Design and Build a Coconut Ripeness Classifier Using Sound Sensor

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Abstract— **The difference in coconut flesh's texture is a drawback for sellers who use young coconut meat with a soft texture for their product. It is also a disadvantage for industries that use old coconut meat with a hard texture, such as the production of coconut milk, coconut oil, and coconut flour. Therefore, consistency in determining the thickness of the coconut flesh is very much needed. This research will design a tool to classify the maturity of coconut fruit itself based on a sound sensor that determines the maturity of the coconut fruit. In determining how young or old the coconuts are based on sound, a bat is used so the beats obtained are the same, using a servo motor as a driving force to hit the surface of the coconut to make a sound. The test is done with the help of coconut fruit suppliers in the area of Karang Ploso, Malang City. This test is done by testing an original type of green coconut. Based on the results, the coconut fruit maturity is classified using a sound sensor and the sound sensor successfully captures sound waves when the bat hits the coconut with 100% success. Coconut fruit can be classified as young if it has a sound intensity of less than 56 dB, because the coconut fruit has the characteristics of a young coconut, which is small in size, bright green in color, and has pink fibres. Meanwhile, if the resulting sound intensity is more than 56 dB, the coconut is classified as an old coconut because it has the characteristics of an old coconut, which is brown or dark green in colour, large in size, and has white fibers. The coconut is hit by the bat using a servo motor that can hit with a highly accurate turning angle of 0% error percentage and has the same speed and power as it has the same input voltage of 5Volt.**

Keywords— **Coconut Ripe, Sound Sensor, classification.**

I. INTRODUCTION

Many types of technology have been created by humans to help carry out daily activities. Like a device/component that is used to detect changes in physical quantities, this component is known as a sensor [1]. One of the developing sensor technologies is a sound sensor as a detector of coconut ripeness [2]. The parts that are often consumed in coconuts are the meat and the water. The texture of the meat on the coconut fruit is erratic, the texture varies based on the age of the coconut [3][4]. Old coconut meats have a hard and thick texture and are high in fiber [5]. While young coconuts have a thin and smooth texture [6]. So, consistency in determining the thickness of the coconut meat is essential to determine the ripeness of coconuts [7].

In a previous study titled "Acoustic Frequency Detection in Magelang Coconuts (Cocos Nucifera) Using Spectra PLUS-DT Software", the result was able to determine the ripeness level of coconuts using SpectraPLUS-DT Software which found the average frequency value of coconuts by recording the sound of fruit beats coconuts at various levels of fruit maturity using a recorder and then the recorded file is converted into "wav" format[8]. Several researchers have the disadvantage of requiring PC assistance to use the SpectraPLUS-DT Software [9][10] and it is necessary to record and then change the sound format in the form of "wav" so the development of hardware is necessary to make the system easier to use [8].

Based on this background, a tool was designed to classify the ripeness of coconuts using a sound sensor [11]. In determining whether the coconut is young or old based on

sound [12], a bat is moved using a servo motor [13] on the surface of the coconut to make a beat. Then there will be a reflection of sound vibrations [14], If the beat intensity obtained is <56dB, it can be classified as young coconuts because the coconut meat is thin so it produces a small beat intensity [15]. Otherwise, it can be classified as old coconuts because the coconut meat is thick.

II. METHOD

A. System Design

Fig. 1 describes the tool design process, which includes a block diagram that explains the relationship between components.
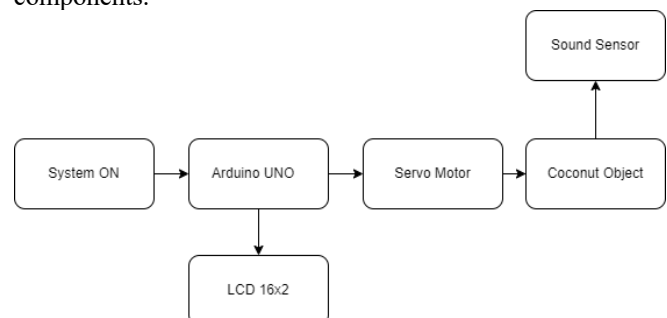

Figure 1. Block Diagram System

The system consists of the Arduino UNO Micro-controller, Sound Sensor, servo motor, and 16X2 LCD. Arduino as a micro-controller will give the servo command to move the coconut beater which has been determined by the strength of

the blow through the degree of rotation of the servo, the blow causes the coconut to emit sound waves which will be received by the Sound Sensor and will be processed through Arduino to be classified according to sound waves so whether the coconut is young or old can be determined and displayed on the LCD. The LCD also displays the total count of the young and the old coconuts based on the total amount of the coconuts that have been tested.

B. Tool Planning

Fig. 2 is electrical planning which illustrates how the electronic components work. In this stage, the schematic and how each component works will be shown in Fig. 2.
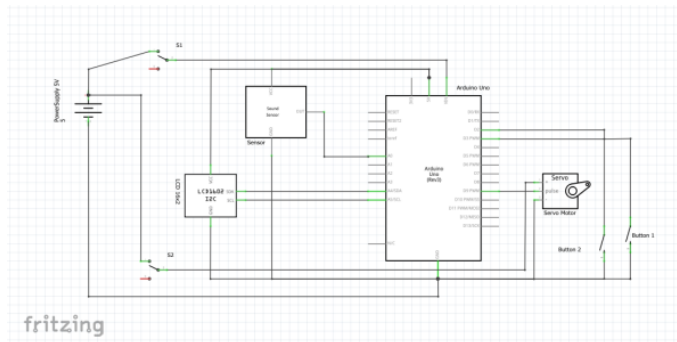

Figure 2. Electrical Planning

C. Working Procedure and Parameter

The determination of the working procedure used in the research with the title Design and Build of a Coconut Fruit Ripeness Classifier using a Sound Sensor is shown in Fig. 3.
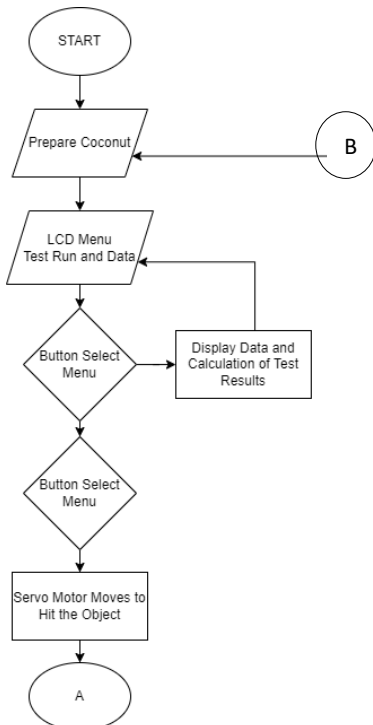

Figure 3.a. Flowchart of research procedures : Step 1

In Figure 3.a and Figure 3.b. illustrates the system program flowchart, the first thing to do is to prepare coconuts which will be tested at a predetermined place. This tool uses 5v of Power Supply as required by the voltage provider. After the Arduino Microcontroller is operated, the servo motor as a bat/knocking device will work in a consistent tapping force that has been determined through the degree of servo rotation in order to produce sound on the surface of the prepared coconut. Then the sensor will receive sound waves from the tapping earlier, if the sound intensity obtained is <56dB, it can be classified as a young coconut and if the sound intensity is >56dB, it can be classified as an old coconut. Furthermore, the results of the ripeness will be calculated and also sent to the LCD to be displayed in the form of text.

The parameters used in this study are as follows: (a) Accuracy of the sound sensor as the receiver of the sound waves that are hit; (b) The hitting force resulting from the degree of servo rotation (must be consistent/same); and (c) Sound waves produced from different coconuts.
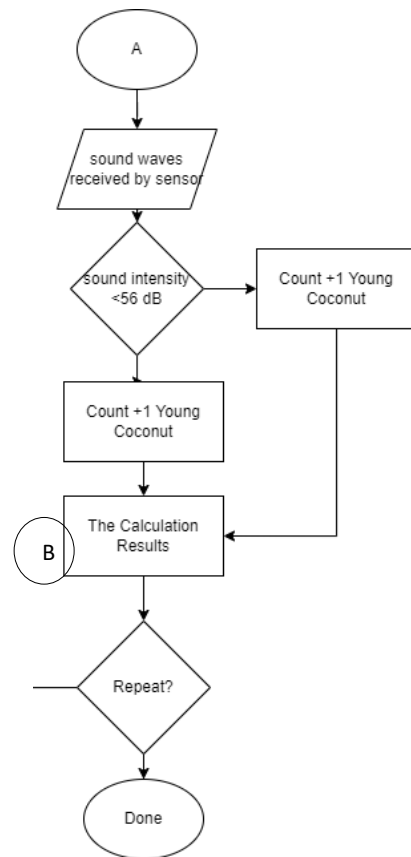

Figure 4.b. Flowchart of research procedures : Step 2

III. RESULTS AND DISCUSSION

A. Implementation Results

The results of the implementation of the coconut fruit ripeness classifier using a sound sensor are shown in the following figure:

Figure 5. Front View Tool Implementation

B. Results of the Classification of Coconuts Maturity Class

Based on the test results from Table 1., the coconuts have the same characteristics as the coconuts that are being tested.

TABLE 1.
TESTING DATA FOR CLASSIFICATION OF COCONUT FRUIT MATURITY

No.	Coconut	Results Using Tools	Results Using the Sound Meter Apk	Classification
1	Coconut 1	52 dB	58 dB	Young
2	Coconut 2	59 dB	62 dB	Old
3	Coconut 3	49 dB	51 dB	Young
4	Coconut 4	55 dB	58 dB	Young
5	Coconut 5	61 dB	66 dB	Old

It can be concluded that coconuts can be classified as young if the sound waves produced are less than 56 dB, because these coconuts have the characteristics of young coconuts, which are small, bright green in colo,r and have pink fibers. Meanwhile, if the sound wave produced is more than 56 dB, the coconut is classified as an old coconut because the coconut has the characteristics of old coconuts, which is brown or dark green in color, large in size and has white fibers.

C. Servo Hitting Test Results

Servo Motor Testing is done to determine the accuracy of the servo movement. Thus, it can be known whether the desired movement with the actual movement is corresponding. The error percentage can be calculated using the following equation:

$$\text{Error Percentage} = \frac{Sensor\ Angle - Arc\ Angle}{Sensor\ Angle} \times 100\% \quad (1)$$

TABLE 2.
SERVO HITTING TEST

No	Angle Servo °	Result			Error Percentage
		1	2	3	
1	45 °	45°	45°	45°	0%
2	90 °	90°	90°	90°	0%
3	140 °	140°	140°	140°	0%
4	180 °	180°	180°	180°	0%

Based on Table 2 on the test data of the hitting by the servo, it has an accuracy value with an average error percentage of 0%. This shows that the servo can hit the coconut with an accurate rotation angle. The bat moved by the servo can move with the same speed and power because it has the same input voltage of 5Volt.

D. Calculation of Force on Servo Batter Tool

$$f = \frac{r}{T} \quad (2)$$

where: f = Force (N); r = Distance (cm); and T = Torque.

$$f = \frac{20cm}{11kg.cm} = 0{,}55\ N \quad (3)$$

In the calculation of the force above, the distance value is obtained from the lever on the tool measuring 20cm. While the Torque/Moment of force is known in the datasheet with a value of 11kg.cm
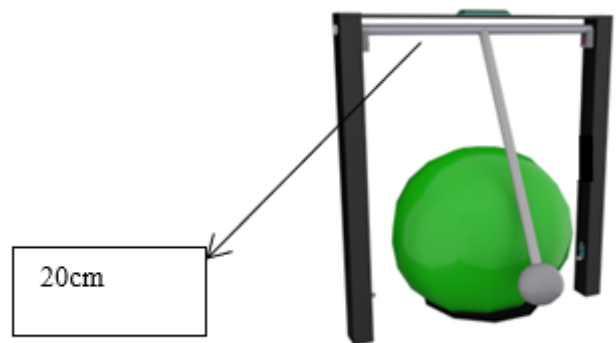

Figure 6. Illustration of torque measurement

IV. CONCLUSION

The coconut fruit ripeness classifier using a sound sensor can be carried out and the sound sensor successfully captures sound waves when the bat hits the coconut with a 100% success rate. Coconut fruit can be classified as young if it produces a frequency of less than 56 dB, because the coconut has the characteristics of young coconuts, which are small, bright green in color, and has pink fibers. Meanwhile, if the resulting frequency is more than 56 dB, the coconut is classified as an old coconut because the coconut has the characteristics of old coconuts, which are brown or dark green in color, large in size, and white fibers. The bat for coconut fruit uses the servo motor that can do a beating with a very accurate turning angle with an error percentage of 0% and has the same speed and power because it has the same input voltage of 5Volt.

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