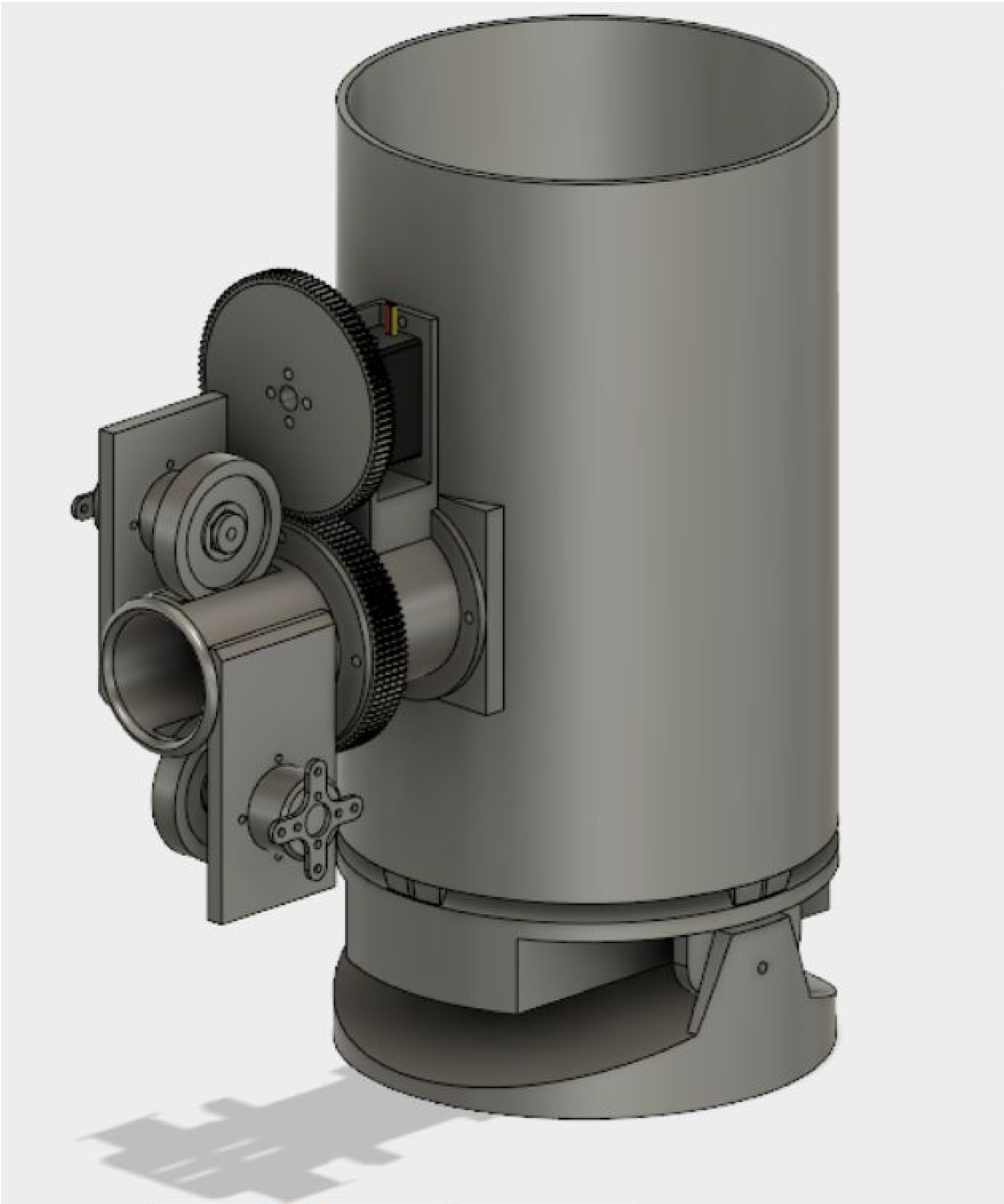
To accomplish this, a platform piece will be used to allow the robot to rock back and forth.

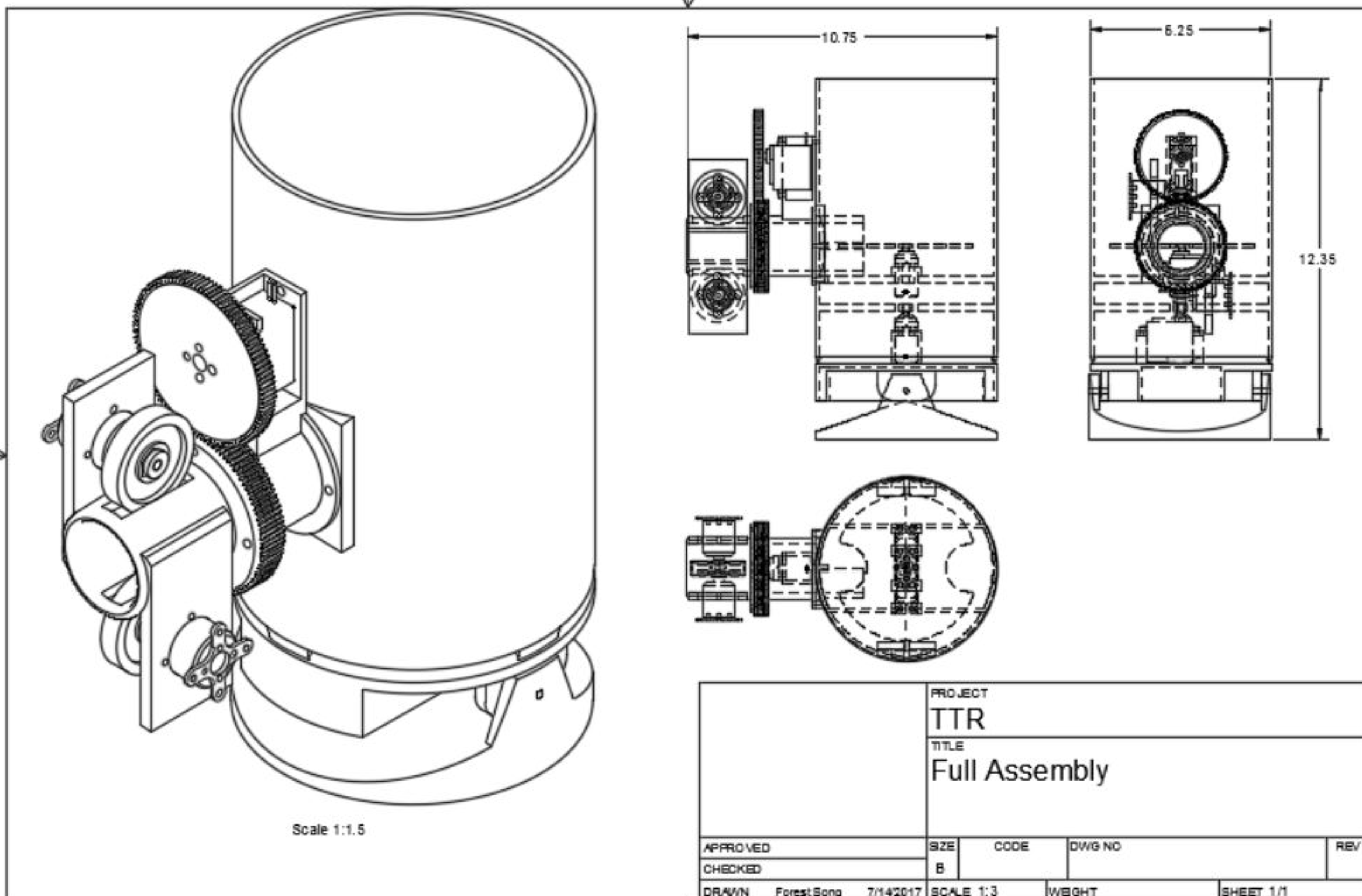
- ❖ It can adjust up to 20 degrees upward and downward.
- ❖ It is attached to the swivel and hopper system using screws that can be loosened to adjust the angle manually, then tightened to keep it there.
- ❖ Using wing screws will allow for easy manual adjustment.



- ❖ Sloping on both ends allows for the shooter to angle in either direction.
- ❖ Extended part of the base swivel will allow it to rest with a lot of support when on the maximum angle.

Entire Robot Assembly

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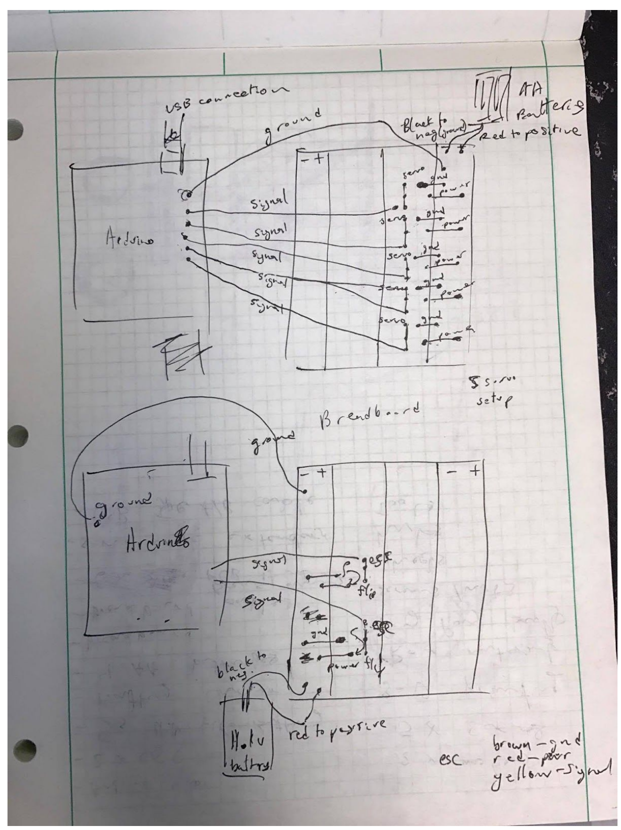
Appeal

This robot has several advantages over many robots on the market.

- ❖ Transportability
  - ➢ The robot is extremely lightweight. Considering that it is made almost entirely of 3-D printed parts, it will be easy to move around, making it very appealing over many heavy duty table tennis robots.
  - ➢ The robot is also smaller than the majority of other playing robots. The total height of the robot is just over 12.5”; this is small enough to fit into the vast majority of backpacks and bags.
- ❖ Shot Variation
  - ➢ Because of the dual flywheel and shooter swivel, the robot can create all types of spin, which is something many robots on the market do not have.
  - ➢ The shooter swivel allows the process to be automated, and not have to be adjusted manually.
  - ➢ The base swivler and angler give additional options for shot variety.
- ❖ Ball Count
  - ➢ Relative to the size of the robot and its transportability, the robot can fit many more balls than other robots.
  - ➢ This will appeal to more advanced players that want to take practice more seriously.

Electronics

The robot will be controlled using an Arduino Uno, the setup is shown on the right.



- ❖ The Arduino receives code from a computer through the laptop connection.
- ❖ The Arduino can hold up to 14 PINS, which is plenty for this project. It requires only 3 servos and 2 motors, which means only 5 pins will be used.
- ❖ Because Arduino limits the voltage at a constant 5V, separate power sources will be required to power the servos and motors, which require more than that amount.

The digital servos being used require about 6V. To supply this, 4 AA batteries will be used to power them. Through wiring on the breadboard, the servos can be chained so they all receive the same power from the batteries.

Powering the motor is more complicated. Brushless DC motors require an additional controller because they lack internal brushes. This allows them to control the speed at which the motor rotates. The motors also require batteries with a higher voltage.

To determine the correct electronic speed controller(ESC) and battery, the maximum amperage of the motor must be found. Once it's found, the amperage of both the ESC and battery must be greater than that of the motor.

- MotorMaxAmperage = (MotorWatts/BatteryVoltage)
- The voltage of the battery is 3S, or 3*3.7 = 11.1V
- Based on the specifications on the motor data sheet:
  - $\frac{243W}{11.1V} \approx 21.9A$
- Therefore, both the ESC and Battery need higher than 21.9A in order to not hold the motor back.
- Therefore, a 25A ESC should suffice for these motors.
- To calculate the amperage of a battery:
  - $\frac{mAh*C}{1000}$ = amperage, where mAh is milliamps and C is Capacitance for discharging.
  - mAh*C = 21.9*1000 = 21,900
- Therefore, the battery should have a mAh and C rating that multiply to be greater than 21,900.
- The battery chosen has ratings of 1000mAh and 25C, which multiplies to 25,000, which is sufficient for these motors.

In summary:

- The Arduino Uno will make it easy to program and wire the various servos and motors for this project.
- Based on the motor specifications, the specific ESC and battery were chosen so that minimal energy is wasted.

Budget

Part	Price	Quantity	Total Price	Description
Motor	$25.00	2	$50.00	For shooter
Shooter Swivel Servo	$27.39	1	$27.39	Extra Rotation
Feeder Servo	$37.39	1	$37.39	Continuous Rotation
Base Swivel Servo	$39.99	1	$39.99	High torque
3-D Printing	$30	1	$30	Estimated
Wheel	$2.50	2	$5.00	Flywheel
Wheel Hub	$4.00	2	$8.00	
Arduino Uno	$24.95	1	$24.95	
Electronic Speed Controller	$9.60	2	$19.20	25A
3s LiPo Battery	$6.00	1	$6.00	
Breadboard	$5.00	1	$5.00	
Breakboard Cables	$13.99	1	$13.99	
Break Away PCB Header	$1.50	1	$1.50	
Servo Wire Extenders	$3.45	1	$3.45	6"
USB Type A/B Cable	$3.95	1	$3.95	
Tools	$20.00	1	$20.00	Estimated
Miscellaneous	$10.00	1	$10.00	Screws, Nuts, Raw Materials, etc.
		Total	$305.81	

Links

Part	Link
Motor	http://www.robotshop.com/en/brushless-motor-880kv-168a.html
Shooter Swivel Servo	https://www.servocity.com/hs-485hb-servo#259=26
Feeder Servo	https://www.servocity.com/hs-485hb-servo#259=27
Base Swivel Servo	https://www.servocity.com/d645mw-servo
3-D Printing	N/A
Wheel	http://www.banebots.com/product/T40P-193BG-HS4.html
Wheel Hub	http://www.banebots.com/product/T40H-SM41.html
Arduino Uno	https://store.arduino.cc/usa/arduino-uno-rev3
Electronic Speed Controller	https://www.banggood.com/Emax-Simonk-Series-12A-20A-25A-30A-40A-ESC-For-Quadcopter-QAV-250-p-918126.html
3s LiPo Battery	https://www.amazon.com/ZIPPY-Compact-1000mAh-Lipo-Pack/dp/B00TDCDKLW/ref=sr_1_8?ie=UTF8&qid=1499115045&sr=8-8&keywords=3s+lipo+battery+pack

Breadboard	https://www.adafruit.com/product/64?gclid=CLfWwPuLiNUCFcSLswod61EHRQ
Breakboard Cables	http://www.frys.com/product/4612408?source=google&gclid=CNbV-auJ7tQCFYeFswodZgoBdQ
Break Away PCB Header	https://www.sparkfun.com/products/116
Servo Wire Extenders	https://www.servocity.com/hitec-standard-duty-extensions#358=189
USB Type A/B Cable	https://www.adafruit.com/product/62?gclid=CPmE1tiMiNUCFYaLswod2T0N8Q
Tools	N/A
Miscellaneous	N/A

Total Cost: $305.81

Potential Future Improvements

While the robot has been designed, this is just the first prototype of the robot. After more extensive testing, many further improvements can be made to improve the robot.

- Aesthetics
  - If the model is successful, future iterations may have some sort of covering for the various mechanical systems of the shooter. This will make the robot look much cleaner and safer to use.
- Custom Materials
  - While 3-D printing is useful, it is not the strongest material and may wear out over time. Future iterations may use stronger materials to ensure the robot is consistent over longer periods of time.
- Automated Angler
  - Currently, the angler has to be adjusted manually. In the future, the action could be controlled by another servo, so it can adjust on its own.
- Linear Motion
  - In order to emulate human motion, using linear motion of the robot across the table can simulate a person moving back and forth. By putting the base of the robot on a slide that can move from side to side on a table, it will test the player in how they react to different angles. It can also incorporate ultrasonic sensors to detect where a player hit the ball, then move the robot to that point and shoot from there, to truly emulate how a match works.
- Ball Recycling

        - While 50 balls is sufficient for practice, it still requires pickup or a separate net. Future iterations could potentially provide a way to recycle balls so no separate work is needed.
- Power
    - Currently, the Arduino Uno only supplies 5V, which is not sufficient for the servos and motors. As such 2 separate power sources are required, which is inconvenient for replacements. In the future, the robot should be wired so only one power source is needed.

Project Deliverables

The project encompasses a vast amount of knowledge about robotics. From doing this project, I'll be able to improve my understanding of the engineering design process, CAD, Arduino programming, and mechanical systems. This will allow me to be a much better engineer and ultimately help me a lot in the future when I tackle other projects.

Furthermore, if the project is successful, it will significantly improve the speed at which the table tennis community grows. Since it would be a very effective training partner, it would be easier to improve faster than ever before, which will encourage involvement in the game. If the project is potentially mass produced, it could reduce the need for coaches to put in the effort to practice with the players and allow them to focus more on teaching. It can also make practice significantly faster and more consistent, if the shooting is consistent and accurate, as well as more effective, by putting various spins on the ball.

The project would also boost the engineering community at Rutgers. A successful, practical, and useful robot can be shown off at various Rutgers Engineering events which would promote Rutgers Engineering in general. Furthermore, the project would encourage other STEM majors to tackle projects on their own. Ultimately, the level of interest and quality in STEM would increase.

Conclusion

The purpose of the robot is to sufficiently serve as a training partner for table tennis players when practicing alone. The mechanical and electrical design were created with this in mind. Hopefully with this iteration and future ones, this project can be the best robot in accomplishing this goal.