UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DEVELOPMENT OF SHUTTLECOCK LAUNCHER WITH DUAL MODE TRAJECTORY SYSTEM FOR BADMINTON TRAINING PURPOSE

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

by

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I hereby, declared this report entitled "Development of Shuttlecock Launcher with Dual Mode Trajectory System for Badminton Training Purpose" is the results of my own research except as cited in references.

Signature	:	**…….**
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Date	:	**19TH DECEMBER 2017**

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:

……

(MR. MOHAMAD HANIFF BIN HARUN)

ABSTRAK

Pembangunan pelancar bulu tangkis dengan sistem dwi cara untuk latihan badminton direka untuk membantu jurulatih dan pemain badminton untuk latihan mereka. Pelancar bulu tangkis dengan system dwi cara ini terbahagi kepada empat bahagian penting iaitu, pelancar, *feeder,* tapak pelancar dan juga sistem pengawal. Pelancar direka untuk melancarkan pelbagai trajektori antaranya ialah trajektori pukulan lob, trajektori pukulan pendek dan trajektori pukulan atas jaring. Manakala pula, *feeder* direka untuk menampung 10 bulu tangkis dan melancarkannya kebawah satu persatu dalam masa yang tertentu. Tapak pelancar pula direka untuk kestabilan apabila ia menampung pelancar dan juga *feeder.* Tambahan pula, tapak pelancar digunakan untuk mendongakkan tapak pelancar untuk mendapatkan darjah pukulan trajektori tertentu. Bagi sistem kawalan pula, kawalan mikro Arduino Uno digunakan. Ia berfungsi sebagai kawalan kepada motor A.T, kawalan motor elektrik *jack* kereta dan juga kawalan untuk pergerakan kekiri dan kekanan motor servo. Pengawal mikro Arduino Uno boleh diprogram menggunakan pengisian Arduino. Untuk bahagian akhir sekali, bahagian mekanikal dan bahagian pengisian program akan digabungkan sekali untuk membentuk pelancar bulu tangkis dengan dwi cara ini. Ia akan di uji terlebih dahulu trajektorinya untuk mengetahui tahap keberkesanan dan kecekapanya.

ABSTRACT

The shuttlecock launcher with dual mode system are designed for helping the coaches and the badminton players to train by them self. The shuttlecock auncher is divided into four major parts which is the launcher, the feeder, the stand and also the controller. As for the launcher it is designed to launch the shuttlecock with many kind of trajectory,which is the lob shot trajectory, short shots trajectory and also over the net trajectory. Menwhile the feeder is designed to deposite the shuttlecock one by one according to the time sequences and it can carry 10 shuttlecock in a time. The stand is designed to be stable for the launcher and the feeder to hold on. Moreover the stand also required to elevate the launcher so that the lob shot trajectory and short shots trajectory would be possible. Lastly, the controller Arduino Uno act as the brain for the shuttlecock launcher. It will control the speed of the Dc motor for the launcher , control the elevation of the electrical scissor car jack and also control the movement of the servo motor for left and right function. The arduino microcontroller will be programmed by using arduino software. Lastly, the mechanical part and the software will be combined together. Since the shuttlecock launcher is design for a few types of trajectory, it is crucial for the shuttlecock launcher to undergo several tests and investigate its reliability performance.

DEDICATION

To my beloved parents, Mr Mazlan Bin Abd Ghani and to my mother Norhayati Binti Noh, I acknowledge my sincere gratitude to them for their love, dream and sacrifice throughout my life. Their sacrifice had inspired me from the day I learned how to read and write until what I have become now. I never dream that I would go this far in life, their spirit and determination has inspire me to do so. I cannot find the appropriate words that could properly describe my appreciation for their devotion, support and faith in my ability to achieve my dreams

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LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

DC	-	Direct Current
PWM	-	Pulse Width Modulation
CPU	-	Central Processing Unit
RAM	-	Random Access Memory
ROM	-	Read Only Memory
PIC	-	Peripheral Integrated Circuit
SPI	-	Serial Protocols Interface
LED	-	Light Emitting Diode
USB	-	Personal Computer
ICSP	-	In-Circuit Serial Programming
AC	-	Alternate Current
RISC	-	Reduced Instruction Set Computing

CHAPTER 1
INTRODUCTION

1.0 Introduction

Badminton is one of the most famous sport in our country and our famous athlete such as Datuk Wira Lee Chong Wei has been holding the No 1 ranking in the World Badminton Federation (WBF). We can see that in every school, tertiary education facilities and also in every town there is at least one badminton court for our students to train our beloved sport, which is badminton. Badminton is played with two player for single and our player for double or double mix. But in this era of technology, we should have a device or machine to help our athlete to practice with intense training even though if there is only one player .So to counter this problem, my project focused on assisting badminton coaches and for badminton players for self -training. This shuttlecock launcher will have two mode of projection which is the automatic and manual trajectory. For the automatic projection system, the machine will set a few angles for the shuttlecock launcher to launch as if the user are playing with a real player. The second mode is the manual mode. As the name suggest, in this mode the user can manually set the trajectory angle for the shuttlecock launcher to launch according to its preference. There will be a few angle for the shuttlecock to launch so that the shuttlecock would project in *lob shots,short shots*, and also *over the net shots*. With this shuttlecock launcher with dual mode it would help the users which is the badminton player and coaches to reduce the cost, energy and other human error while practicing their strokes

1.1 Background

For coaches, to train the badminton athlete they will use a rather traditional or conventional way such as throwing the shuttlecock in targeted area in the court where they find it is the weakness of their athlete over and over again. As a human being, fatigue is the enemy in intense training for the coaches, throwing the shuttlecocks again and again in high speed will easily make the coach to felt tired over some time. By using this project, the shuttlecock launcher with dual trajectory system would help to solve the problem by constantly feed the shuttlecocks by using a feeder system and to launch the shuttlecock by using a launcher. The speed of the shuttlecock can be control by controlling the speed spin of the dual roller and the trajectory of the shuttlecock can be control by controlling the degree of launcher body. This control circuit will be using ARDUINO as its main control system and it is responsible for controlling the speed and the degree of the body so that it can project the shuttlecock similar to the intense training by human coach.

Finally, the hardware and software will be combined all together. By developing a control system, the shuttlecock launcher can be more user friendly interface, especially when doing the dual mode trajectory. Since it is designed for athletes and coaches, it will undergoes several experiments and tests for investigating reliability performance of the shuttlecock launcher because accuracy and precision are crucial for intense badminton training.

1.2 Problem Statement

The ability of a human trainer for badminton is limited due to many factors such as efficiency and consistency .this would affect the players to focus on certain angles of training. The available shuttlecock launcher in the market is expensive and are not suitable for the beginners to buy it. Moreover there are none shuttlecock launcher in the market with a dual mode in trajectory. To enhance the rate of intense training and reduce the complexity for the coaches to train, the advantages in human perception and recognition skills with consistent and accuracy of the machine are combined to make the most outcome in badminton training

1.3 Description of prototype

a) Shuttlecock feeder
   i. To store 10 or more shuttlecock in a container for the feeding process to the shuttlecock launcher..

b) Shuttlecock launcher
   i. A launcher that has two roller that are attach with a servo motor in high speed for trajectory purpose.

c) Control circuit
   i. This control circuit should be able to control the speed of the roller or trajectory and also to control the degree of elevation at the body. This is to ensure the lob, short and over the net trajectory is possible.

1.4 Objectives of Research

Shuttlecock launcher machine is still new in the market and are very expensive to buy especially for the beginners to train themselves. The available product in the market such as *knight trainer* and *Appolo trainer* that cost about RM 15000 and 17000

per unit . Moreover there is limited in trajectory for available product in the market. By developing this project, the cost will be cut down and functionality of the product should be increase. In this project, there are three objectives that need to be achieved. The objective of this project is:

a) To design a suitable shuttlecock launcher that can project *lob, short* and *over the net* shots.
b) To design a suitable To design a suitable design for the stand to withstand the elevation of the launcher and feeder for the shuttlecocks

c) To reduce costs of material and maintenance.

1.5 Scope of Research

A few guidelines are proposed to ensure that the project will achieve the objectives by narrowing the needs for this project. These are the scopes covered in this project:

a) To build the platform with trajectory angle by using stepper motor or servo motor

b) Design a circuit for the launcher motor.

c) Design a programming for the automatic mode using ARDUINO UNO

d) Build a shuttlecock holder or feeder that can withstand 10 shuttlecock with sequence.

1.6 Thesis Outline

The structure and layout of the thesis are as follow:

Chapter 1 – Introduction: This chapter briefly explains about the introduction which cover the objectives, scopes of the project and the problem statements.

Chapter 2 – Literature Review: This chapter will describe what shuttlecock launcher with dual mode trajectory system is and also what have been research and developed by the previous researchers. It also consists of the information which will be the parameter for the developing this project.

Chapter 3 – Methodology: This chapter explains about the methodology of this project, which describe details about the method used for developing this project and also approach taken in order to complete the project.

Chapter 4 – Project Development: For this chapter explaining about the shuttlecock launcher which the hardware parts and software will be highlighted.

Chapter 5 – Expectation Result: This chapter will consider about the expectation result of the shuttlecock launcher with dual mode trajectory system movement.

Chapter 6 – Conclusion and Recommendations: This chapter will conclude about the entire project and future expectations that can be done for the future project.

CHAPTER 2
LITERATURE REVIEW

2.0 Introduction

In this chapter we will discuss about the previous journal, article and other related information and explore option or ideas that are possible to build the shuttlecock launcher with dual mode. There is a few part that are crucial for the development of this project, which is the study about the flight trajectory of the shuttlecock, the launcher, the feeder, the controller and also the workspace. The main objective of this chapter is to obtain as much as possible ideas thru previous journals and article and give an overview to the readers of the source that have been explored.

2.1 Badminton Theory

Badminton is one of the most popular sports in the world and one of the most waited sports in Olympic. Badminton is played with two player for single games and four player for double and mix games. Racquet and shuttlecocks is the tools for playing badminton. This sport is considered popular because it need few aspects of tactical, technical skills, physical skills and psychological demands. During intense rally, heart rate can climb up quickly to 10% higher than the normal heart rate. This is what makes badminton is so interesting to play among peers (Lidija Petrinović Zekan, Dubravka Ciliga,2002) .

In international level, badminton players need to undergo extreme and intense training to develop their skills and their durability. Badminton players is tested with long hours of training and cardio exercise from their respected coaches. (MAZIN AHMAD, SARAHANG ABDULLAH ,2014).

2.1.1 The badminton Court Dimension

There are a few types of badminton court surface found which is, surface made out of wood, bituminous material, concrete and also carpet. According to the researcher (May kwan,2013), the layout for the badminton court should be in rectangle shape with 13.4m in length and 6.1 meter in width. Moreover, the post pole of the court must be 1.55m from the surface of the court and the net depth should be 0.76m and 6.1 m wide. The court should be 1.524m at the centre of the court and 1.55 m over the sides lines for double. White or yellow (for some cases) lines in the court should be in 0.04m wide. Figure 2.1 below shows the badminton court dimensions.

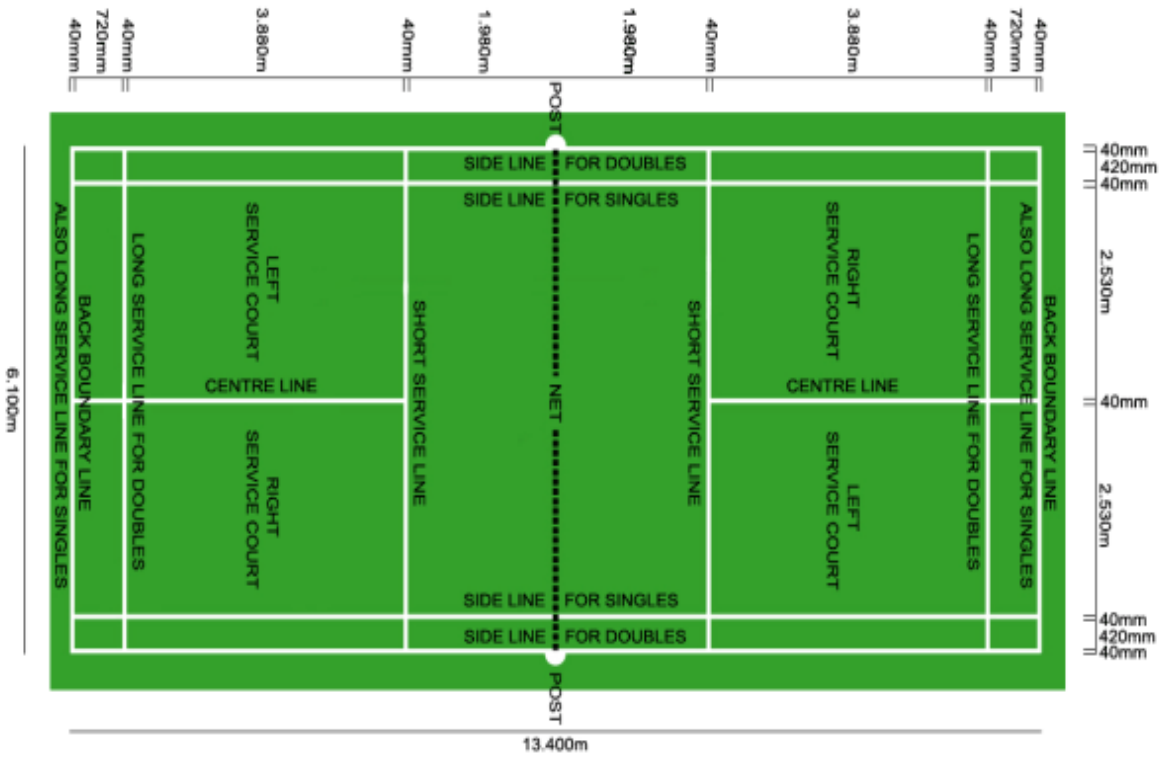

Figure 2.1 : Badminton Court Dimensions

2.1.2 Shuttlecock Dimensions

One of the centre piece of the badminton game is no doubt the shuttlecocks. Conventional shuttlecock are made out of 16 goose feathers that overlap each other to form a cylindrical and attach it to the round cork. Nowadays, there are synthetic rubber shuttlecock which are more durable than the conventional shuttlecock. Shuttlecock is divided by two parts, the skirts usually are made out of feathers and the cock tip. The dimension for a standard shuttlecock approved by badminton world federation (BWF) is 25mm in length for the cock tip, 65 mm diameter for the skirt and 85mm for its total length. Meanwhile the weight is about 5.2 grams. (f.alam,h Chowdhury, c.theppadungpon,h.moria and a.subic,2010).

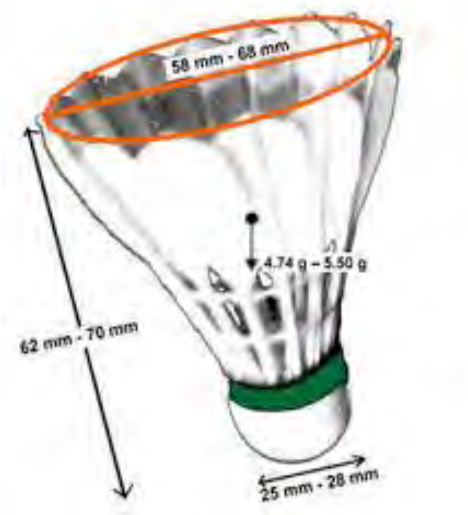

Figure 2.2 : The Shuttlecock Dimensions

2.1.3 **The Flight Trajectory for Shuttlecock**

In badminton game, there are a few shuttlecock trajectory that the players usually used which is the lob shot, over the net and also short shots. This different shots is differ according to the speed and also the angle of strokes of the shuttlecock. According to (Lung-Ming Chen, Yi-Hsiang Pan,and Yung-Jen Chen, 2009) the trajectory of the shuttlecock is affected by the amount of force applied and the angle of the strokes. Since badminton is a fast game to achieve the desirable trajectory of the shuttlecock, badminton player have to determine in a short period of time to control the force for the strokes and also the angle of the strokes.

The force applied for strokes affect the speed of the trajectory. According to the article, the average drop shot speed is about 22-29ms-1, the average speed for smash is 55-70ms-1, clear shots is about 42-51 ms-1.

2.2 The launcher

The launcher mechanism is the main part of this project. The launcher is where the shuttlecock ejected from the machine to targeted area or to do different types of trajectory the launcher determine the trajectory of the shuttlecock by manipulating the angle and also the speed of the machine. There are few types of launcher mechanism found in the market and there are few studies done by the researcher, which is the birdie launcher for shuttlecock, impact mechanism launcher, racquet swing launcher and also two roller type launcher.