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The Automatic Onion Cutter Using Arduino Uno as Control System Tool

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Abstract

Today's technological developments are growing rapidly, but there are still jobs that are done manually and semi-manually. This paper aims to develop a control system to coordinate the work of tools using an electric motor, which is very helpful in the process of cutting onions in large quantities and is more efficient in spending production costs because the tool designed is an automatic onion cutter. This research method begins with the collection of materials and data related to onion cutters, production of onion cutters, and testing of onion cutters. The measurement results of the tool show that every component in the automatic onion cutter works well and optimally; the measurement process is carried out properly and thoroughly. This optimal work result is supported by Arduino Uno. The Arduino Uno microcontroller acts as a tool controller. In the main system, the onion cutter is controlled by the Arduino Uno with the Arduino programming language. This automatic onion cutting system will work when the onion you want to cut has been inserted into a cross-section that has been equipped with an ultrasonic sensor, and then the onion cutting process is carried out. Compared with the manual method, the cutting time is almost the same. It's just that the advantages of slicing with this tool, the resulting slices are relatively more uniform. Besides that, another advantage is that it doesn't hurt the eyes of the onion slicer. So that this tool can be used by small entrepreneurs and onion farmers to increase productivity and the community's economy.

Keywords: Onion, Automatic, Arduino Uno, Control System

1. Introduction

The development of science and technology in the world of electronics and telecommunications. Currently progressing rapidly, this is proven by the existence of new discoveries that can minimize and streamline time and energy. With the developments in the world of electronics and telecommunications, humans are increasingly spoiled with the latest products in the field of electronics and telecommunications. With the expansion of the unions harvest in West Sumatra from year to year, the production of unions also increases [1]. Unions are a staple in cooking, especially in the culinary field. Unions as a raw material, even connoisseurs of taste in every dish. Therefore, the production and consumption of unions in West Sumatra is quite high, so a method of handling and processing of unions is required.

This onion slicing machine is expected to support increased production of sliced unions, which are ready to be fried. On a small scale, the work can be done manually with a knife. Problems will arise if the production to be sliced or cut is available in large quantities. Therefore, the production and consumption of unions in West Sumatra are quite high, so a serious way of handling and processing unions is needed, such as drying unions [2], and includes onion cultivation [3]. The work of cutting onions can be done manually with a knife. Problems will arise if the product to be cut is available in large quantities, optimal effort is needed to cut the onion. Onion-cutting tools on the market are still semi-manual. The disadvantages include that this type cannot load in large quantities, and hands can get tired faster because they have to rotate it, as shown in Figure 1.

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Figure 1 Onion Cutting Tools

Therefore, a tool for cutting onions is needed that works automatically and is durable, as well as easy to use, sturdy, and can save time in cutting onions. This automatic onion cutter is equipped with an Arduino Uno microcontroller and supporting sensors so that it can work continuously in cutting onions as an alternative. The development of science and technology in the world of electronics and telecommunications is currently advancing rapidly, this is proven by the existence of new discoveries that can minimize and streamline time and energy. This alternative design of the automatic onion cutting tool is expected to be able to help and be useful as desired, especially in terms of effectiveness and practicality in cutting onions.

The design of this tool will be able to shorten the time and make it easier to cut onions. Able to adjust the thickness of the cut of the onion. This onion cutter is capable of excelling in onion cutting speed, is safe because it reduces the risk of work accidents, and is definitely not painful to the eyes. The design of this tool is also equipped with a cutter knife. So that the cut will be more perfect. The design of this tool will add a motor driver output and two sensors so that it can work automatically. Users can start by pressing the power button. After that, the sensor will start working by itself. In order to facilitate the community in processing unions. After observing and learning more about the background of the problem, namely how to produce an onion slicing machine with uniform slices using different angles of inclination on the knife.

2. Research Methodology

The design of the Arduino Uno-based onion cutter to further simplify understanding so as to explain the working principle of the tool as a whole, which is a combination of electronic and mechanical principles controlled by programming, can be seen in Figure 2:

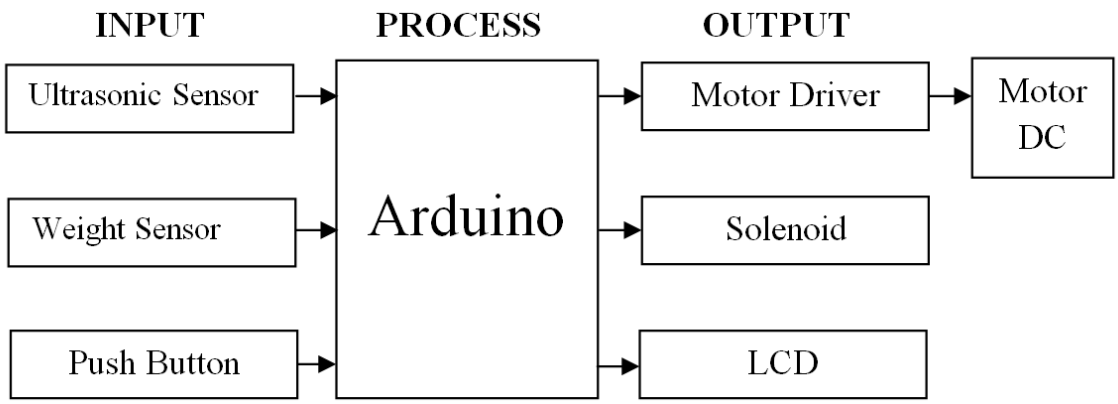

Figure 2 Block Diagram of Automatic Onion Cutter Design Tool

Ultrasonic sensors, weight sensors and push buttons are used as input for the automatic onion cutter whose data will be processed on the Arduino Uno, then the output is a DC motor, solenoid, and Liquid Crystal Display (LCD). Furthermore, the automatic onion cutting machine is one of the tools that

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aims to support the increase in the yield of onion cut products and does not need to use a lot of energy to cut onions. And of course also improve the production process of fried onions. The working principle of this automatic onion cutter is that if the onion is inserted into the onion container, the ultrasonic sensor will detect the incoming onion and then send information to the solenoid so that the solenoid opens and the onion automatically descends into the onion cutter. Next, press the push button to determine the weight of the onion to be cut (e.g. 200 grams). After that the tool will work to cut the onion and the pieces will fall into the container where the weight sensor is located. If the weight of the onion has reached the desired weight, the tool will stop automatically.

The main voltage of the automatic onion cutting system comes from the data supply connected to the Vin pin and the Arduino Uno ground. then the input from the ultrasonic sensor and the weight sensor which is the sensor for detecting onions and the weight of onions that have been cut are connected to analog pins 1 and analog 0 of the Arduino Uno. Then pin out 10, 11 12, 13 Arduino Uno is a pin out that serves as input for the motor driver which functions to drive the cutting motor. Next is the physical design of the onion cutter in Figure 3 and Figure 4.

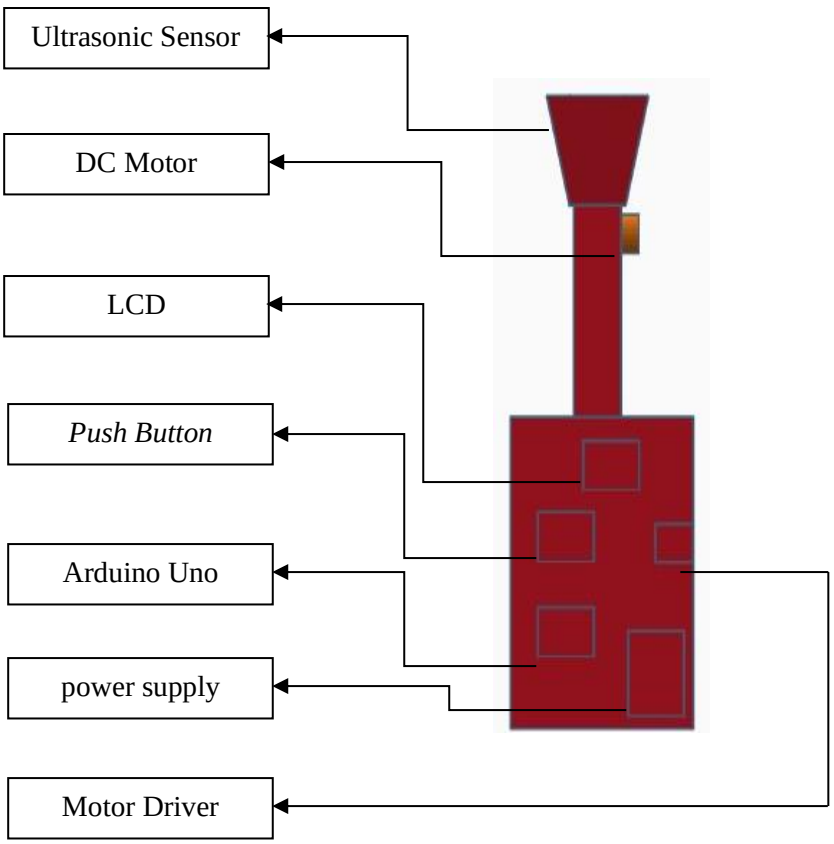

Figure 3 Front View Design

Figure 3 is a front view design consisting of an ultrasonic sensor, DC motor, LCD, push button, Arduino Uno, power supply, motor driver. Each of these parts has their respective functions that complement each other to carry out the function of the onion cutter.

Likewise in Figure 4, the front design consists of windows and weight sensors, each of which has a function and role in supporting the onion cutter.

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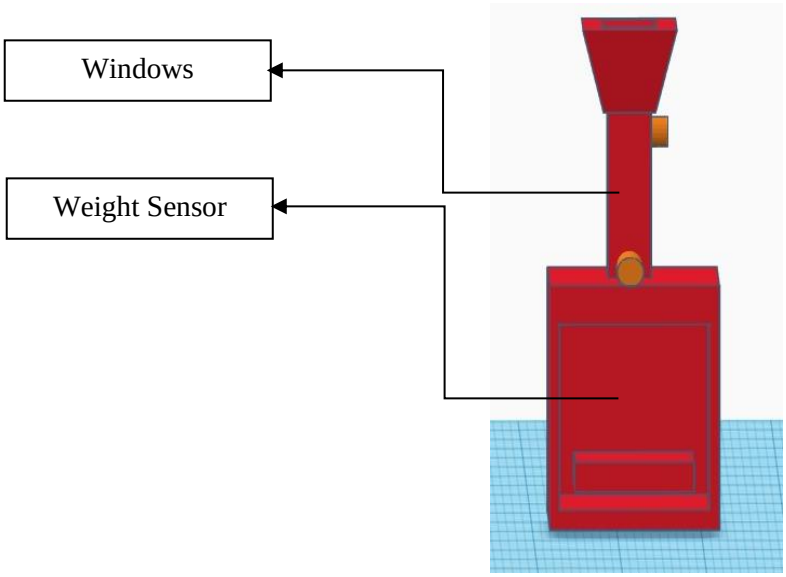


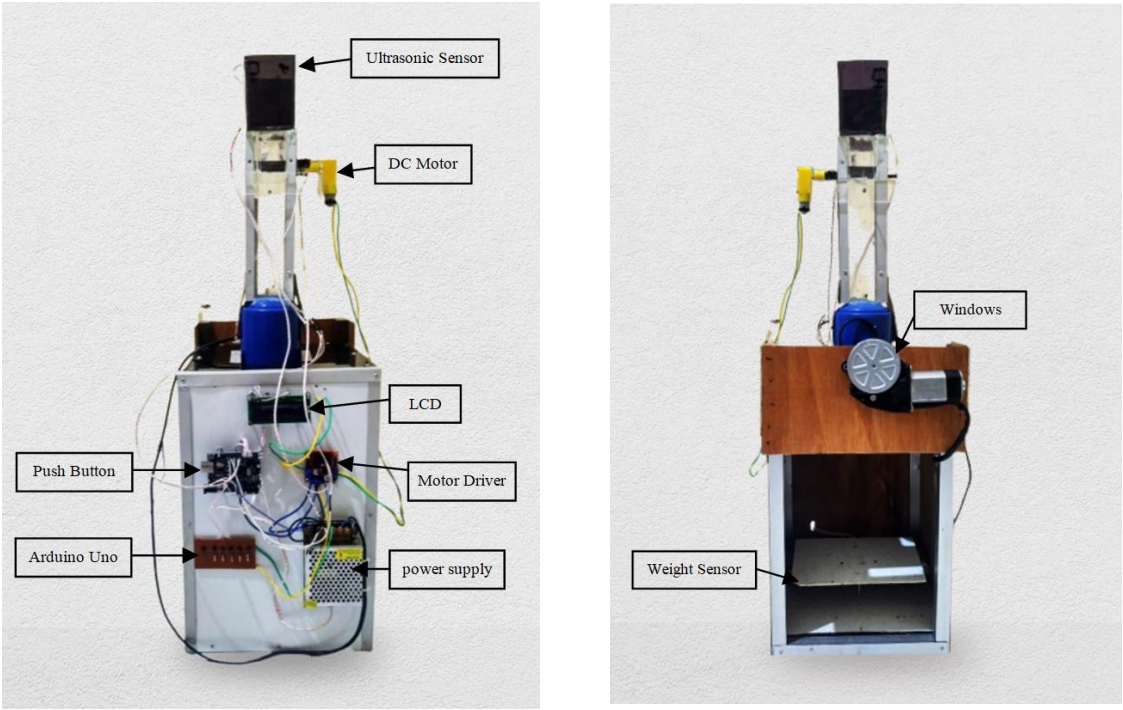
Figure 4 Front Form Design

3. Result and Discussion

In the results and discussion section, we discuss testing and analysis on hardware. The purpose of this test and analysis is to find out whether the hardware is functioning properly and according to the design. This test and analysis is aimed at testing the components contained in the system and is carried out separately on each circuit unit.

3.1. Tool Making Results

The results of making the tool are documented after the tool is made based on application and manufacture. The results of making automatic onion cutters are shown in Figure 5:



a. Physical Shape of Rear View Tool

b. The Physical Form of the Tool Front View

Figure 5 Physical Shape of the Tool

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As in general tools with control systems, run the process according to the design that has been made. In the main system, this automatic onion cutter is controlled instead of regulated by Arduino Uno with the Arduino programming language. The design of this system will work when the onion is inserted into the onion cutter. Here's the program algorithm of the onion cutter:

```
#include "HX711.h" //Pemanggilan Libraries Sensor Timbangan
#include <LiquidCrystal.h> //pemanggilan Libraris LCD
const int rs = 2, en = 3, d4 = 4, d5 = 5, d6 = 6, d7 = 7; //penentuan PIN lcd ke PIN arduino
LiquidCrystal lcd(rs, en, d4, d5, d6, d7); //pengaktifan pin LCD
//sensor HX711
#define DOUT  A0
#define CLK  A1
HX711 scale(DOUT, CLK);
float calibration_factor = 500;
int GRAM;
//sensor HCSR-04
int triger = 8; //pemanggilan pin trigger pada sensor jarak
int echo = 9; //pemanggilan pin echo pada sensor jarak
long duration, cm ; //pengaktifan inisialiasi duration dan cm pada sensor jarak
//push button
int push5 = A5; //pemanggilan push button A5
int push4 = A4;//pemanggilan push button 400 gr
int push3 = A3;//pemanggilan push button 300 gr
int push2 = A2;//pemanggilan push button 200 gr
int push1 = 13;//pemanggilan push button 100 gr
//driver l298N
int IN1 = 10; //pemanggilan pin pada motor dc gearbox (+)
int IN2 = 12; //pemanggilan pin pada motor dc gearbox (-)
//motor power window
int Motor = 11; //pemanggilan pin pada motor powerWindow
//tombol
int a , b, c, d, e; //inisial untuk pembacaan kondisi button
void setup() {
  Serial.begin(9600); //Baudrate pada Serial monitor
  lcd.begin(16, 2); //pemanggilan LCD 16x2
  pinMode(push1, INPUT_PULLUP);  //pengaktifan push button 1 sebagai output
  pinMode(push2, INPUT_PULLUP);//pengaktifan push button 2 sebagai output
  pinMode(push3, INPUT_PULLUP);//pengaktifan push button 3 sebagai output
  pinMode(push4, INPUT_PULLUP);//pengaktifan push button 4 sebagai output
  pinMode(push5, INPUT_PULLUP);//pengaktifan push button 5 sebagai output
```

```
//kondisi pembacaan sensor timbangan
void loop() {
  //==============================//
ok:
  jarak();
  timbangan();
  a = digitalRead(push1); //menampilkan data analog dari push1 ke a
  b = digitalRead(push2); //menampilkan data analog dari push2 ke b
  c = digitalRead(push3); //menampilkan data analog dari push3 ke c
  d = digitalRead(push4); //menampilkan data analog dari push4 ke d
  e = digitalRead(push5); //menampilkan data analog dari push5 ke e
  Serial.print(e);
  if (a == LOW) {
    Serial.println("Siap Mulai");
    digitalWrite(Motor, HIGH);
    while (a == HIGH) {
      jarak();
      timbangan();
    }
  }
  else if (b == LOW) {
    Serial.println("Siap Mulai 1");
    digitalWrite(Motor, HIGH);
    while (b == LOW) {
      Serial.print("Masuk");
      jarak();
      timbangan1();
    }
  }
  else if (c == LOW) {
    Serial.println(c);
    Serial.println(d);
    Serial.println("Siap Mulai 2");
    digitalWrite(Motor, HIGH);
```

```
//kondisi pembacaan sensor jarak
void jarak() {
  digitalWrite(triger, LOW); //pengaktifan triger dalam kondisi logika LOW
  delayMicroseconds(5); //delay dalam 5 microsecond
  digitalWrite(triger, HIGH);//pengaktifan triger dalam kondisi logika HIGH
  delayMicroseconds(10);//delay dalam 5 microsecond
  digitalWrite(triger, LOW);//pengaktifan triger dalam kondisi logika LOW
  pinMode(echo, INPUT); //pengaktifan echo dalam kondisi INPUT
  duration = pulseIn(echo, HIGH); //rumus mendapatkan jarak
  cm = (duration / 2) / 29.1; //hasil dari jarak dalam satuan cm
  lcd.clear(); //lcd dalam kondisi dihapus bersih
  lcd.setCursor(0, 0); //mengatur text tampil pada kolom 0 dan baris 0
  lcd.print("Jarak: ");  //cetak tulisan Jarak:
  lcd.print(cm); //mencetak hasil cm
  lcd.setCursor(10, 0); //mengatur text tampil pada kolom 0 dan baris 0
  lcd.print("cm"); //cetak tulisasn cm
  Serial.print("Jarak: ");
  Serial.print(cm);
  Serial.print(","); //delay tulisan selama 0.5 detik

  //kondisi pertama
  if (cm > 6 && cm < 8) { //jika sensor jarak terbaca 7, cm
    digitalWrite(IN1, HIGH);//pengaktifan motor IN1 dalam kondisi HIGH
    digitalWrite(IN2, LOW);//pengaktifan motor IN2 dalam kondisi HIGH
    delay(2000); //jeda 2 detik
    digitalWrite(IN1, HIGH);////pengaktifan motor IN1 dalam kondisi HIGH
    digitalWrite(IN2, HIGH);//pengaktifan motor IN2 dalam kondisi HIGH
    delay(2000);  //jeda 2 detik
    digitalWrite(IN1, LOW);//pengaktifan motor IN1 dalam kondisi LOW
    digitalWrite(IN2, HIGH);//pengaktifan motor IN2 dalam kondisi HIGH
    delay(2000); //jeda 2 detik
    digitalWrite(IN1, HIGH);//pengaktifan motor IN1 dalam kondisi HIGH
    digitalWrite(IN2, HIGH);//pengaktifan motor IN2 dalam kondisi HIGH
    delay(2000); //jeda 2 detik
```

3.2. Evaluation of the Structural Model (Inner Model)

After the manufacture of the tool is complete, the designed tool is tested both in terms of hardware and software. This test is carried out to determine the success of the designed tool and to compare it with the desired specifications. In terms of hardware, voltage measurements and circuit analysis are carried out. Here are the circuits that were measured and analyzed.

3.2.1. Ultrasonic Sensor Measurement

Ultrasonic sensors are used to detect the presence of onions to be ground by the machine, this sensor is placed on top of the tool. The distance data obtained by the ultrasonic sensor is sent to the Arduino Uno microcontroller, as shown in Table 1.

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Table 1 Ultra Sonic Sensor Reading Distance

No	Distance	Ultrasonic Sensor Reading
1	1 cm	Can not be read
2	2 cm	Can not be read
3	3 cm	Read
4	4 cm	Can not be read
5	5 cm	Can not be read
6	6 cm	Can not be read
7	7 cm	Can not be read
8	8 cm	Can not be read
9	9 cm	Can not be read
10	10 cm	Can not be read
11	11 cm	Can not be read
12	12 cm	Can not be read

Next, ultrasonic sensor measurements were carried out using a multimeter, measurements were made on the ECHO pin and trigger as shown in Table 2.

Table 2 Ultrasonic Sensor Measurement Results

Pin	**Voltage**
ECHO	4.8v
Trigger	4.8v

Based on Table 2, it can be seen that in measuring the ECHO pin with a multimeter, the negative on the multimeter is placed on the ground and the positive for the ECHO pin. In measuring the negative trigger on the multimeter, it is placed on the ground pin and the positive on the trigger.

3.2.2. DC Motor Measurement

The DC motor is used to turn the solenoid and the power window motor rotates the onion cutter blade, as shown in Table 1.

Table 3 DC Motor Measurement

Motor Type	Motorcycle Pins	Voltage
DC Motor	+	10v
	-	10v
Motor Window	+	9 v
	-	0v

Based on Table 3, it can be seen that the DC motor measurement point is measured at positive polarity in positive and negative polarity in negative when opening and closing the opposite. Next, the motor window is measured in the motor driver, the positive is at output1 and the negative is at output2.

3.2.3. Motor Driver Measurement

Measurements on the motor driver which is a 5 Vdc relay module are carried out to determine whether the voltage that enters the relay is normal or not. Measurements are also made on the input data on the relay, when the relay gets logic 1 and logic 0 from Arduino, as shown in Table 4.

Table 4 Motor Driver Measurement

Pin	Voltage
5v	4.8v
12v	12v
GND	0v

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Based on Table 4, it can be seen that to measure the input voltage to the motor driver at pin 5v, it is measured with a positive multimeter on the 5v pin, while the negative multimeter is placed on the ground pin. Then for the incoming voltage to the motor driver at pin 12v, it is measured with the positive of the multimeter on pin 12v, while the negative of the multimeter is placed on the ground pin. The measurement points for Ultrasonic Sensors, DC Motors, and Motor Drivers are shown in Figures 6, Figures 7, and Figures 8. Furthermore, measurements of the Weight Sensor, Push Button, and Power Supply are carried out.

Figure 6 Ultrasonic Sensor Measurement

Figure 7 DC Motor Measurement

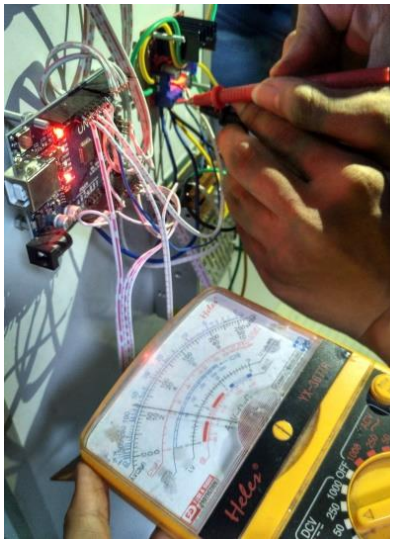

Figure 8 Motor Driver Measurement

3.2.4. Weight Sensor Measurement

The weight sensor is used to measure the weight of the onions to be packed, the results of the weight sensor measurements are as in Table 5 below.

Table 5 Weight sensor measurement results

Pin	Voltage
5v	4.8v
GND	0v

Based on Table 5, it can be seen that to measure the negative weight sensor on the multimeter it is placed on the ground pin and the positive is placed on the 5v pin.

3.2.5. Push Button Measurement

The push button is used to determine the weight of the onion to be weighed, the results of the push button measurement are as in Table 6.

Table 6 Push Button Measurement

Button	ON	OFF
Reset		
1	0v	4.6 v
2	0v	4.6 v
3	0v	4.6 v

Based on Table 6, it is known that to measure push button 1, the positive on the multimeter is placed on positive 1k and the negative is placed on the other resistor leg. And so on.

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3.2.6. Power Supply Measurement

Measurement of the power supply is done by measuring several measurement points on the power supply. By using a multimeter. Measurement of the power supply voltage while working is carried out at the measurement point (TP) as shown in Table 7.

Table 7 Measurement of power supply voltage

Pin	Voltage
12v	12v

Based on Table 7 it can be seen that to measure the power supply, the positive of the multimeter is placed on the positive of the power supply and the negative is placed on the negative of the power supply. Furthermore, the measurement points for the Weight Sensor, Push Button, and Power Supply are shown in Figures 9, Figures 10, and Figures 11.

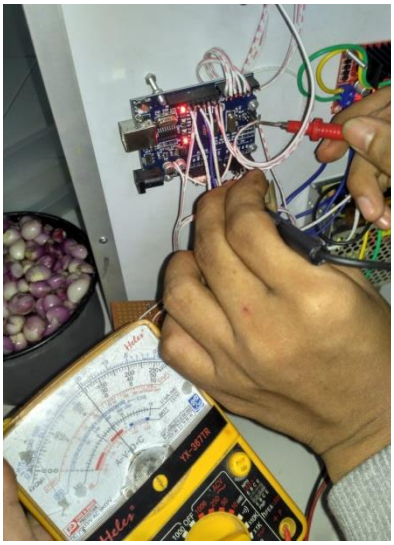

Figure 9 Weight Sensor Measurement

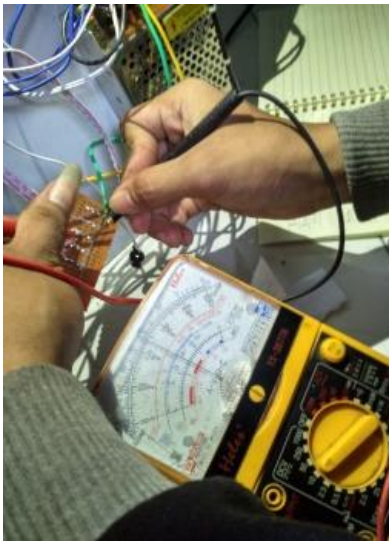

Figure 10 Push Button Measurement

Figure 11 Power Supply Measurement

The test is carried out by slicing onions weighing 100 gr, 200 gr, 300 gr, and 400 gr, which can be selected via the available buttons. Slice thickness setting is 1 mm. The success of the test was seen from the slicing time and the uniformity of the slices. Based on the test, the slicing time was 1 minute, 2 minutes, 3 minutes, 4 minutes and 5 minutes, respectively. Compared to the manual method, the slicing time is almost the same. It's just that the advantages of slicing with this tool, the resulting slices are relatively more uniform. Of course, another advantage is that it doesn't hurt the eyes of the onion slicer.

The results of research and design of onion cutting tools such as onion cutters with AC electric motor drive [4-7], vertical type [8], blade disc type [9], [10], Pulse Witdh Modulation (PWM) technique [11], semi mechanical [12], testing and manufacturing of the tool has been carried out, but the automatic version using Arduino Uno is still rarely found in the market and there has not been too much research on this.

The design of this automatic unions cutter facilitates post-harvest handling, especially for farmers and can function as a tool that can be used by small businesses, especially the fried unions business [13], [14]. The abundance of onion production demands an alternative tool that is able to work automatically, carrying cutting tools Arduino Uno-based automatic red icon is an effective and efficient alternative solution. Arduino uno is the choice because it helps electronic circuits from simple to complex for various needs and purposes [15-17]. Next hthe measurement results of the tool show that each component works well and optimally, the measurement process is carried out properly and carefully. There are several measurement points carried out starting from measurements of Ultrasonic Sensors, DC Motors, Motor Drivers, Weight Sensors, Push Buttons, and Power Supply.

4. Conclusion

Based on the results of this study, a controlled system was produced to coordinate the work of the tool using an electric motor which is very helpful in the process of cutting onions in large quantities and is more efficient in spending production costs, because the tool designed is an automatic onion cutter. Furthermore, the components used include ultrasonic sensors, weight sensors and push buttons that are used as input for automatic onion cutters. Then the Arduino UNO module microcontroller as the Main Process and data processor, the output is a DC motor, solenoid, and LCD. Besides that, compared to the manual method, the slicing time is almost the same. It's just that the advantages of slicing with this tool, the resulting slices are relatively more uniform. Of course, another advantage is that it doesn't hurt the eyes of the onion slicer.

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