

## **PING-PONG BALL THROWER FOR TRAINING**

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*ABSTRACT: Our work called Ping-pong ball thrower for training includes the following chapters: Introduction, current status, mission formulation, specification setting, conceptual design and detailed design. We started by identifying customer needs portfolio, and then finding opportunities to put them into practice on our device. In the next chapter on specifications we folded them according to the needs portfolio. Then, based on these, several design ideas were analyzed, of which the most reliable was preserved. With this, further consideration was given to the characteristics and technical specifications of the basic components for the device that we designed with the help of the specific software.*

*KEYWORDS: Ping-pong, thrower, concept, design.*

### **1. Introduction**

The presented product will be a ping pong ball thrower for training, the objectives are to make improvements by differentiating from the other competing products currently on the market and the way of developing the product is that of research, analysis and comparison with other similar products.

### **2. Current status**

#### **2.1. Strategic marketing of the product**

##### **2.1.1. Identifying market opportunities**

#### **A.1 Portfolio of customer needs**

N1: The need to acquire reflexes during a ping pong game;

N2: The need to increase the punching accuracy of the ping pong ball;

N3: The need to play ping pong by yourself without the need for a teammate;

N4: The need to learn to hit the ping pong ball better and better;

N5: The need to improve your technique;

N6: The need to be able to monitor game statistics directly from your mobile phone using an application.

#### **A.2 Opportunities / Products / Customers**

##### **a) Market opportunities (reasons for the need):**

*For the N1 need:*

*There is no equipment on the market that helps you improve your reflections.*

*For the N2 need:*

*There is no equipment on the market that helps you improve the punching accuracy of the ping pong ball;*

*For the N3 need:*

*There is no equipment on the market that helps you play ping pong by yourself;*

*For the N4 need:*

*There is no equipment on the market that helps you hit ping pong balls efficiently,*

*For the N5 need:*

*There is no equipment on the market that helps you to quickly improve your game technique.*

*For the N6 need:*

*There is no device on the market that can quickly connect to an app directly from your mobile phone that will help you monitor the statistics of each ping pong match.*

#### **b) Products that meet specified needs:**

*For the N1, N2, N3 needs:*

For the three needs listed above, a device will be created (device that helps you to play table tennis without needing an opponent).

#### **c) Potential clients:**

*For product P1:*

- \* \*athletes who are passionate about ping pong;
- \*college students;
- \*students;
- \*children with minimum age of 7 years;
- \*sports clubs;
- \*fitness centers;

### **2.2 Restrictions on the production of the product prototype**

*R 1: To have a simple constructive form;*

*R 2: Have high execution speed;*

*R 3: To be able to process large parts;*

*R 4: To be able to process parts with heavy weights;*

*R 5: Contain items made of cheap and easily procured materials;*

*R 6: To have a large potential market;*

*R 7: Have the lowest possible cost.*

### **2.3. Mission formulation**

Our mission is to build the best pitcher that is aimed at beginners and children at a low price, that will give you in time special abilities of hitting, positioning on the ping pong table, agility and very high reflections. We thought about implementing some special features that will make this robot aim at one ball or more balls at a time frame selected by the user so that we can adjust the throw speed of each ball and we also thought about programming it in such a way that to be able to connect to the internet through a proprietary application that will allow you to set these functions directly from your phone and besides this we also thought to put a lighting system in front of him so that we can play ping pong and during the time night. [1]

### **2.4. Collected data from potential customers:**

What do you think of the ping pong ball throwing machine?

Do you think it is necessary to implement an application in order to be able to monitor the statistics of each game and to be able to control the device remotely?

What will this device do to give up various opponents during the entire ping pong match?

What would you expect from this device?

**Potential competitors on the market:**



Fig.1. Shotmaker [3]



Fig.2. Donic Newgy Robopong [4]



Fig.3.SUZ Table Tennis [5]

**3. Specifications settings**

Based on the primary needs we have established the measurable sizes corresponding to each need, taking into account the indications on translating customer needs into measurable sizes and the specifications of the competing products analyzed.

An important step in the development of the product is to establish the objective specifications of the product, those values of the characteristic sizes of needs, for which the success in the market of the product is possible. According to these sizes, the conceptual design of the product, as well as its architecture, is carried out.

Matrix requirements – quality characteristics;

In order to determine the specifications objectively, we must find a correspondence between each primary need and the measurable size that characterizes it. The following recommendations shall be taken into account in relation to the composition of the list of sizes:

- The sizes must be dependent and not independent;
- The sizes must be practical;
- Subjective quantities shall be deleted where possible;
- Sizes should include popular comparison criteria.

In the following table is presented the matrix needs - quality features:

**Table 1. Specifications settings**

Needs	Quality characteristics				
	Information processing	Ball positioning speed	Launch speed	Positioning accuracy	
				Positioning accuracy	The tilt angle of the device
Productivity	*	*	*	*	*
Precision	*	*		*	*
Ergonomic form		*	*	*	*
Design	*	*	*		




Performance of competing products;

“Robo pong 2055, Newgy Donic”, “Table tennis robot” and “professional table tennis robot” are products that offer the operator an activity where he can train at fun and professional level.

The basic model for the first steps in working with a robot. Affordable solution for hobby players, beginners as well as professionals. With a low ball frequency, as well as a low spin/speed for learning basic movements.

The major disadvantage of these devices is the volume and the purchase price of these, being devices of beginner and professional level practice. These devices are intended for any age group depending on the level of training they want to reach.

**Table 2. Competing products**

Device name	Robo Pong 2055, Newgy Donic	Table tennis robot	Professional table tennis robot
Pictures	 Fig.4. Robo Pong 2055, Newgy Donic [6]	 Fig.5. Table tennis robot [7]	 Fig.6. Professional table tennis robot [8]
Price	5800 lei	310 lei	2600 lei
Procedure Type	Mechanical launch	Mechanical launch	Mechanical launch
Material	PVC	PVC	ABS
Number of balls	120	30	80
Competitional level	Intermediar	Beginner	Professional
Ball speed	2 - 44 m/s	2 – 5 m/s	4 – 40 m/s
Dimensions	152x79x46cm	35x24x27cm	41x36x32cm
Weight	8 kg	2 kg	4,5 kg

Objective and limit values – acceptable for quality characteristics.

Characterization: To establish the ideal objective values and acceptable limit, for each size, an ideal target (the best result the team can hope for) and an acceptable limit target (the value that allows the product to be commercially viable) is chosen. The following table shows the limit values and ideal values.

- Without looking for a real opponent,
- Speed adjustable according to the desired rhythm,
- The ability of the ball introduced,
- Battery/needle power type,
- Functions for different ball launch angles,

In this chapter were identified the necessary sizes for the realization of the conceptual and detailed design of the product, as well as their ideal values. [2]

## 4. Conceptual design

### 4.1. General function and component functions

The general function of this device is to launch ping-pong balls at a repetitive pace, creating a mechanism that allows the ball to be launched in different ways, allowing the auxiliary functions to be controlled manually by the user via the control panel.

### 4.2. Breaking down the general function into constitutive sub-functions.

Following the breakdown of the general function into the sub-functions, the functional shaft of the product will be formed. Primary and secondary functions will result. The main functions are qualities of the product that determine the general function, and secondary functions result from the interaction of the

main functions with each other and from the interaction between the main functions and the environment in which they develop.

**Table 3. Breaking down the general function into constitutive sub-functions**

SYMBOL FUNCTION	DEFINING THE FUNCTION	CONSTITUTIVE SUB-FUNCTIONS	Components that participate
	(verb + noun)		
A	IT ABSORBS WEIGHT	a. Withstand the weight	Resistance structure
		b. Uniform distribution	Resistance structure
B	PROVIDE MECHANICAL ENERGY	a. It provides energy	Power cable
		b. It converts electric energy into mechanical energy.	Electric motor
		c. Provides power supply	Power cable
C	PROVIDES COMFORT	a. Provides contact (actuation)	The support of the tool
		b. It provides ergonomics	The housing of the device
D	LOCK POSITION	a. Inability to move	The housing of the device
		b. Change position	Position step (angle )
E	IT ALLOWS MAINTENANCE	a. Resists dirt	Storage box
F	IT HAS A LOOK	a. It gives satisfaction	Form
G	IT USES ENERGY	a. Provides power source	Electric motor
		b. Ensures the wheel is engaged	The silicone wheel
H	IT CONTROLS SPEED	a. Allows to change speed	Control panel
I	IT ALLOWS ANSAMBLING	a. Allows mounting of components	The housing of the device
		b. Allows mounting for attachment	Assembly components
J	LONG USE RESSISTANT	a. Resists actuation requests	Material
		b. He can stand the weight	Assembly
		c. Allows maintenance	Material
		d. It resists wear	Material

#### 4.3. External research to identify known constructive solutions (interviews, patents, literature, data banks on competing products, synthesis).

In the paper “specification setting and conceptual design of a ping-pong ball pitcher for training”, conceptual solutions for the development of main functions were collected by accessing the Espacenet website from which several known patents for the development of main functions were extracted.

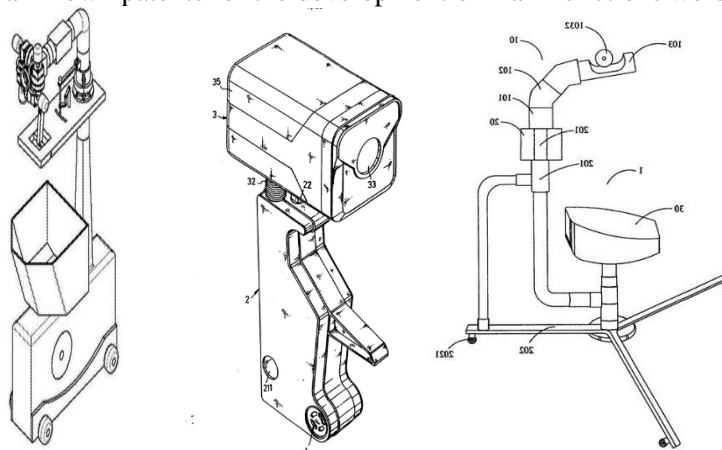


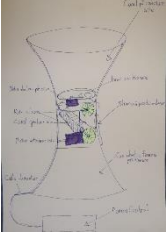

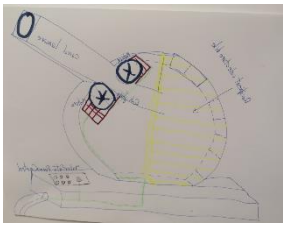

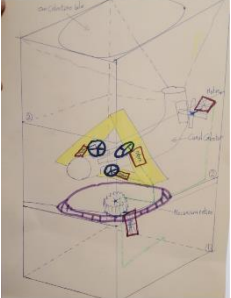

Fig.7 Extracted patent models

#### 4.4 The triage of concepts

In this step of selecting the optimal concept, the concepts resulting from the previous stage were taken. Following the concept generation stage, a number of 6 integral product concepts developed by the team that is entitled to.

#### 4.5. Table of integral concepts

**Table 4. Integral concepts**

 <p>Fig.8 Concept 1</p>	<p>Concept 1</p> <hr/> <p>Concept 2</p>	 <p>Fig.9 Concept 2</p>
 <p>Fig.10 Concept 3</p>	<p>Concept 3</p> <hr/> <p>Concept 4</p>	 <p>Fig.11 Concept 4</p>
 <p>Fig.12 Concept 5</p>	<p>Concept 5</p> <hr/> <p>Concept 6</p>	 <p>Fig.13 Concept 6</p>

#### 4.6 Making the Triage matrix

**Table 5. Triage matrix**

Characteristic	Concept 1	Concept 2	Concept 3	Concept 4	Concept 5	Concept 6
<b>Design</b>	+	+	+	+	+	<b>0</b>
<b>Type</b>	-	-	-	-	+	<b>0</b>
<b>Pos. Fab.</b>	+	-	+	-	+	<b>0</b>
<b>Technology</b>	-	-	-	-	+	<b>0</b>
<b>Cost</b>	+	-	+	-	+	<b>0</b>
<b>TOTAL</b>	<b>3</b>	<b>1</b>	<b>3</b>	<b>1</b>	<b>5</b>	<b>0</b>

Following the triage of concepts, 3 integral concepts of the product were selected. Concept 1, 3 and 5. As a reference concept, I chose concept 5 (fig.12) because this concept is an obvious solution to the design problem. It is a simple solution that involves relatively low costs. [1]

## 5. Detailed design

As we have presented in the previous chapters, a number of product concepts have been developed, resulting from the combination of existing technical solutions and concepts studied by the team, considering also the possibility of realization.

This will allow the following concept to be used, which will have minor design changes along the way:

Determination of the materials used.

Following a study by the team on the potential materials that could be used for manufacturing, the materials used in the production of the developed product were chosen based on a market study. The aim was to identify the requirements for the materials used in the manufacture of this type of product.

The structure of the device will be made of lightweight plastic alloys to provide both strength and vibration reduction, while maintaining a light weight. All additional fixing parts will be made of metal, although attempts will be made to reduce their number as much as possible.

Accessories and parts that can be made by 3D printing will be made of plastics. [2]

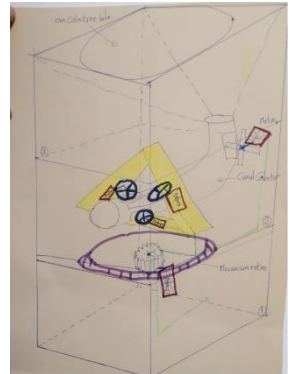
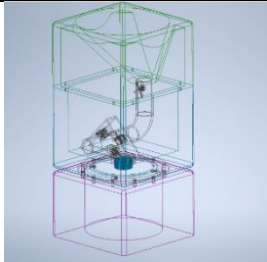
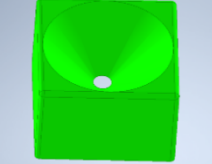
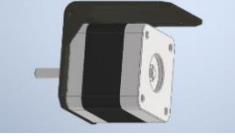

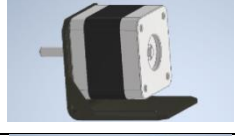
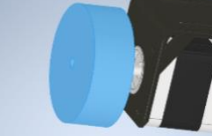

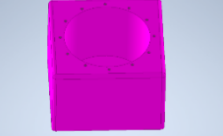



Fig.14. Concept 5

**Table 6. Data sheet**

No.	Part name	Part Sketch	Functional role
1	Assembly of the part	 Fig.15	Launch ping-pong balls to the client for training.
1	Cone for collecting balls	 Fig.16	Provides sufficient volume to release a large number of balls
2	The electric motor that drives the disc	 Fig.17	Generates rotation motion
3	Exterior plastic structure	 Fig.18	Fixates the inner components
4	Wheel drive motor	 Fig.19	Generates rotation motion
5	Silicon wheels	 Fig.20	Launches the balls according to the controls set in the control panel

No.	Part name	Part Sketch	Functional role
7	Swing band part	 Fig.21	Rotate the top of the pitcher according to the data received from a sensor
9	Plastic cone for fixing and positioning	 Fig.22	Provides a correct launch angle and provides stability
10	Ball-throw design system	 Fig.23	Provides top-spin slide-spin and bottom-spin effects

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