UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DEVELOPMENT OF SMART TABLE TENNIS TRAINER CONTROLLED BY USING ANDROID APPLICATION

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Electrical Engineering Technology (Industrial Automation & Robotics) with Honours.

By

ARUN A/L MAHESWAREN
B071410225
940414-02-5823

FACULTY OF ENGINEERING TECHNOLOGY

2017

DECLARATION

I hereby, declared this report entitled "Development of Smart Table Tennis Trainer Controlled by Using Android Application" is the results of my own research except as cited in references.

Signature   :   …………………………………………….

Author's Name :   …………………………………………….

Date   :   …………………………………………….

APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Electrical Engineering Technology (Industrial Automation & Robotics) with Honours. The member of the supervisory is as follow:

…………………………………

(Madiha Binti Zahari)

ABSTRAK

Dalam abad ke-2 ini, sukan adalah salah satu sektor hiburan terbesar dalam kalangan orang ramai. Walau bagaimanapun, sukan kedua dengan penyertaan yang paling popular adalah ping pong dan juga dikenali sebagai tenis meja. Pada masa yang sama, ping pong juga setaraf dengan bola sepak dengan lebih dari 10 juta pemain bersaing dalam kejohanan yang dianjur setiap tahun. Sehingga hari ini, terdapat kira-kira 300 juta pemain tenis meja di seluruh dunia dan sehingga 218 persatuan tenis meja dari seluruh dunia dibentuk di bawah Persekutuan Tenis Meja Antarabangsa (ITTF). Kenyataan ini menunjukkan bahawa sukan tenis meja menjadi popular di seluruh dunia. Oleh itu, wujudnya robot jurulatih tenis meja untuk meningkatkan kaedah latihan pemain. Walau bagaimanapun, disebabkan produk yang tidak ekonomik di pasaran semasa, terdapat keperluan atau permintaan untuk pembangunan satu alat latih tenis meja yang berpatutan dan automatik, iaitu 'a-BAT'. a-BAT adalah peluncur bola tenis meja yang bertujuan untuk memperbaiki dan meningkatkan kaedah latihan pemain tenis meja untuk menjadi lebih efektif dengan kelajuan, putaran, dan arah bola seperti yang diprogram. Papan Arduino UNO berfungsi sebagai pengawal sistem utama untuk mengawal dua motor arus terus, satu motor Stepper dan sepasang motor servo untuk menyesuaikan kelajuan, putaran dan arah bola. Dengan mengawal kelajuan motor arus terus, motor Stepper dan sudut servo motor, pelbagai jenis latihan boleh dihasilkan dan jenis latihan yang berbeza boleh dipilih oleh pengguna untuk latihan. Kesimpulannya, jurulatih tenis meja boleh meningkatkan kemahiran tenis meja pemain dengan menyediakan kedudukan lantunan pertama bola yang tepat.

i

ABSTRACT

In this 20th century, sports are one of the largest entertainment among the peoples around the world. However, in the world, the second most popular participating sport is the ping pong and also known as table tennis. At the same time, ping pong is also in the world next to soccer with over 10 million players compete in sanctioned tournament each year. Until today, there are around 300 million of table tennis players throughout the world and up to 218 table tennis associations from all around the world formed under International Table Tennis Federation (ITTF). This statement shows that table tennis sport is becoming popular around the globe. Hence exist of table tennis trainer robot to enhance the player practicing method. However, due to uneconomic product in the current market, there is a need or demand of designed an affordable and automated table tennis shooting equipment, namely 'a-BAT'. a-BAT is a table tennis ball launcher which targets to improve and enhance table tennis player practice method to be more effective by programmable speed, spinning, and direction of the ball. The Arduino UNO board serves as main controller of the system to control two DC motors, a stepper motor and a pair of the servo motor to adjust the speed, spin and direction of the ball. By controlling the speed of the DC motor and angle of the servo motor, various types of drills can be generated and different type of drill mode can be selected by user for training. In conclusion, Table Tennis Trainer can enhance user table tennis skill by providing precise and accurate of ball shooting location.

ii

DEDICATION

I dedicate my dissertation work to my family and many friends. A special
feeling of gratitude to my loving parents, Mr. Maheswaren S/O Raju and Mrs. Emilie
D/O Selvarajoo.

I also dedicate this dissertation to my many friends and societies who have
supported me throughout the process. I will always appreciate all they have done,
especially Tanesh Nair, Vasantha Kumaran, Shanmugam, Raajapandian and Shatish
for the many hours of proofreading,

ACKNOWLEDGEMENT

First and foremost, I would like to express my sincere acknowledgement to my supervisor Mrs. Madiha Binti Zahari from the Electrical Engineering Department from Faculty of Technology Engineering, Universiti Teknikal Malaysia Melaka (UTeM) for her guidance, advices, valuable and constructive suggestions during the planning and development of this project. I would like to thank everyone who is involved in this project either directly or indirectly for their helps and co- operation, and also to my family. Without their support I would not have been able to finish my final year project. Finally I would like to thank the beginning teachers, mentor-teachers and administrators in our faculty that assisted me with this project. Their excitement and willingness to provide feedback made the completion of this research an enjoyable experience. Special thanks to Mrs. Saleha Binti Mohamad Saleh, Mrs. Siti Nur Suhaila Binti Mirin, Mr. Azhan Bin Abdul Raub, Mr. Mohamad Adli Bin Nut Jamudin, Mr. Muhammad Nurarif Bin Sapee, Mr. Basri Bin Bidin & Mr. Rohayat Bin Husin

TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

ITTF	-	International Table Tennis Federation
DC	-	Direct Current
3D	-	3 Dimensional
AC	-	Alternative Current
RPM	-	Rotation Per Minute
ABS	-	Acrylonitrile Butadiene Styrene
MYR	-	Malaysian Ringgit
PWM	-	Pulse Width Modulation
STL	-	Standard Tessellation Language
PCB	-	Printed Circuit Board
UV	-	Ultraviolet
AI	-	Artificial Intelligence

CHAPTER 1
INTRODUCTION

1.1   Project Background

Table tennis is an indoor sport and also known as commercial sports. In Malaysia sport sector, table tennis sport contributes a large number of achievements in world games by competing with other advanced country such as China, Germany, Japan and South Korea. There are several factors that affecting the performance the table tennis player. The duration of the training session and the quality of coaching have played an important role.   Most of the table tennis players, especially beginners, are faced with a problem with consistency of the shots.

Due to the sport sector demand, there is a need of having a robotic training partner to enhance the quality level of the competition. Based on the past research paper, the existing table tennis trainer in the market has not fulfilled the user's requirements. Some of the trainers which matched with the user's requirements, cost too high.

In this project, a table tennis trainer is developed which can be controlled by using Android system. The specification of the shots can be controlled by the user by customizing the setting of the trainer. Based on this project, the error of the shot is within the range of 5%.

1.2   Problem Statement

The table tennis coaching organisation should aim to get each table tennis player perform very well and maintain the consistent level in the tournament, so that it can develop a large number of the players to be good at competing with other advanced country in this sport.

Today the athletes are too busy with so many things that result a failure of attending the training session on time. So that, the current training system is less efficient in order to optimize the athlete's time and energy. If the training hours reduce, the performance of the athletes will drop which make the players less competitive. By contributing to a slow performance progress, it creates an unfavourable reputation table tennis sport.

Using a robotic table tennis training system which can be programmed to launch the ball with specific spins, players are able to complete their practice on time productively. Optimization of current training system is very important for the continued competitiveness of the sports sector. In this project, the alternative training system is analysed for the system's consistency.

1.3   Objective

Due to the problem statement above, it is cleared that the objectives of the project are:

i.   To design a table tennis launcher which able to affect the spin from a fixed position.

ii.   To develop a customizable training system by using Android Application.

iii.   To analyze the performance of the table tennis trainer.

1.4   Scopes of Work

The scopes of work for the project include the following areas:

i.   Launch the balls with only 4 types of spin such as top spin, back spin, side spin and no spin.

ii.   The position and rotation of the robot trainer are fixed.

iii.   The prototype is designed by using SolidWork 2015 Software for 3D printing.

iv.   6V Power supply is used to power up the controller and motors

v.   An Android application is developed by using MIT Application Inventor 2.0 Android developer.

CHAPTER 2
LITERATURE REVIEW

2.1   Introduction

This chapter includes the current knowledge and substantive findings as well as theories and information related to the scope of this table tennis trainer project. Besides that, theoretical and methodological contributions to the previous research on the table tennis trainer are reviewed. According to the project, ball launching system, ball recycling system and trainer controlling system are relate to this chapter.

2.2   Table Tennis Background

The first records in the sports formed in 1890's with a very first attempts to design an indoor tennis. The racket with a long handle and covered by a membranous layer was used to hit the ball which made up of cork and rubber. In 1920's, the table tennis sport gradually risen due to the development of a better quality ball that made up of synthetic plastic.

J. Jacques, Son, England and Parker Brothers, United States are major sports institutes who have organized the table tennis tournament successfully. In Europe, the table tennis game began to develop in the sport clubs. In 1927, a world championship was conducted for the very first time after the formation of a board for the table tennis sport which is International Table Tennis Federation.

4

In 1930's, a wooden racket covered with the rubber sheet was introduced and it contributes a great success to the growth of the table tennis sport. In the beginning stage, the player only able to hit the ball with the limited spins and some spin stroke methods were discovered [1].

2.2.1   Basic Equipment

2.2.1.1   Ball

The average mass of a table tennis ball is 2.7 gram and it is in spherical shape with a radius of 20 millimetre. According to the rule, the ball shall have a restitution coefficient of 0.89 to 0.92 which shows when a ball drop onto a standard steel surface from a height of 305 millimetre, the ball need to bounce up to an average height of 250 millimetre. The quality of the ball can be determined based on the number of the stars which means the higher number of stars the higher the quality. The example of table tennis ball with 3 stars is shown in Figure 2.1 [1][2].

Figure 2.1: Table Tennis Ball with 3 Stars

2.2.1.2 Table

The length and width of a table are 2.74 metre and 1.525 metre respectively. A dark non-reflecting green or blue with a 19.05 millimetre white border is shown in the Figure 2.2. The table produces a progression in the bouncing of a ball with a common ratio of 0.767 where the ball will bounce up to a height of 230 millimetre when it release from a height of 300 millimetre [1].


Figure 2.2: Dimensions of Table Tennis Table

2.2.1.3 Racket

It is known as a blade and for choosing it there are two options where choose based on the racket itself or its covering. The functions of the each type of blade are totally different from one another, such as the fast blade is normally used for the attacking style. The slower blade will be very useful for the defensive style.

There are three types of covering in for the blade surfaces. The first type is Inverted sponge where a sheet of pimpled rubber is inverted. Due to the stickiness of the sponge it helps for spinning of the ball, but causes a loss of control. Secondly Pips-out sponge is an ideal covering for smashing but not that effective for the spinning. The third

6

covering is the hard rubber covering which is not very effective at all. The types of the table tennis racket covering is shown in Figure 2.3 [2].
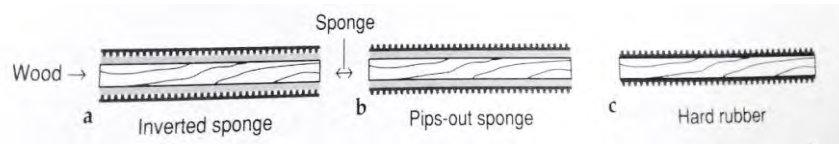

Figure 2.3: Covering of Table Tennis Racket

2.2.2 Method of Practice

Table tennis training methods can be classified into 5 methods where the first method is practicing with another player. This is a very common method and simplest method to allow the player to take a turn for the drills. The next method is practicing with a coach where this really helps a player to improve on the weak points but the player have to pay for a coach. The third method is practicing alone where the player can shadow stroke the various shots and techniques as well as practicing serves. Multi-ball is another method of practice for two players where one player practice, while another player feed the balls. This is a good way to learn more about the shots, but the disadvantage is only one player can practice at a time. The last method is the robotic trainer which is a continuous multi-ball feeder and the player can customize the setting of the launching [2].

2.3 Table Tennis Trainer

The design patent of Daley, W. as shown in Figure 2.4 covers the sides of the serve, repeated motion; all the combination of spin except cork spin, adjustable shot speed and recycling system. With the present of these features, the trainer can provide a challenging platform for training [3].

7
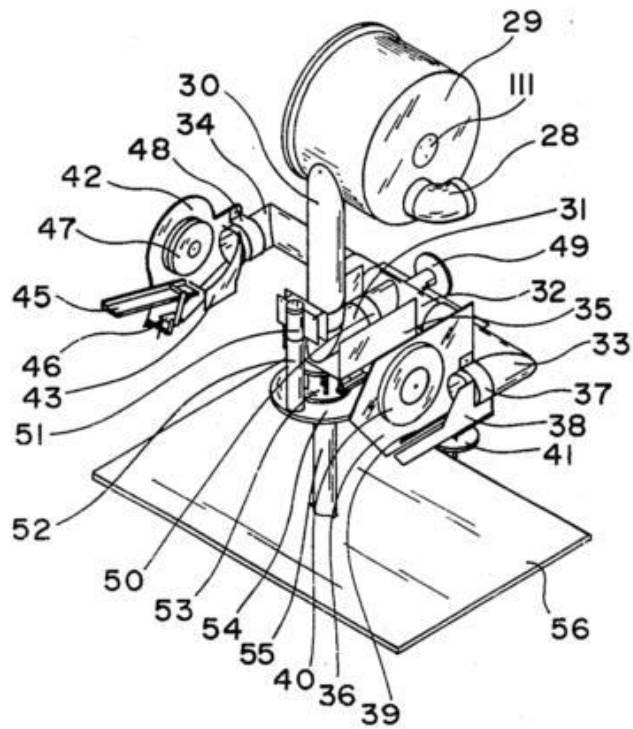
Figure 2.4: Design Patent of Daley, W

2.3.1   Launcher

In the current market, there are more than 10 commercialized table tennis launcher with various specification. This is because the desired target of the trainer for launching the ball to certain location need to be achieved [4]. Table 2.1 shows that the specification of the commercialized table tennis trainer.

Table 2.1: Features of Table Tennis Trainer

	Butterfly SmartPong	Killerspin Throw Robot	Newgy Robo 540	i-Pong Topspin	i-Pong Pro
Price	RM5405	RM2699	RM636	RM319	RM728
Wireless Controller	Yes		No		
Power Supply	AC adapter			9V battery	AC adapter
Recycling System	Yes		No		
Target Selection	-	-	18	-	3
Yaw Adjustment	Yes	No			
Spin Type	Yes	Top & Bottom Spin	Yes	Top Spin	Top & Bottom Spin
Variable Speed	Yes			No	
Pre-program drills	9 drills`	64 drills	No		
Frequency of the ball	Adjustable				
Programmable	No		No		
Performance Analysis	No				

2.3.1.1 Components

There are three types of launcher with different number of motors and the rollers. The first type of launcher is a single motor launcher which is a low cost trainer, but it gives a very limited spins [5]. The second type is a launcher with 2 motors controlling the side spins and no spin whereas the additional one more motor is used to manipulate the side spin of the launcher to the top spin and back spin [6]. The other type of launcher made up of 3 motors which is able control all the ball spin with rotating itself [7].

9

Based on a previous project, the miniature brush motor as shown in Figure 2.5 has been chosen for the launcher system. The reason for choosing that DC motor because of its high speed and low torque due to the light weight of the ball [8]. The nominal voltage supply of the motor is 3V DC. The speed and torque of the motor are 13,500 RPM and 1.37 mN.m respectively.

Figure 2.5: The Miniature Brush Motor

Based on other previous project, DC motor with the model number FK-130SH-17102 as shown in Figure 2.6 was used in the launcher. The value of the speed and torque of this motor is 6000 RPM and 0.95 mN.m respectively. The shooting wheel radius was about 18 mm [9]. The nominal voltage of the motor is 6V DC.

Figure 2.6: Motor model FK-130SH-17102

The other DC motor used in the previous project is a micro-metal gear motor. It is used to recycle the ball as well as control the frequency of the ball. This motor is a high torque, low speed motor

10