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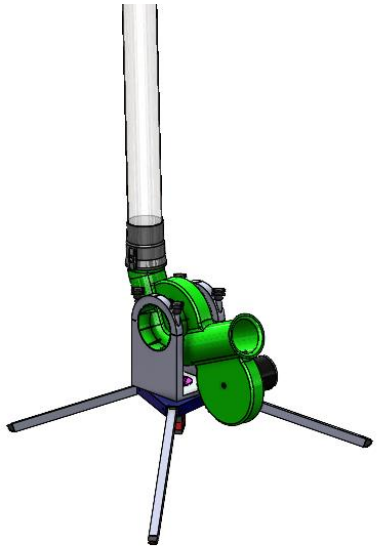
Product SOW

BallBoy Rob – Tennis Ball Server



Revision No.	Description	Edited By	Approved By	Publish Date
00	First publish	Doron Doctoras Ido Sharabi	Tsachi Davidov Amir Levit	03/04/2022
01	Second publish, updated design – no casing	Doron Doctoras Ido Sharabi		05/07/2022

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1. CUSTOMER:

Name	Project
Alex	Ball Boy Rob – Tennis Ball Server

All links and references to existing components and products are for example uses ONLY

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2. CONTENTS

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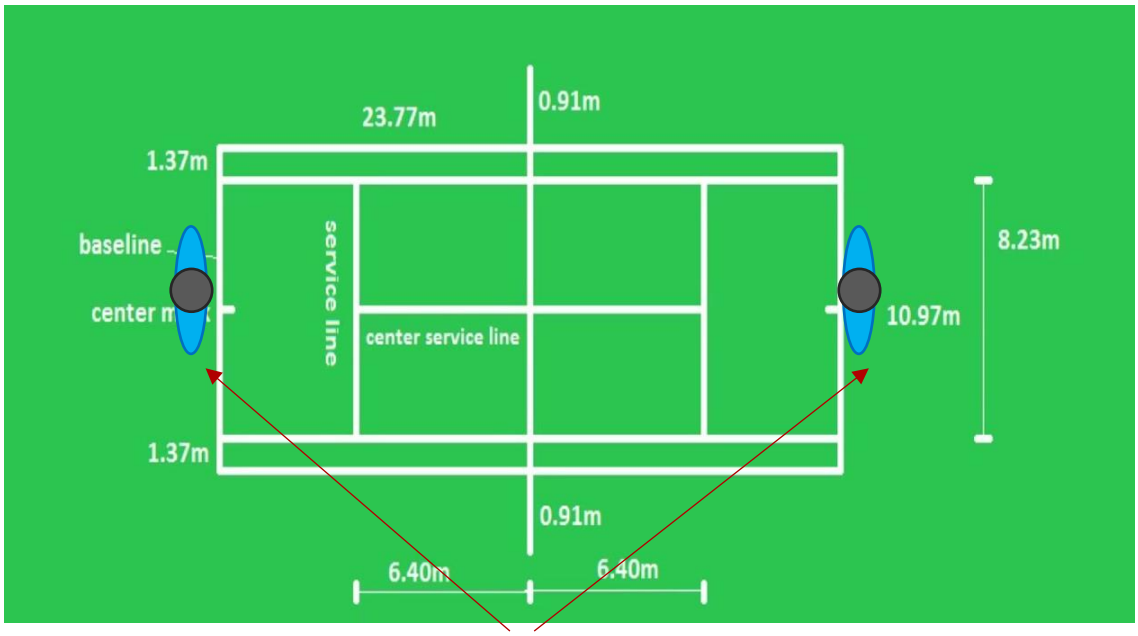
3. TASK DESCRIPTION

Product introduction video https://you tu.be/6vpBgkqp_wE

During a tennis game or practice, the players require tennis balls to serve.

Tennis fields dimensions are:



Players

The loose balls in the field are gathered usually with a tennis ball collection tube such as this one:

For each serve, the players need a ball to serve, if the ball is not near them, they have to pick it up from the ground.

Links for acceptable ball collectors:

(4) Tennis Ball pick up tube | Vermont - YouTube

Amazon.com: Gamma Tennis Ballhopper Balltube 18 - Clear - Holds 18 Balls: Tennis Ball Hoppers: Sports & Outdoors

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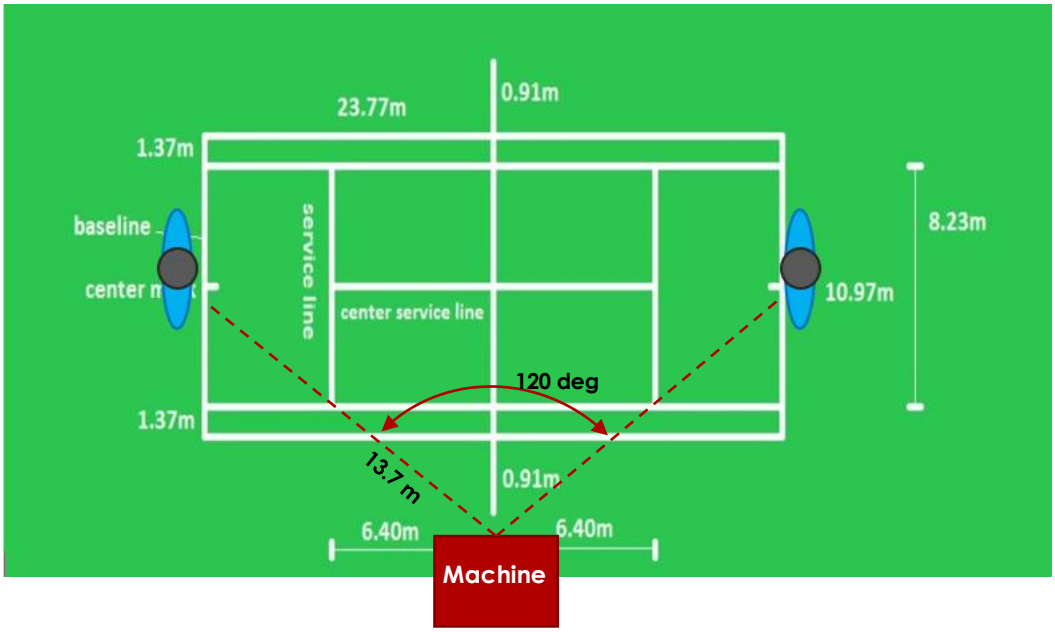
4. PRODUCT TYPICAL OPERATION

To solve the problem of looking for a ball before each serve, a machine is suggested, to throw a single ball each time a player wants to serve.

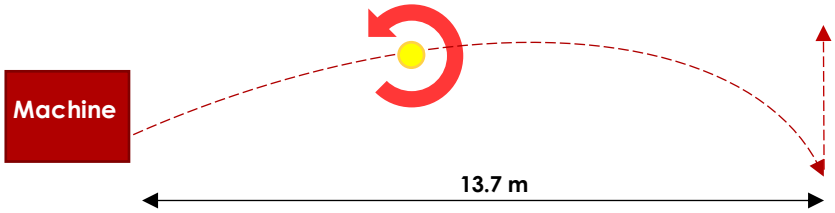
Figure 1 Standard tennis field



The distance from the machine to each player is 13.7 m and the angle between them is 120 degrees.

The ball reaches the players with mostly downward motion and bounces back no more than 1 m, for ease of catch. The ball exits the machine with a Backspin which helps the ball bounce vertically off the ground.

The desired ball trajectory is demonstrated in the figure below and on ----- video



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5. PRODUCT GENERAL REQUIREMENTS

5.1. Machine launching range

The launching range of the machine is **13.7 m.**

5.2. Pan range

The angular range, panning right and left equally is **120 degrees** total.

5.3. Machine general dimensions

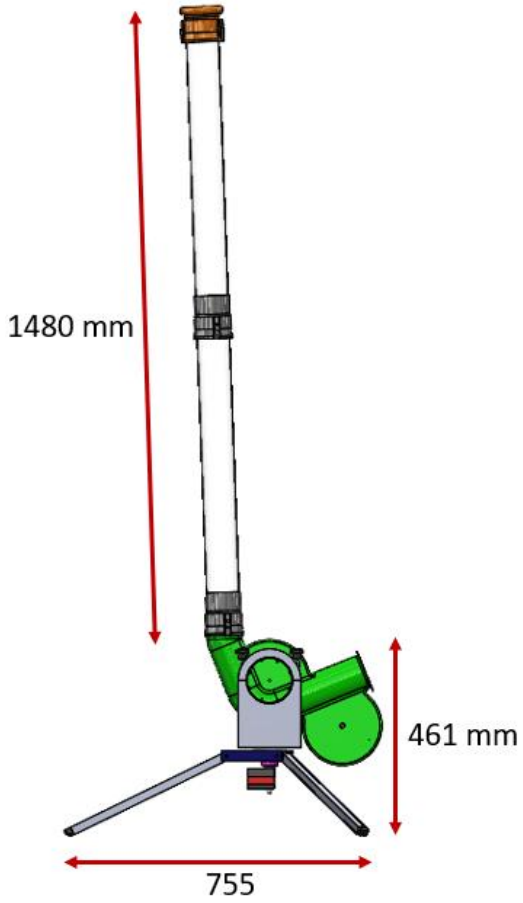

Figure 2 Machine in transport mode

5.4. Ball hopper requirements

The hopper should be tube-shaped consist of two tubes; each contain 10 ball (total of 20 balls)

The ball collector-hoper should be able to be installed easily by a single operator
The ball hopper should be able to act as a ball collector ()

The tube should be standard clear plastic with a "male" and "female" adaptors for installation on the launcher and for connecting 2 tubes together for a larger ball collector

The male and female connectors are permanently connected to the tube, the "collector connector" is an add-on that connect to the male connector with a simple latch. It has a small and flexible inner diameter ring that allows tennis balls to be pressed in but they won't roll out.

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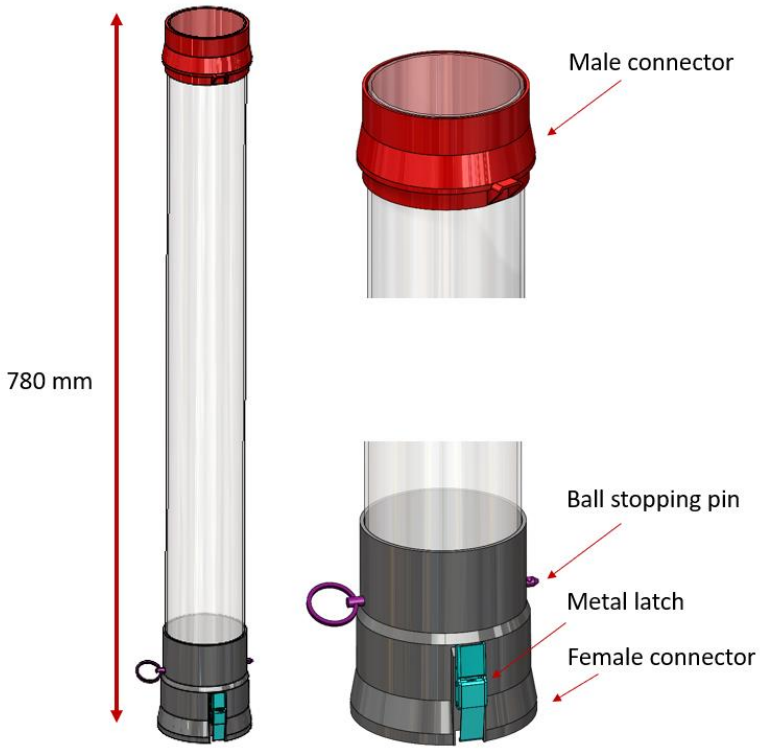
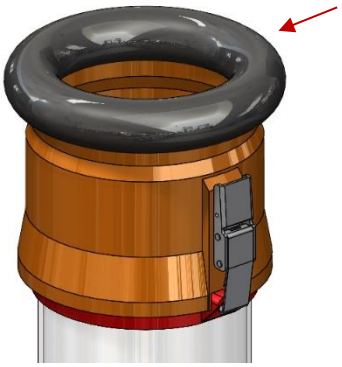
The tube can be attached to another tube to become a long ball collector hat can contain up to 20 balls.

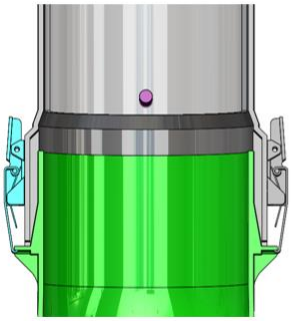




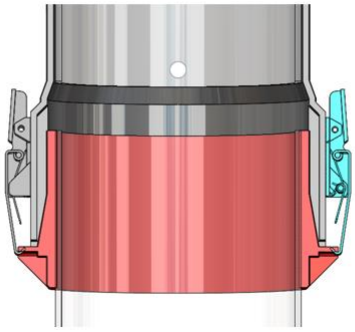
Collector connector

Soft ring with an inner diameter smaller than a tennis ball

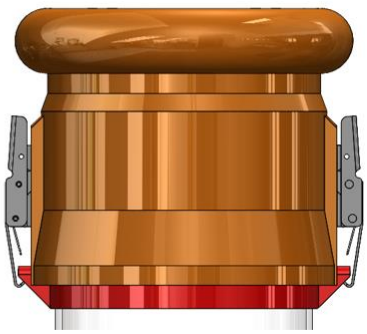
Female to launcher



Female to male



Collector to male



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5.5. Machine reaction time

From the moment a player is clicking on the remote till the moment the machine launches a ball, should be **2 seconds or less**. The machine will maintain the wheel speed (we recommend having an "heavy" fly wheel with high moment of inertia).
In case that no ball is being ask for 4 minutes the wheel will be stopped.

5.6. Machine single operation cycle

Assuming the machine will be required to launch every 10-20 seconds, and practice sessions can be up to 3 hours, and assuming the players take some breaks,

The machine should be able to fire: **350 balls a session**.

5.7. Power requirements

The machine consumes power through the launching motor, feeder motor, panning motor, and players' RC communication. The battery should last for at least **3 hours**.

5.8. Total machine life cycle

Base assumptions:

- The machine is expected to last **3 years**.
- The machine is used for **3 hours in each session**.
- The machine is used **5 days a week**.
- For each ball launch the machine pans to the other player.

Machine element required longevity:

5.8.1. The battery should be usable for up to 780 charging cycles.
5.8.2. The ball launching mechanism should last for at least 375,000 launches.
5.8.3. The panning mechanism should last at least 75,000 cycles of 120-degree pans.
5.8.4. Ball feeder should last for 375,000 feeding to the launcher.

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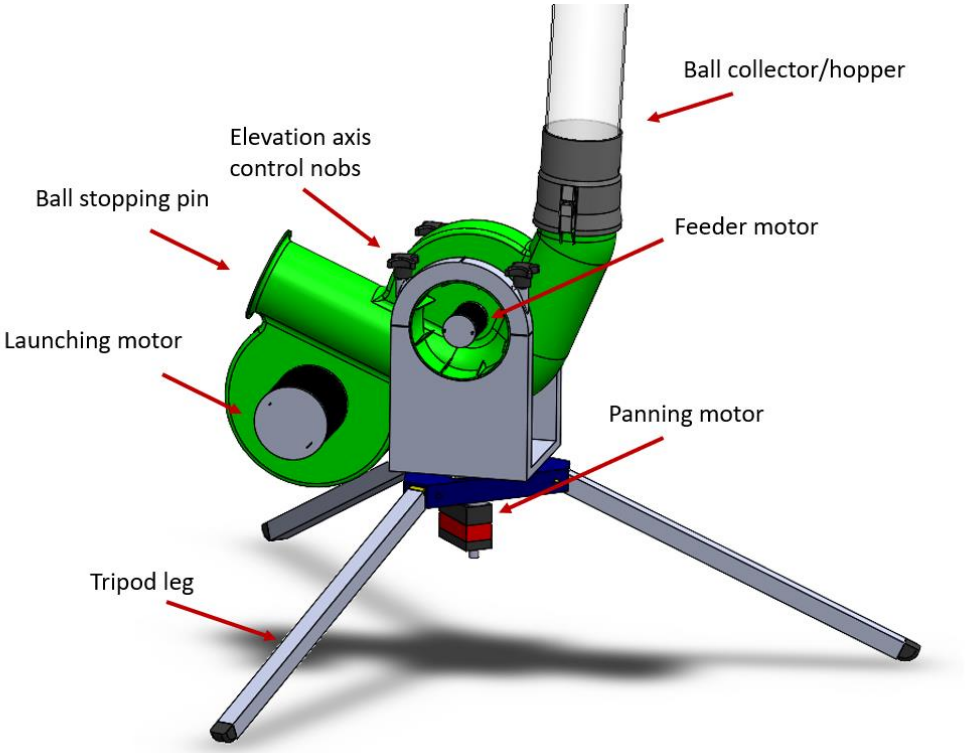
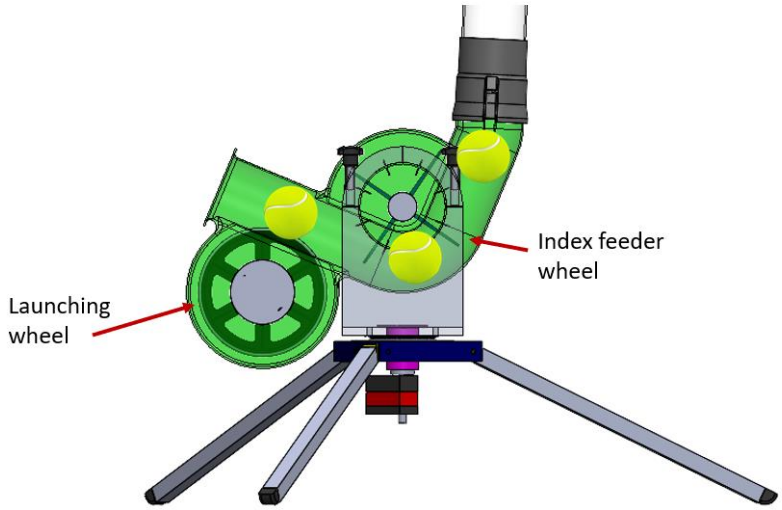
6. MECHANISM MAIN ELEMENTS





6.1. foldable tripod

The machine will be mounted on a foldable tripod provide the user sturdy base for assemble and disassemble the **ball hopper (6.2).**

Each leg will have rubber ending for better friction.

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6.2. Ball hopper

The ball hoper will be from **clear plastic tube**, **top collecting part** and **connector**. The ball hoper will have double purpose: feeding the launcher and easy ball collecting tool for the player.

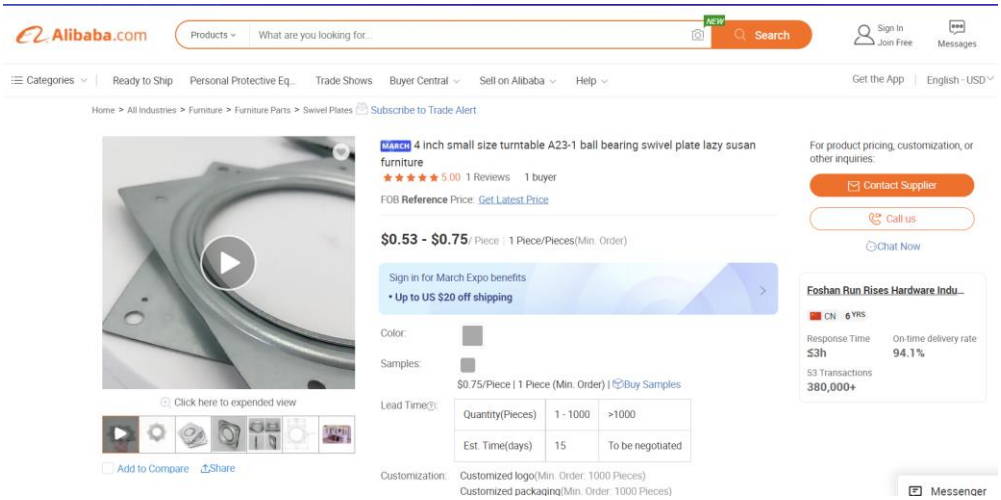
The ball hopper will be made from **2** clear tubes (we suggest using the same connecting mechanism as offered for connecting the ball hoper to the machine.)

When the hopper is assembled the latch will allow ball passing throw the **connector** (see figure below)

6.3. Panning subsystem

6.3.1. panning bearing

In order to reach the **120 degrees** pan requirement we recommend mounting the lunching system on "4-inch swivel bearing"



[4 Inch Small Size Turntable A23-1 Ball Bearing Swivel Plate Lazy Susan Furniture - Buy Small Size Turntable,Ball Bearing Swivel Plate,Lazy Susan Product on Alibaba.com]

6.3.2. Panning motor and control

Since the machine is required to reach 2 positions: **player 1** and **player 2.** These positions are on 120 degrees arc.

Because of that we recommend using servo motor for panning (the reason we recommend using servo motors is that they contain the control loops and electronics).

For the servo motor we recommend heavy-duty (metal gears) "60KG"servo motor. Only If those motors performance will allow the product to meet the machine desired

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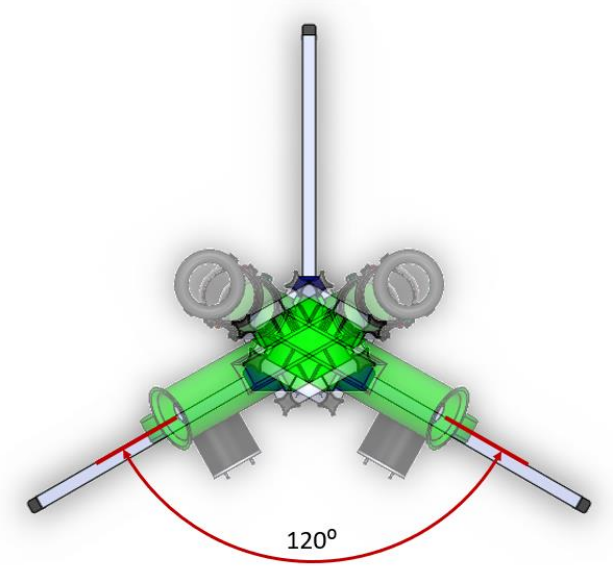
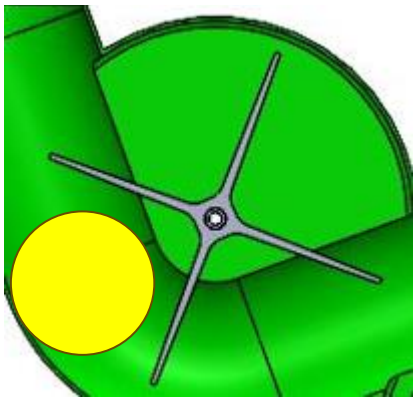


6.4. Feeder wheel

The feeder wheel will be able to feed the launcher with one ball at the time. We recommend that the feeder wheel will have some flexibility to protect the motor and prevent ball jamming.



6.5. Battery

The battery should last for 4 Hours of typical operation as described in section "5.7 Power requirements"

The battery should be relatively lightweight, lead based battery is not an option.

6.6. Launcher

The launcher shoots standard tennis balls to a distance of 13.7 m.

The launcher elevation angle will have 10 degree adjustment, to determine the required nominal angle more testing is required after choosing a specific launching motor.

The motor should be able to accelerate to the launching speed in **under 1.5 seconds**

The fly wheel will be **static and dynamic balance** to reduce vibrations, noise and to protect the parts longevity.

The launcher elevation angle can be adjusted using 4 nobs. The nominal angle should allow the launcher to hit the 13.7 m distance with a standard tennis ball. Then, the min and max deviation should be 10 degrees up and down on each direction.

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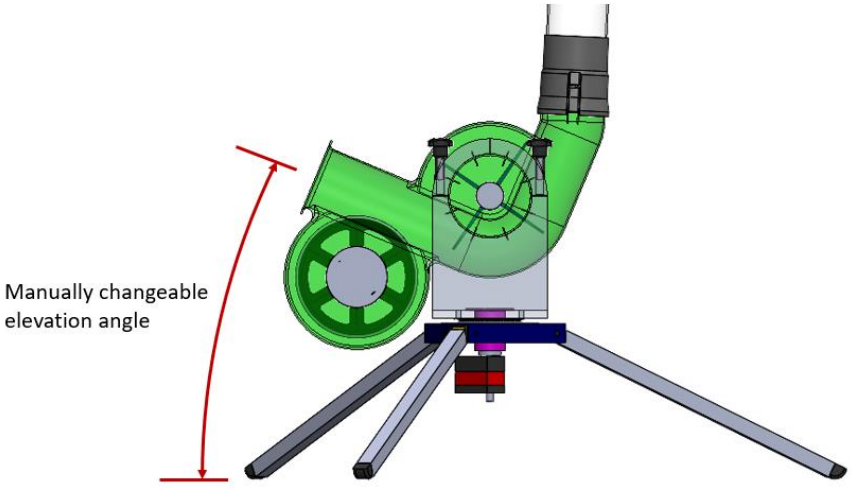

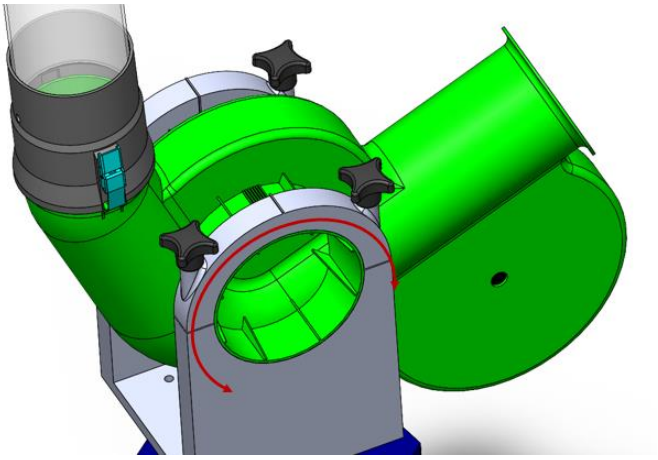

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7. PRODUCT CONSUMER INTERFACE

7.1. Machine operating

Users will perform 2 actions using this machine:

7.1.1. Requesting a ball, by pressing on a small remote with a belt clip, existing RC from the market will be used. The remote will have clips allow the player to attach it to his Sports shorts / Sports skirt.

7.1.2. Reloading the ball hopper by replacing the ball tube

7.2. Machine indication lights

All indication lights should be visible even under direct sunlight.

7.2.1. On/Off light: this light should react to the main power switch.
7.2.2. Battery light: should be 5 segments, for every 20% battery capacity.
7.2.3. Remote trigger light: lights up each time one of the remotes is triggered.
7.2.4. Feeder jam: if the feeder jams, the light turns on.

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8. PRODUCT MAINTENANCE

8.1. Maintenance levels

There are 2 maintenance levels, technician level, and customer level. A technician will handle most of the maintenance operations, but some simple tasks the customers should be able to perform.

8.2. Key maintainable elements

Elements maintained by a technician:

8.2.1. Launching motor
8.2.2. Launching wheel
8.2.3. Feeder motor
8.2.4. Panning motor
8.2.5. Main command board

Elements maintained by the user:

8.2.6. Launching wheel
8.2.7. Feeder wheel – clearing simple jams
8.2.8. Cleaning the launcher from clay residue after playing on clay fields

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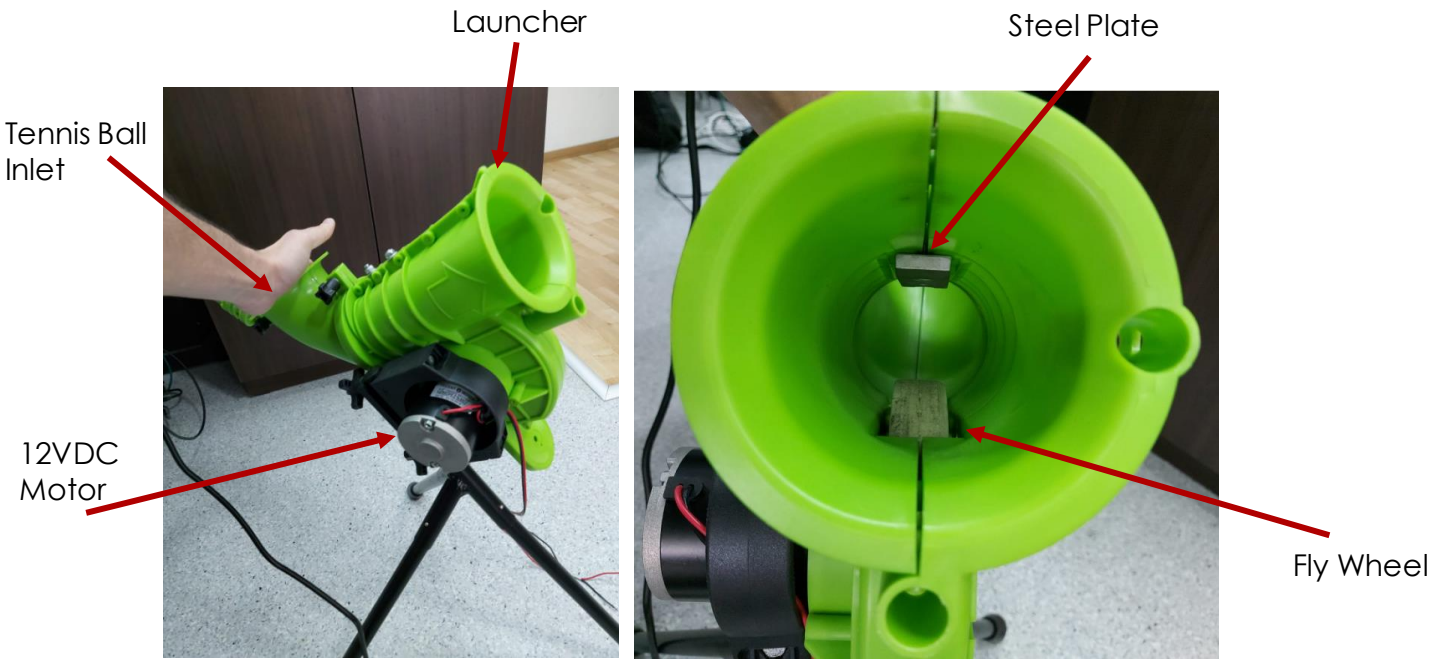
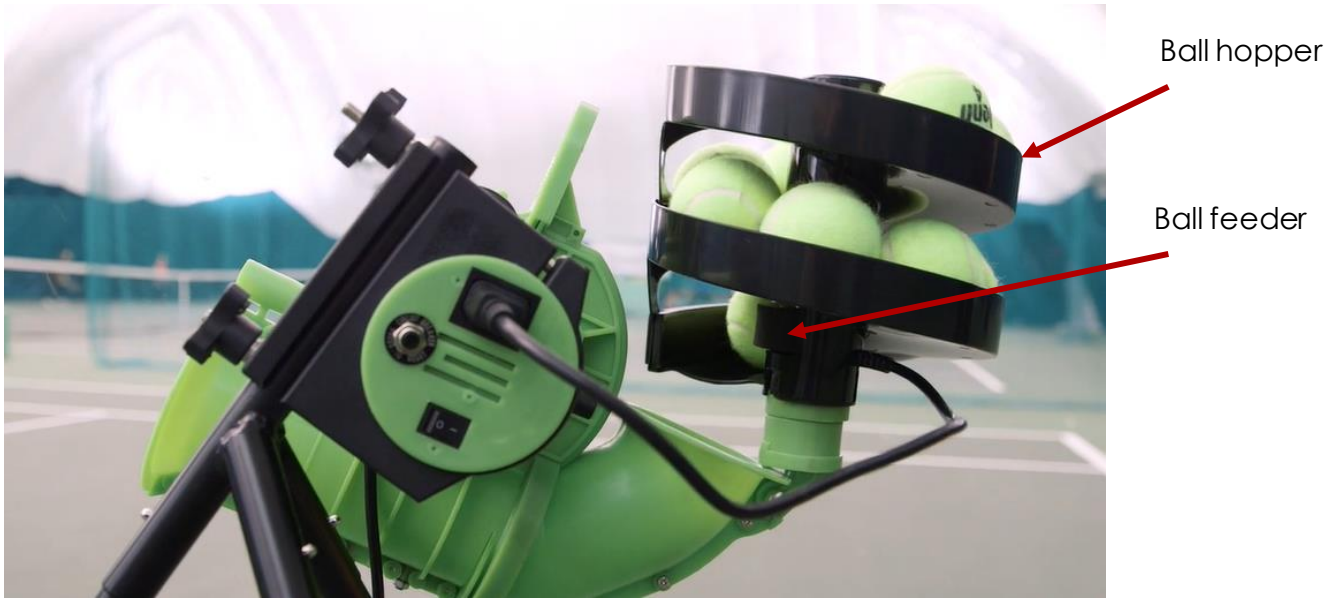
9. RELEVANT SIMILAR PRODUCTS

The "Baseliner Slam tennis machine" fits many of our product requirements regarding range, backspin, simplicity, and ball launching rate:

The product has the following sub-systems:

1. 300-500W 12VDC Motor + flywheel for throwing the tennis ball.
2. The original motor was replaced with the current motor to support a 2-second launching rate.
3. 12VDC feeder motor, incorporated in the ball hopper. The feeder is automatic and continuous, meaning there is no way to launch balls one at a time.





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10. PRODUCT REGULATION REQUARMENTS

TBD

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11. CUSTOMER AGREEMENT

The customer has read the document and approves its content:

Customer name: _____

Sign:_____

Date: _____