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DESIGNING A DIGITAL-BASED INSTRUMENT OF FOREHAND SERVICE BALL PLACEMENT ACCURACY FOR TABLE TENNIS

Bafirman HB, Asep Sujana Wahyuri, Albetra
Faculty of Sport Science
Universitas Negeri Padang, Indonesia

ABSTRACTS

The application of technology in the world of sports is able to support athletes' efforts from an early age, so that achievements of athletes can be improved faster, and it will be more efficient. The aim of this research is to design a digital-based instrument of forehand service ball placement accuracy for table tennis. The traditional instrument of ball placement accuracy has several weaknesses, so athletes and coaches find it difficult to observe the accuracy of the ball carefully, and are impractical. This was a Research and Development (R&D) study which adopting 7 steps, namely: (1) potential and problems; (2) information collection; (3) product design; (4) design validation; (5) design improvements; (6) product testing, and (7) product revision. The product produced is a digital-based instrument of ball placement accuracy for table tennis by using an electrical circuit automatically arranged when the ball touches the instrument, producing an output data in the form of an automatic count in accordance with the number of balls that touch the tool. Results of output data will be displayed on the LCD display, so that users can immediately record the data when the ball touches the accuracy instrument.

Key words: Instrument, Forehand Service, Digital-based Instrument, Table Tennis

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1. INTRODUCTION

The development of technology has many benefits for human life, one of which is in the world of sports. The application of technology in the world of sports brings many benefits, among others to improve physical abilities, basic technical skills in sports, sports competitions and so on. Advances in technology can support athletes' efforts from an early age, achievements of athletes can be improved faster, and it will be more efficient. Athletes are able to prepare themselves early and be able to face various forms of competition challenges. Achieving a record in a sport is not merely born from human strength only, but also a record can be achieved by the use of technology.

In the game of table tennis, it does not only emphasize achievement but also physical education as a mediator to educate someone to become a table tennis athlete who later becomes an intelligent, skilled, honest and sportive person. In addition, through table tennis, it is expected that an athlete will grow and develop a spirit of competition, cooperation, social interaction and moral education. The achievement of a table tennis athlete is determined by several important factors, including athlete's nutritional intake, physical health, physical condition, technical skills, mental maturity, strategy and ability to adjust to environmental conditions.

In a table tennis match, there are various basic techniques; one of the techniques that must be mastered is the forehand service technique. Service is very decisive victory in every game because it acts as the first attack on every rally, aiming to harden opponents to return the ball. Forehand service is very easy to do by both novice and professional athletes. In order to determine the level of technical skill of the athlete, it can be measured by an instrument of ball accuracy test on a table tennis court (Rizka Putra, 2015; Santosa, 2016).

A service that is often and easily performed by an athlete by both beginners and professional athletes is the forehand service. To determine the level of technical skill of an athlete, it can be measured with an instrument of ball accuracy testing on a table tennis court (Suratmin, 2007). The accuracy of placing the ball is a very important element in table tennis (Atmaja & Tomoliyus, 2015). Accuracy is needed and can affect one's appearance both when attacking and defensing.

In table tennis matches, the accuracy of placing the ball is needed by all athletes in seeking victory with a variety of variations. Every athlete will try to hit the ball in a direction that is difficult for opponents to anticipate. Therefore, the accuracy of the ball is very important and determines the success of an athlete in obtaining a victory because accuracy is a matter of circumstances, exact nature, accuracy, and clarity (Sutarmin, 2007; Novitasari, 2017).

Based on the description above, the coach is very important to have data from the athlete's ability to place the ball on the table tennis court. On the other hand, recently, instruments to determine the accuracy of the ball are only made of thin plywood. It has several weaknesses, so that it is difficult for the coach to observe the accuracy of the ball carefully, and it is impractical. Therefore, it is necessary to develop a digital-based instrument of forehand service ball placement accuracy for table tennis. The urgency to develop a digital-based instrument of forehand service ball placement accuracy for table tennis is to assist the athletes to place the ball for forehand service training, and greatly assists the coach in improving the athlete's performance.

2. METHOD

This is the Research and Development (R&D) method because the final results of this study will produce the digital-based instrument of forehand service ball placement accuracy for table tennis. Sugiyono (2014) states that there are 10 research steps in R&D. This study only adopted 7 steps, namely: (1) Potential and Problems; (2) Information Collection; (3) Product Design; (4) Design Validation; (5) Design Improvements; (6) Product Testing, and (7) product revision. The seven steps adopted are as follows:

First, the development of the digital-based instrument of forehand service ball placement accuracy becomes a potential and a problem to do this research, and the development of forehand service ball placement accuracy prototype has a very important role for forehand service skills. Therefore, this research needs to be developed so that the creation of digital-

based instrument of forehand service ball placement accuracy, should be made efficiently with affordable costs.

Second, the process of gathering information is carried out factually in consultation with several people who have the ability in the field of table tennis in order to overcome problems in the training process. Information gathering is also obtained from various references. Researchers also consulted with mechanics experts about making this tool to collaborate in making products to be developed.

Third, the product design or development model produced is the creation of the digital-based instrument of forehand service ball placement accuracy that can help coaches and athletes in every training process. This tool will work automatically as a service training aid.

Fourth, design validation is a process to assess whether the product design is more effective or not. Validation is done by asking experts in this field of research various considerations to assess product design.

Fifth, after the product design is evaluated and analyzed by experts, various inputs and weaknesses of the design will be gathered. From this result, a number of changes will be made in order to make qualified instrument. If there is no revision, the researcher proceeds to the next step of the study.

Sixth, after the design improvement, product testing is carried out. Product trials are carried out several times in accordance with the needs of the analysis. This product testing is carried out to determine the character, pattern values, units, quantities, and working principles of the technology of table tennis forehand service accuracy. The performance of the real table tennis forehand service accuracy is measured based on the results of the forehand service performed.

Seventh, after re-testing the product, then it is evaluated and analyzed by experts. Various inputs and weaknesses of the design are gathered, and then some changes will be made to make this tool more qualified.

3. RESULTS AND DISCUSSION

3.1. Table Tennis

Table tennis is a no-age restrictions sport, ranging from children, adolescents, and adults even elderly can play and do this sport. Because table tennis can be used to maintain fitness and recreation (Mahendra, Nugroho,& Junaidi, 2012). Table tennis uses small ball done on the table. The ball is hit with a racket called a bet. Table tennis is played by two players facing each other (in the single category), and four people in the doubles or pairs category, requiring high concentration (Pujianto, 2015; Damiri, 2015; Damiri & Kusmaedi,1992).

Table tennis requires players to master the skill of ball controlling, serving, and defending. It is also an enjoyable sport.

1.Table tennis court

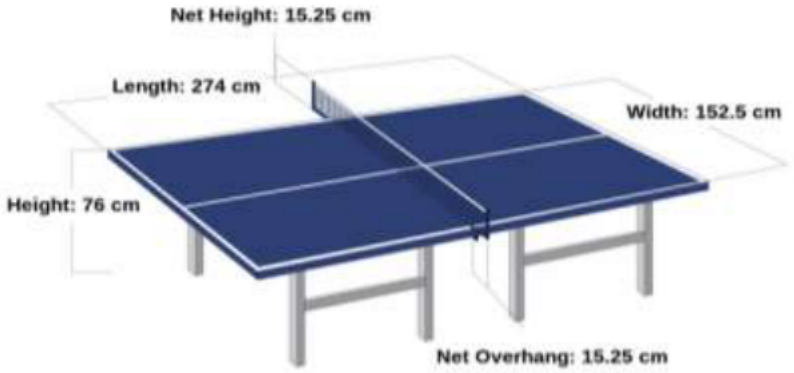

Figure 1. Table tennis court

Source:https://i11211501976.wordpress.com/gambar-peralatan-tenis-meja/

2.Size of a net in table tennis

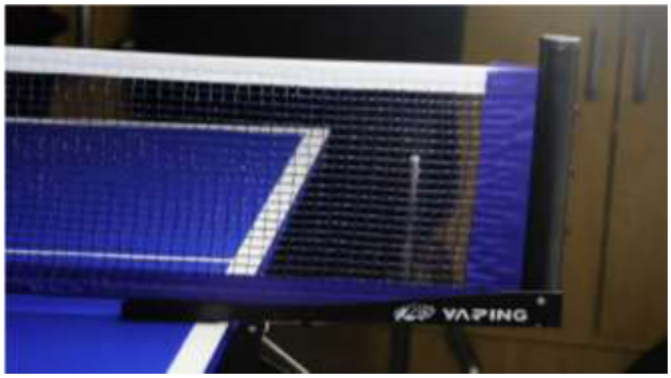

Figure 2. Size of a net

Source:https://i11211501976.wordpress.com/gambar-peralatan-tenis-meja/

The provisions on net size in table tennis are as follows. On the surface of the table, the sides are divided into two parts, where both parts have the same size, and the two parts are separated by a net with a boundary at the end of the table. The net is stretched with ropes that are attached to both sides of a supporting pole with a height of 15.25 cm. While the boundary side of the two supporting poles has a distance of 15.25 cm from the edge of the table surface. The length of the table tennis game from left to right must be 1.83 meters. The length of the net, from the top end to the surface of the table is 15.22 cm.

3.Ping-pong ball (ball for table tennis)

Figure 3. A Ping-pong ball

Source:https://i11211501976.wordpress.com/gambar-peralatan-tenis-meja/

A Ping- pong ball has a weight provision of 2.7 grams and a diameter of 40 mm. It ball is white or orange and is made from lightweight cellulose material. Its reflections must reach 23-26 cm in the first bounce when it is dropped. It usually has the stars mark from one to three stars that indicate its quality. Three stars show the best quality of ping-pong ball that can be used in official tournaments.

3. Table tennis bat (paddle)

Figure 4. Table tennis bat

Source: https://i11211501976.wordpress.com/gambar-peralatan-tenis-meja/

The size and weight of table tennis bat are not determined. The round of the racquet (blade) must be made of wood; the thickness is evenly distributed, stiff and flat. On each side of the surface must be set to have a dark gloomy color on all the top edges that are used as blade decoration rather than white or reflecting.

3.2. Forehand Service

Service is one of the basic techniques in sports games that aim to start the game and at the same time the first attack on the opponent (Suratmin, 2007, Permatasari, 2017). Several kinds of service techniques are found in table tennis games, namely: forehand service, back hand service, top-spin forehand service, top-spin back hand service, loop-spin service, cook service, and so on (Suratmin, 2007). Forehand service is one of the service techniques that are often used by athletes in the game, because it is easy to perform.

A player tries to place the ball on target with a fast ball speed, and out of the reach of opponents, making it difficult to return the ball (Sopiing, 2014). The accuracy of the ball service on a predetermined target makes the opponent run to hit the ball that is far from reach (open the side court), also used to complete a game (rally) or the so-called winning point, so as to produce a score (Nurhasan ,2015:2; Atmaja& Tomoliyus,2015).

3.3. Design of the Digital-Based Instrument of Forehand Service Ball Placement Accuracy for Table Tennis

The design of the digital-based instrument of forehand service ball placement accuracy for table tennis requires measurement and electronic components, such as Power Supply, Microcontroller ATmega328 and Arduino UnoRev 3, vibrating sensors, Interfacing and Display (LCD) circuits as digital readings to be assembled into the target board that is connected using a USB 3.0 cable, so that it produces the output data from the measurement results.

3.3.1. Power Supply

Power Supply is an electrical device that can provide electrical energy for electricity or other electronic devices. Basically, this Power Supply requires an electrical energy source and then convert it into electrical energy needed by other electronic devices. Therefore, Power Supply is sometimes also referred to as Electric Power Converter.

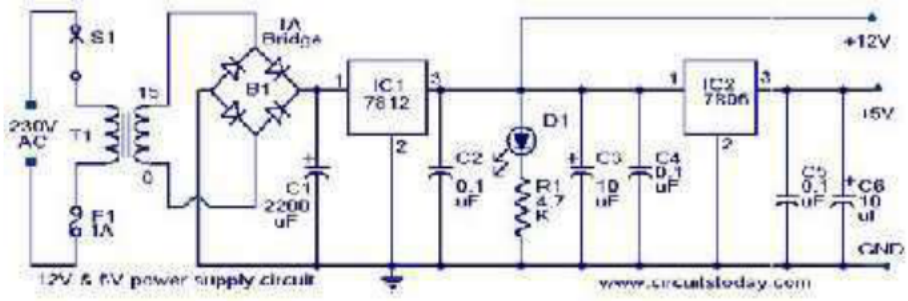

Figure 5. Power supply circuit

Source: https://www.google.com/search?q=rangkaian+power+supply&tbm

3.3.2. MicrocontrollerATmega328 dan ArduinoUnoRev 3

Saptaji (2015: 23) in Bahrin (2017: 284) states, "Arduino is an ATmega Microcontroller-based electronic board that meets the minimum microcontroller system so that it can work independently (Standalone Controller)". According to Feri Djuandi (2011: 8) in Bahrin (2017: 284), the main component in the Arduino board is an 8 Bit microcontroller with MerkATMega made by Atmel Corporation. Various Arduino boards use different Atmega types depending on the specifications, for example ArduinoUno uses Atmega328 while the more sophisticated ArduinoMega 2560 uses Atmega2560.

This research uses Microcontroller Arduino board type of ArduinoUno which uses Atmega328 Chip. Ahmad (2015: 11) states that Arduino board microcontroller is a module that uses the ATmega328 Microcontroller and uses a more sophisticated series, so it can be used to build a minimalist sized but reliable and fast electronic system. A variety of the latest modules and sensors can be installed on this board equipped with various demo codes.

Table 1. Arduino Specification

Microkontroller	ATMega328P
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limits)	6-20V
Digital I/O pins	14 (of which 6 provide PWM output
Analog Input Pins	6
DC current per I/O pin	40 mA
DC Current por 3.3V pin	50 Ma
Flash Memory	16 KB (Atmega168) or 32 KB (Atmega 328) of which 2 KB used by bootloader
SRAM	1 KB (Atmega 168) or 2 KB (ATMega328P)
EEPROM	512 bytes (ATMega328P)
Clock Speed	16 HZ

Source : Ahmad, et.al (2015:11)

Furthermore, Bahrin (2017: 284) states that there are parts on the Arduino Uno board, among others, as shown in Figure 6.

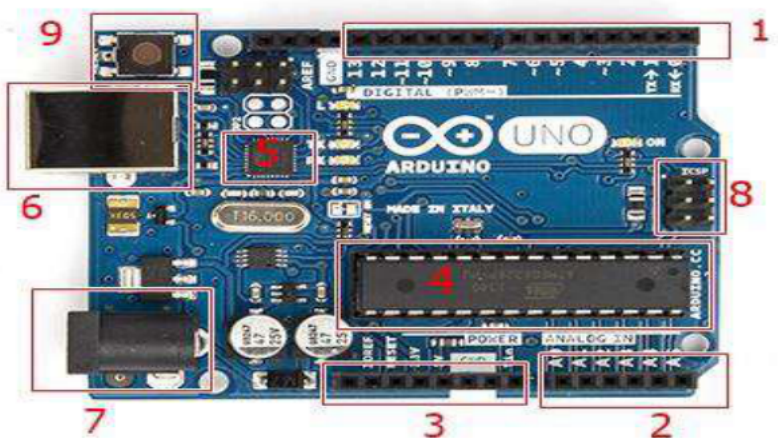

Figure 6. Parts of *ArduinoUno (*Bahrin (2017)

ArduinoUno device has; (1) Digital Input / Output Pins (Labeled 0 to 13). In general, this Pin I / O is a digital Pin that works at digital voltage levels (0V to 5V) for both input and output. (2) Analog Input Pin (labeled A0 to A5), accept Analog Input voltages between 0V to 5V, these voltages will be represented as numbers 0 - 1023 in the program. (3) Pins for voltage sources, this group of pins is a collection of pins related to the power source, for example Output 5V, Output 3.3V, GND (2 Pins) and Vref (voltage reference for internal ADC reading). (4) ICATMega328, act as a data processing control center. (5) ICATMega16U, this IC is programmed to handle data communication with PC via USB Port. (6) USB jack, a type B USB socket as a serial data connector with a PC. (7) Power Jack, a socket for external power supplies between 9V to 12V DC. (8) ICSP (In-Circuit Serial Programing) Port, used to program Arduino without Bootloader, and (9) Reset Button, used to Reset the Arduino Microcontroller board to start the program from the beginning.

3.4. Vibrating Censor

The ArduinoUno device has a vibrating sensor that functions to detect the vibrations that will be converted into electrical signals. This sensor is also called cassing measurement. In the vibration sensor there is a acceleratorometer that is very sensitive can be made into a component in the device that we want, the vibration impulse is transmitted and then received back by the Receiver. This sensor is suitable for electronic applications that require detection of a vibration impulse including sensors for robots.

Vibration sensor module is a product from Devantech. Vibration sensor has become an absolute device used in Robotics and Aeronautics applications. Vibration sensor basically functions to receive vibration stimulation that touches the location of the sensor installation.

Figure 7. Vibrating Censor

Source:https://www.google.com/search?ei=30bkXMn6Jarn_QbB6LyoAQ&q=sensor+getar

3.4.1. LCD (Liquid Crystal Display)

Electronic display is one of the electronic components that functions as a display of data (characters, letters or graphics). According to Priscilla et al (2017: 58) "LCD has the ability to display numbers, letters of the alphabet, words and symbols". LCD (Liquid Cristal Display) is one type of electronic display made with CMOS Logic technology that works by not producing light but reflecting the surrounding light to the Front-Lit or transmitting light from Back-Lit. It also functions as a data viewer in the form of characters, letters, numbers or graphics.

LCD is a layer of organic mixture between a layer of clear glass with indium oxide transparent electrodes in the form of a Seven segment display and Electrode layer on the rear glass. When the electrode is activated by an electric field (voltage), long, cylindrical organic molecules adjust to the electrodes of the segment. The Sandwich layer has a front Vertical light Polarizer and a rear Horizontal Light Polarizer which is followed by a Reflector layer. The reflected light cannot pass through the molecules that have adjusted and the activated segment appears to darken and form the character of the data to be displayed.

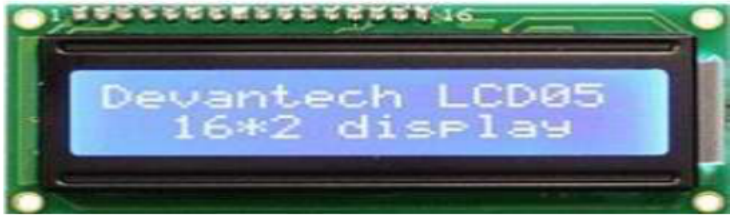

Figure 8 *LCD*

Source:https://www.google.com/search?ei=WEnkXKyjCe2v_Qa6va3YAw&q=lcd+devantec

The design of the digital-based instrument of forehand service ball placement accuracy for table tennis prevents errors when recording the results.

Gambar 9 Alat akurasi bola pada lapangan tenis meja

4. CONCLUSION

The product is the digital-based instrument of forehand service ball placement accuracy for table tennis using a circuit that is automatically arranged when the ball touches the tool, producing an output data in the form of an automatic count according to the number of balls that touch the tool. Output data results will be displayed on the LCD Display layer, so that subjects who measure can immediately record data in the form of the results of each ball touching the unified accuracy tool.

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