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Automation system of table tennis ball throwing machine employing arduino microcontroller

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ABSTRACT

Table tennis is one sport that necessitates the usage of automation technologies. A microcontroller running Arduino programming software serves as the foundation for this table tennis ball tossing apparatus. A straightforward tool that helps coaches and athletes be more efficient. A different tool design model is what the author desires. Equipment for tossing table tennis balls is still quite hard to come by in Sumatra, particularly in the West. The created tool is utilized in the training procedure for tennis balls. In West Sumatra, tennis instruction is typically conducted by hand. Athletes can move by throwing the ball one at a time. It is less efficient to do this. Coaches and sportsmen may find it more convenient if table tennis ball throwing equipment are automated. This instrument takes the shape of a ball that can be controlled with a Bluetooth switch. Training for table tennis is no longer done by hand thanks to this tool.

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1. INTRODUCTION

Currently, the advancement of science and technology has developed rapidly, so that it requires everyone to adapt to technology for work efficiency and effectiveness. One form of popular technology is automation technology. Automation is a technology related to mechanical, electronic, and computer applications based on systems to operate and control production [1]. Several machines around us have used many automation systems. However, in the world of sports, not all automation technologies are applied in daily sports activities. One sport that requires the use of automation technology is table tennis [2]-[3].

The author wants to develop a simple tool design model that provides convenience and efficiency for athletes and coaches with the help of a microcontroller-based table tennis ball launcher using Arduino programming software to hone their abilities in playing table tennis. This simple tool is to hone the ability of various table tennis techniques such as block techniques, push strokes, drive strokes, flick strokes, and other techniques. This table tennis ball launcher is only a small part, hopefully it can help during practice. With the advancement of sports technology, hopefully the development of sports in Indonesia will be more advanced and successful, especially in the sport of table tennis[4]-[6].

Table tennis ball launcher is a tool used to help the tennis training process made from a series of electronic devices and irons assembled into a tool that has been designed. Table tennis ball launchers themselves are still very difficult to find in the Sumatra area, especially in West Sumatra. Tennis training in West Sumatra usually uses a manual system, namely by hitting the ball one by one, making it troublesome and difficult to evaluate the athlete's movements [7]. This is less effective to do during training and is a waste of time if there are many athletes who will be trained at the same time without additional tools in training. Thus, the ball launcher is believed to be able to overcome this problem [8].The automation applied to the tool can provide convenience for coaches and athletes in carrying out the training process [9]. This is because there is a system that works automatically, namely in the form of ball control that can be accessed wirelessly

using a Bluetooth switch so that the launcher can be controlled by the coach via a smartphone or gadget connected to Bluetooth from the tool. with this improvement, the coach can provide athlete skills in hitting the ball [10]. With this tool, it is hoped that the table tennis training process will no longer be done manually and will provide convenience and efficiency for athletes and coaches.

2. METHOD

The design of a table tennis ball launcher uses hardware and software to support the formation of the desired tool, namely: Power Supply, Arduino Mega 2560, DC Motor, L298N Motor Driver, HC-05 Bluetooth Module and Liquid Crystal Display (LCD) with Arduino IDE and Blue-Droid software. Figure 1 shows the block diagram of the proposed system.

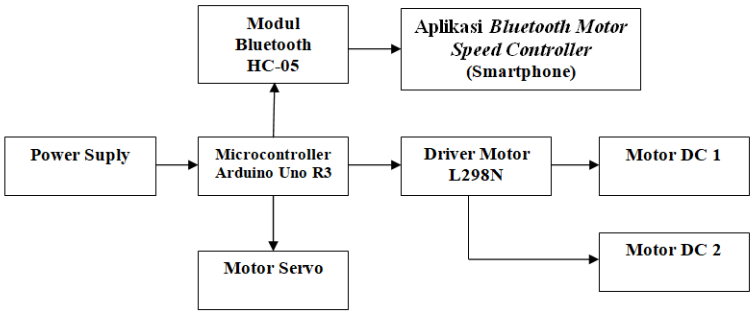

Figure 1. Block diagram of the proposed system

The working principle of this table tennis ball launcher is when the device is connected to a power source and the switch is pressed so that it shows the on position, the device will be active and in standby condition. Then the device will be connected to the Bluetooth of the Smartphone that we have via the Bluetooth Motor Speed Controller application [11]. After the device is connected to Bluetooth, we can choose the training mode that we will use. There are three modes provided, namely: easy, medium, and hard modes. After the desired mode is selected, the DC motor in the ball reservoir will be active, and the ball will fall from the casing and be thrown by the DC motor which functions as a launcher. When the device is finished being used, the user can stop the device by deactivating Bluetooth on the smartphone and pressing the power button and unplugging the power cord from the socket [12].

To start running the tool we must first turn on the tool, then open the Bluetooth Motor Speed Controller application on our Smartphone, Connect the HC-05 with the Android that we have, if it is connected, then we can select the tennis ball throwing mode that we want, then the motor will turn on and the ball will be thrown, then we can start training [11]-[14]. Figure 2 below is a design of the table tennis ball throwing tool that we will make. This tool uses 2 DC motors that function as ball selectors and ball throwers. 1 servo motor functions as a ball throw direction controller.

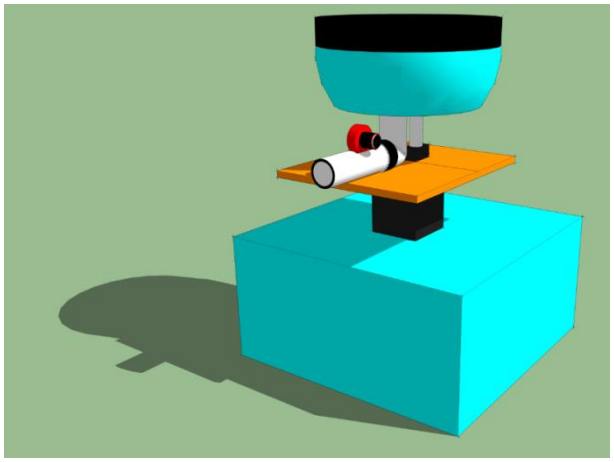

Figure 2. Design of table tennis ball throwing machine

Figure 3 shows the flowchart of proposed table tennis ball throwing machine

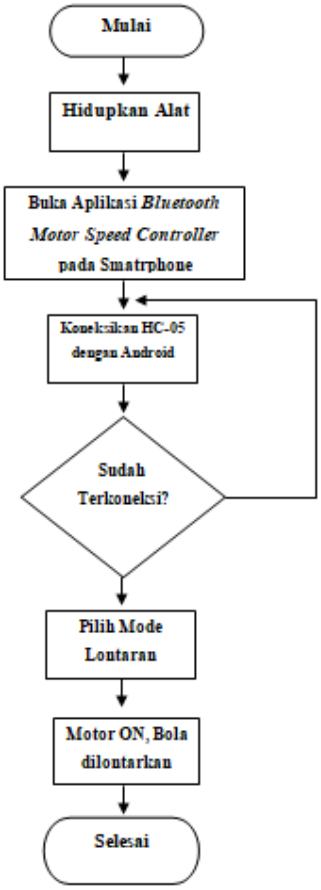

Figure 3. Flowchart of of table tennis ball throwing machine

3. RESULTS AND DISCUSSION

Tool testing is done to determine the performance of the tool made whether it has functioned as desired. In making this tool, the speed of the tool can be set by the (user) himself. The first test was conducted to see the performance of the DC motor. Table 1 describes the results of the DC motor test.

Table 1. DC motor testing on microcontroller-based table tennis ball thrower

Testing	Duty cycle	Motor speed (%)	Level speed
1	10	3,92	OFF
2	25	9,80	OFF
3	50	19,61	Slow
4	75	29,41	Slow
5	100	39,22	Slow
6	125	49,02	Medium
7	150	58,82	Medium
8	175	68,63	Medium
9	200	78,43	Fast
10	225	88,24	Fast
11	250	98,04	Fast

Based on the table above, it can be explained that the motor PWM value affects the motor rotation speed. The higher the PWM value, the higher the Motor Speed Percentage (RPM) value will be. Based on the PWM experiment from 0% -10% the motor will remain in OFF condition, the experimental value from 11% - 100% the motor will be ON with a speed based on the PWM input given. Next, the servo motor performance test was carried out, as described in Table 2.

Table 2. Servo motor testing on microcontroller-based table tennis ball thrower

Test	Direction of servomotor	Firing Angle	(On/Off)
1	Clock Wise	30^{O} CW	ON
2	Counter Clock Wise	30^{O} CCW	ON
3	Clock Wise	30^{O} CW	ON
4	Counter Clock Wise	30^{O} CCW	ON
5	Clock Wise	30^{O} CW	ON
5	Counter Clock Wise	30^{O} CCW	ON
7	Clock Wise	30^{O} CW	ON
8	Counter Clock Wise	30^{O} CCW	ON
9	Clock Wise	30^{O} CW	ON
10	Counter Clock Wise	30^{O} CCW	ON

Based on the table above, it can be explained that there are two directions of rotation of the servo motor, namely Clock Wise (Clockwise / Right) and Counter Clock Wise (Counterclockwise / Left). The servo motor will always rotate 300 CW and 300 CCW alternately and continuously. Next, testing of the entire tool was carried out. The test results are described in Table 3.

Table 3. Testing of bluetooth motor speed controller and LCD applications

Testing	Speed input (%)	Level speed	LCD Display
1	0%	*OFF*	" Speed Motor Lontar : 0% "
2	10%	*OFF*	" Speed Motor Lontar : 10% "
3	15%	*OFF*	" Speed Motor Lontar : 15% "
4	20%	*Slow*	" Speed Motor Lontar : 20% "
5	25%	*Slow*	" Speed Motor Lontar : 25% "
6	30%	*Slow*	" Speed Motor Lontar : 30% "
7	35%	*Slow*	" Speed Motor Lontar : 35% "
8	40%	*Slow*	" Speed Motor Lontar : 40% "
9	50%	*Medium*	" Speed Motor Lontar : 50% "
10	55%	*Medium*	" Speed Motor Lontar : 55% "
11	60%	*Medium*	" Speed Motor Lontar : 60% "
12	70%	*Medium*	" Speed Motor Lontar : 70% "
13	75%	*Fast*	" Speed Motor Lontar : 75% "
14	80%	*Fast*	" Speed Motor Lontar : 80% "
15	85%	*Fast*	" Speed Motor Lontar : 85% "
16	90%	*Fast*	" Speed Motor Lontar : 90% "
17	95%	*Fast*	" Speed Motor Lontar : 95% "
18	100%	*Fast*	" Speed Motor Lontar : 100% "

4. CONCLUSION

Based on the data that has been studied from the results of field trials and discussion of research results, it can be concluded that, producing a final product in the form of a Table Tennis Ball Thrower using a Microcontroller, the tool can help coaches, individuals, and athletes in gaining efficiency in practicing Table Tennis independently. In the experiments conducted, the tool that was made has worked according to the system that was made. The tool can throw table tennis balls using a Bluetooth Smartphone connection with a Microcontroller. The speed control system on the tool can be adjusted according to the needs of each user. The speed of the table tennis ball thrower can be adjusted from 0% to 100% with 3 conditions, namely Slow, Medium and Fast

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