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Design An Automatic Shuttlecock Output Device Using An Arduino Based Servo Motor

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ABSTRACT

Badminton is a sport that uses a racket tool as a bat and shuttlecock as a bat and the slop itself is a container for placing a shuttlecock with a length of 37 cm. Badminton is a sport that the majority of many enthusiasts. And began to emerge associations of badminton players who were then trained by coaches to then make a profession or their own expertise. In general, shuttlecocks are removed manually and do not know whether the contents of the slop are exhausted or still filled. Therefore, automatic shuttlecock storage devices can make it easier for coaches to provide training to students who are in the association of badminton players. This tool can store shuttlecocks and remove shuttlecocks automatically which are stored in a dislop containing 12 seeds, the microcontroller used is Arduino Uno, the servo motor is used to remove the shuttlecock that has a dislop and if the shuttlecock is not filled then the Servo Motor does not run or open to remove the shuttlecock so that the slop must be replenished, then the HC-SR04 Sensor above the slop functions as a device that detects whether the shuttlecock is still there, then there is the ISD1820 Sensor which functions as an alarm to notify by voice that the shuttlecock is up and time to refill, then a tripod as the foundation for this automatic shuttlecock storage device. The result of this research test is that 12 shuttlecock seeds were successful. In this case, it is hoped that this research can help and facilitate coaches in training in a badminton player association on a large scale as well as efficiently knowing the exhaustion of shuttlecocks.

Keywords: shuttlecock,Arduino Uno,Motor Servo,HC-SR04,ISD1820

INTRODUCTION

Badminton or badminton is one type of achievement sport that is very famous throughout the world and games that have high-intensity activities and include fast-moving games. Badminton is an individual game that can be done by one-on-one or two-on-two people. This game uses rackets as bats and shuttlecocks as hitting objects(Nugroho & Indonesia, 2023). the playing field is rectangular and limited by a net to separate between the game areas (Indahningrum et al., 2020).

Practice of repeating movements and punching skills through drilling training methods can increase strength and affect smash speed (Agustan, 2021). Exercises involving aspects of changing the direction of motion suddenly such as shadow exercises can improve agility and coordination of motion Repetition training methods such as shadow exercises, drilling and strokes can improve movement coordination, speed and muscular endurance (Pamungkas, K.A.A., Indarto 2021). The prototype of the automatic shuttlecock output system based on Arduino Uno is to help trainers to store shuttlecocks used for drilling, where the tool still uses manual while the method still takes time to replenish. Seeing such conditions, this study designed how to remove the shuttlecock automatically. To support the automatic shuttlecock output system, an Arduino Uno mictocontroller is needed as a controller(Michael & Gustina, 2019).

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and a servo motor to remove the shuttlecock will come out, while for the HC-SR04 Sensor as a tool that detects the shuttlecock whether it is still there or has run out. Then there is the ISD1820 Sensor which functions as an alarm to notify by voice that the shuttlecock is up and time to recharge. Results for testing shuttlecocks that exit with a delay of 3 seconds. The way this tool works is to find out when the trainer is for the contents of the shuttlecock and help to remove the shuttlecock (Wahyono et al., 2021). With the prototype of the automatic output system as a fitness facility, it is hoped that the coach will find it easier to find out the shuttlecock has run out and shorten the time because training a badminton player association is not only 1 person, therefore this tool is made.

LITERATURE REVIEW

In research conducted by Ummul Khair, namely making an automatic cat feeding device based on Arduino Uno at a pet shop. This tool was created because of the negative impact on the health and mental health of the pet in this case is a cat because employees only feed but do not provide the right dose of food for the pet. For this reason, an automatic feeding device is needed that contains a weight sensor (loadsell) that has the ability to detect how much food weight will be removed from the tube, as well as RTC as an input for cat feeding time. So that cats can eat on time and according to the dose and are equipped with a buzzer to function as a mealtime alarm through the buzzer sound (Khair & Sabrina, 2019). Research conducted by Adtiya Manggala Putra who explained about automatic fish feeding tools. Feeding is carried out according to a predetermined time and this tool also provides fish feed according to the weight of fish contained in the test pond, making it easier for fish farmers in fish farming. The tool used to weigh the weight of fish feed that will be spilled into the trial pond is (loadsell). Servo motor as an accumulator to open and close gaps in the weighing container or into the pool (Putra & Pulungan, 2020).

In research conducted by Wirna Sari, she designed an infrared thermometer system and automatic hand sanitizer to break the chain of spread of COVID-19. The working principle of this tool is based on sensing infrared radiation emitted by the MLX90614 sensor while the workings of this tool are from the HC-SR04 Sensor and Servo Motor. The infrared thermometer works automatically able to accurately read the human body temperature which is 2 cm to 10 cm away and the measured temperature will be recorded on the LCD in real-time and if the body temperature is above 38 ° C, the buzzer will sound as a warning sign of the person in a state indicated by covid-19 then the handsinitizer automatically releases antiseptic liquid when the palm is detected by the sensor with a distance of 5 cm to 15 cm(Nasution & Rasyid, 2021). Research conducted by Fadhilla Asmana which discusses the design and build of a prototype of an IoT-based automatic shrimp feeding system. This design aims to relieve farmers of their special ponds in vaname shrimp farming. This study aims to spread feed evenly with a throw distance of 1 meter and regular and timely feeding, which is 3 times a day and there is a measure of the weight of feed available in containers. The servo motor serves as a stocking of vaname shrimp feed(Teknologi & Instrumentasi, 2022). In research conducted by Anisa Muhaimin who discussed the Prototype of the Cage Door Security System and Automatic Quail Feeding Based on Microcontrollers This research aims to build a system that can maintain cage safety, provide quail feed automatically and weigh feed weights according to quail needs based on quail feeding times per day. As well as providing limited access through fingerprints that function to open the cage door and if not then the door will close and provide SW-420 as a vibration detector if the door is damaged which sounds the bizzer as an alarm. As well as servo motors are used to dispense food that has been weighed(Muhaimin & Hersyah, 2022).

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METHOD

In this study developing research from automatic fish feed, this study designed a tool that will be applied to the shuttlecock. The input and oputput components in this tool use the HC-SR04 Sensor as input, while the output uses an ISD1820 Sensor and a Servo Motor, for the mictrocontroller used in this study is the Arduino uno microcontroller. The HC-SR04 sensor serves to detect an object where in this study it was used to count the shuttlecock in the slop, if the shuttlecock is indicated to run out, the sensor will send a signal for the ISD1820 Sensor to light up. To use this tool again, fill the shuttlecock into the slop and the HC-SR04 sensor will automatically detect so that the ISD1820 Sensor will turn off (Kurniawan & Surahman, 2021).

System Design

The design of this tool is divided into 3 designing systems. The first of the system design processes involves software design starting with a list of components and wiring, which outlines the components used in the system and connects the data pins used. The second design is a block diagram, covering the working system and how the systems relate to each other. The third design is the creation of a flowcart, which aims to find out more about the workflow of the work system from beginning to end in more detail.

Wiring Design

From figure 2 it can be explained that the design of the wiring software can be seen in the picture below. From the picture, all components are already in a state of being connected and connected. Servo Motor, HC-SR04 Sensor and ISD1820 Sensor are interconnected with Arduino Uno microcontroller.

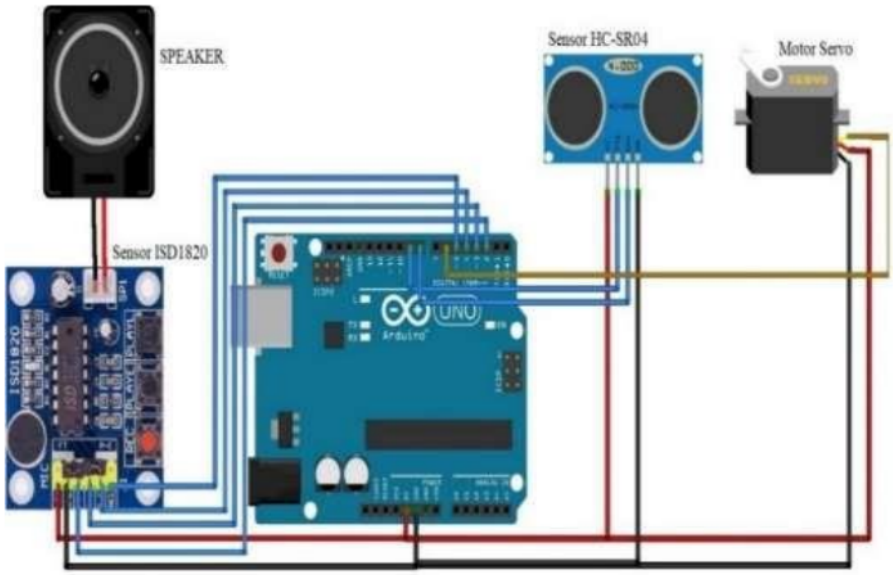

Fig. 1 Wiring Design

(source: researcher property)

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Table 1
Arduino Uno Port Usage

NO	Arduino port	Usage
1	IO 2	FT (ISD 1820)
2	IO 3	P-L (ISD 1820)
3	IO 4	P-E (ISD 1820)
4	IO 5	REC (ISD 1820)
5	IO 6	PWM (Servo)
6	IO 8	ECHO (HC-SR04)
7	IO 9	TRIG (HC-SR04)
8	Speaker Positif	SP+ (ISD 1820)
9	Speaker Negatif	SP - (ISD 1820)
10	Vin	VCC (ISD 1820)
11	Vin	VCC (HC-SR04)
12	Vin	VCC (Servo)
13	GND	GND (ISD 1820)
14	GND	VCC (HC-SR04)
15	GND	GND (Servo)

Table 1 shows cable connections or pin connections of Arduino Uno microcontroller, Servo Motor, ISD1820 Sensor, HC-SR04 Sensor. On the ISD1820 Sensor the + line is connected to Vin then – connected to the GND of the Arduino uno, while the FT on the ISD1820 Sensor is connected to IO 2 on the Arduino Uno, while the P-L on the ISD1820 Sensor is connected to IO 3, while the P-E on the ISD1820 Sensor is connected to IO 4 on the Arduino Uno, while the REC on the ISD1820 Sensor is connected to IO 5 on the Arduino Uno. The HC-SR04 Sensor component of the + line is connected to the Arduino Uno Vin and the – line is connected to the GND of the Arduino uno, while the ECHO on the HC-SR04 Sensor is connected to the IO 8 of the Arduino Uno, while the TRIG on the HC-SR04 Sensor is connected to the IO 9 of the Arduino Uno. On the + line servo motor is connected to the Vin Arduino Uno and the line – The servo motor is connected to the GND Arduino Uno. Then for the PWM pin line the Servo Motor is connected to pin 6.

Block Diagram

The system diagram block can be seen in Figure 2

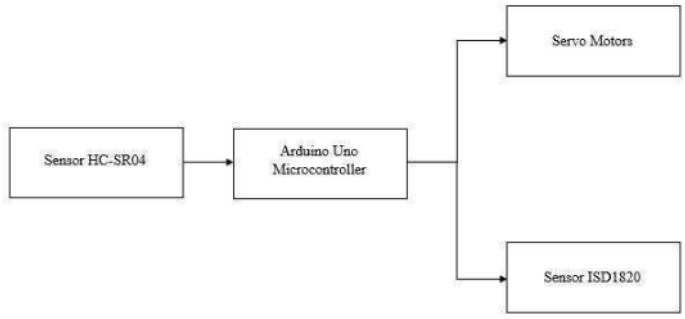

Fig. 2 System Block Diagram

(source: researcher property)

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From figure 2 it can be explained that the hardware consists of 4 parts starting from the HC-SR04 Sensor. Then connected to the vcc and gnd pins on the Arduino uno, after the microcontroller is supplied, it is connected to the ISD1820 Sensor and servo motor to supply the 2 modules. Don't forget to embed the data and then connect all the wiring to completion.

System Flowchart

From figure 3 it can be explained. Starting with the HC-SR04 Sensor and ISD1820 Sensor to Arduino Uno.then the HC-SR04 Sensor will detect the presence of shuttlecocks which are then processed. Otherwise, it will process to the ISD1820 sensor which tells that the shuttlecock is less than 12 seeds. If it is recharged, the next process is the Servo Motor that runs to remove the shuttlecock which is set to delay for 3 seconds. Then it's done.

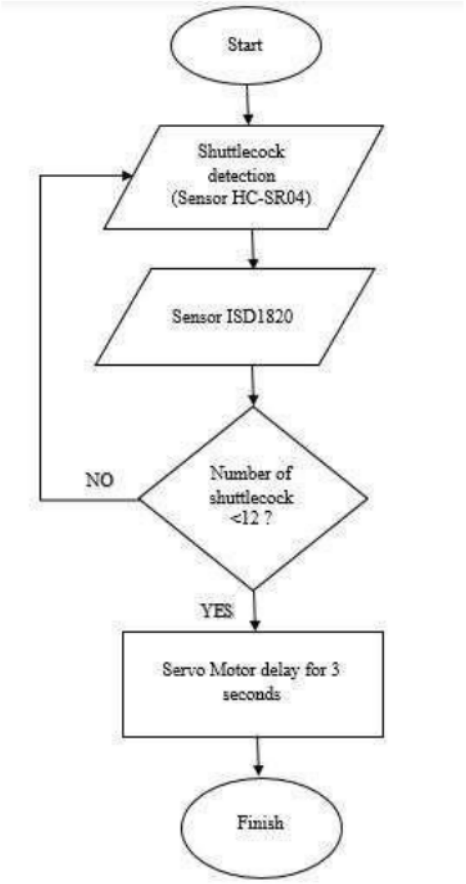

Fig. 3 Master Flowchart Program

(source: researcher property)

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RESULT

From figure 4 it can be explained. that the results of the realization of such tools are. In figure 5 is the result of the realization of the tool. The components of the tool will be described by numbering as follows: 1. 5 volt DC power supply, 2. Testing on Arduino uno microcontroller as data communication, 3. Servo Motor Testing, 4. HC-SR04 Sensor Testing, 5. ISD1820 Sensor Testing.

Fig. 4 Result of tool realization
(source: researcher property)

How to use this tool is as follows:
1. Connect to a power source using a 5 volt DC adapter.
2. Open the slop cover then insert the shuttlecock into the slop
3. Adjust the desired tripod height, then wait for the servo motor to run and it will remove the shuttlecock.

Power Supply 5 Volt Testing

Table 2 shows 5 5 5 volt step down tests with a multitester. In this test, a deviation of 0.0 and accuracy of 100% was obtained, so it can be concluded that the voltage used by 5 volts in this tool is accurate. This 5 volt voltage will be used for the power supply of the output control circuit (Kaleybar et al., 2020)

Table 2. 5 Power Supply Testing

Testing to -	Voltage needed (V)	Multimeter (V)	Deviation (V)	Accuracy (%)
1 st Test	5	5	0	100
2 st Test	5	5	0	100
3 st Test	5	5	0	100
4 st Test	5	5	0	100
5 st Test	5	5	0	10

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Arduino Uno Microcontroller Component Testing

Table 3 shows 3 tests with component connections, namely connections on Servo Motors, ISD1820 Sensor connections and HC-SR04 Sensors used to determine whether they function without problems (Suprianto et al., 2019)

Table 3. Arduino Uno Microcontroller Testing

Testing To Arduino Uno	Connected Components	Condition	Accuracy
1st Test	Motor Servo	Connected	good
2nd Test	Sensor HC-SR04	Connected	good
3rd Test	Sensor ISD1820	Connected	good

Motor Servo Mg90s Testing

Table 4 shows that servo motor testing itself aims to regulate the time to be used at the time of the predetermined inspection. Testing servo motors with degree experiments that are equal to 60° so as to make 5 experiments. Why test time more in shuttlecock storage research because what is used for research is that this tool uses time focus as an influence to eject the shuttlecock. Testing starts from 3 – 10 times. If at the time the time of the command, the time will come out the same as the ordered, it can be said to be successful. For research, this tool used 3 seconds to remove the shuttlecock from the slop(Lonteng et al., 2020)

Table 4. Mg90s Servo Motor Testing

Motor Servo	Degree	Time	Accuracy
1st Test	60°	3 seconds	Success
2nd test	60°	5 seconds	Success
3rd test	60°	7 seconds	Success
4th test	60°	8 seconds	Success
5th Test	60°	10 seconds	Success

HC-SR04 Sensor Testing

Table 5 shows the HC-SR04 Sensor test aimed at adjusting the distance between the shuttlecock and the sensor. HC-SR04 Sensor Testing with 5 experiments.why test distance more in shuttlecock storage device research because it is used to focus distance detection shuttlecock exhausted. As well as being able to show results in accordance with the order(Perdana et al., 2021).

Table 5. HC-SR04 Sensor Testing

Testing	Number of shuttlecocks (pcs)	Sensor HC-SR04 (cm)	Accuracy
1st Test	5	25	good
2nd Test	4	28	good
3rd Test	3	31	good
4th Test	2	34	good
5th Test	1	37	good

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ISD1820 Sensor Testing

Table 6 shows ISD1820 Sensor testing intended as an alarm. This test was carried out 5 times because the experiment was due to the alarm that the shuttlecock had run out and the ISD1820 Sensor so that it showed results in accordance with the desired command (Wahyono et al., 2021).

Table 6. ISD1820 Sensor Testing

Testing	Number of shuttlecocks (pcs)	Shuttlecock Distance (cm)	Condition	Accuracy
1st Test	5	25	Does not sound	good
2nd Test	4	28	Does not sound	good
3rd Test	3	31	Does not sound	good
4th Test	2	34	Does not sound	good
5th Test	1	37	sound	good

Overall Testing Tool

In table 7 below is the overall table of the automatic shuttlecock output design tool using a Servo Motor, the overall test was carried out using 12 shuttlecocks where the distance read from the HC-SR04 Sensor value was 4cm if the shuttlocock was full and 37 cm if the shutloocok was exhausted. For ISD1820 Sensors, if the HC-SR04 Sensor reads a value of 37 cm or is depleted, the ISD1820 Sensor will sound and vice versa. Then for the results of the Servo Motor if the HC-SR04 Sensor detects a run out of cock or a distance of 37 cm then the Servo Motor will not open and vice versa if the HC-SR04 Sensor detects less than 37 cm then the Servo Motor will open.

Table 7. Overall Testing Tool

Number of shuttlecocks (pcs)	Sensor HC-SR04 (cm)	Motor Servo (60°)	Sensor ISD1820	Deskripsi
1	37	close	sound	succeed
2	34	open	Does not sound	succeed
3	31	open	Does not sound	succeed
4	28	open	Does not sound	succeed
5	25	open	Does not sound	succeed
6	22	open	Does not sound	succeed
7	19	open	Does not sound	succeed
8	16	open	Does not sound	succeed
9	13	open	Does not sound	succeed
10	10	open	Does not sound	succeed
11	7	open	Does not sound	succeed
12	4	open	Does not sound	succeed

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DISCUSSIONS

In this study, appropriate results were obtained, namely the shuttlecock can come out using a servo motor without constraints, the HC-SR04 Sensor can also detect the number of shuttlecocks in the shuttlecock storage area, as well as the ISD1820 Sensor can warn when the shuttlecock is finished. For further research, there are several suggestions that can be taken into consideration in this research, such as making a more complete shuttlecock output device in this system, removing shuttlecocks to add several servo motors to facilitate shuttlecock output and bracturing switches to turn the device on and off and adding LCDs to monitor the contents of shuttlecocks from the shuttlecock storage area.

CONCLUSION

Based on the results of the tests that have been carried out which include the process of designing and testing the tool, it can be concluded that. (1) The shuttlecock can come out automatically well, the test is carried out using 12 shuttlecocks where the shuttlecock can come out one by one using a servo motor with an angle of 60 degrees. If the delay is 3 seconds, the servo motor will automatically close again. (2) HC-SR04 Sensor readings can detect the presence of shuttlecocks in the slop or shuttlecock storage area, testing is also carried out using 12 shuttlecock seeds. (3) the result of the ISD1820 Sensor can turn on and give a warning when the shuttlecock is exhausted.

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