AUTOMATIC TOOLBOX DESIGN WITH SMART VENDING MACHINE METHOD BASED ON INTERNET OF THINGS

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ABSTRACT

Toolbox storage of some useful equipment to make it easier for technicians to take a tool. Smart vending machine is the latest innovation from vending machines to dispense goods and can record the results of dispensing the tool. This method begins with the formulation of problems, making tools and writing the final project. Equipped with a camera and web as a vending machine security. There are inputs that are useful for setting controls on the tool then the results of the control are output on the web and 16x2 LCD. Stepper motor testing has been tested with a period of 10 seconds, 60 seconds and 120 seconds then face recognize testing takes at least 7 seconds to detect faces. The tool runs optimally and effectively.

Keywords: ESP32, *Face Recognize,* Motor Stepper, Arduino Nano, Orange Pi, *Internet of Things.*

1. INTRODUCTION

Toolbox is a storage of several useful tools to make it easier for technicians to take a tool. There is a machine with the latest innovation, the vending machine. A machine that functions to issue an item according to the user's wishes. Then equipped via the web controlled via smartphone or laptop and can recognize the user's face with the smart vending machine method. Smart vending machines are equipped with Internet of Things components that are useful to make it easier for users to use vending machines.

Based on the background above, the author designs an automatic toolbox device that functions to remove and return equipment with face recognize security via the web. With this the author made a design entitled "Designing an Automatic Toolbox with the Internet Of Things-Based Smart Vending Machine Method". With the existence of this tool, it is hoped that it can help technicians to borrow equipment with the presence of history on the web.

2. METHOD

2.1 Research Design

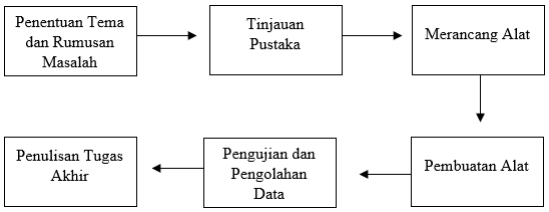

Figure 1. Research Method

This research begins with determine the problem and raise the desired theme. The text stage which is reviewing various supporting journals as a literature study tool design. The next stage is to design a tool about an automatic toolbox with a simple and understandable design. The testing stage as measurement and validation feasibility test of the tool whether it functions as expected.

2.2 Tool Design

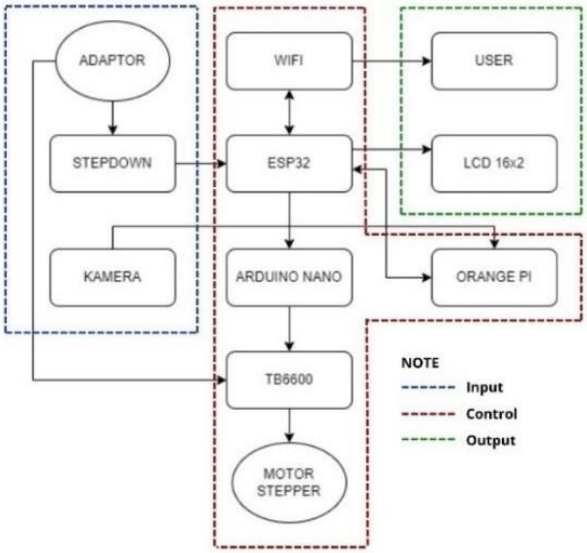

Figure 2. Tool Design

The tool design diagram has 3 parts, namely the input, control and output parts. The input section includes the adapter, stepdown and camera. The 5v output from the stepdown supplies the ESP32, Arduino Nano, Orange Pi and 16x2 LCD. The ESP32 commands the Arduino Nano and manages the stepper motor. Then the camera is processed by Orange Pi and forwarded to ESP32. ESP32 continues to the user and displays LCD 16x2.

2.3 Hardware Components

1. Arduino Nano

Arduino Nano is part of the development of an ATMega 329P chip that has a very small size. This microcontroller has a Mini-B USB connector but no connection to the power supply.

2. ESP32

ESP32 is part of the successor to ESP8266. The ESP32 microcontroller has a Wifi module and the addition of Bluetooth low energy so that it can be an alternative choice in the application of the Internet of Things.

3. Motor Stepper

A stepper motor is a type of motor with step-based rotation. This motor rotates and rotates with varying steps. The step size can range from 0.9° to 90°. The rotation position is relatively accurate and stable.

4. Modul Driver Tb6600

Motor Driver Serves to communicate playback on the motor. Motor control using this motor driver uses 1/1, ½, ¼, 1/8, and 1/16 stepper motors. There are types of TB6600 motor drivers that can be controlled incorrectly, namely NEMA 17 and 23 stepper motors.

5. Modul Stepdown LM2596

The LM 2596 Stepdown Module is a circuit that can drive 5A loads with high capability, line regulation and low towing and good loads. This module has a DC / DC converter circuit using 150 kHz fixed-voltage fixed frequency (PWM step-down) and uses the LM 2596 Regulator IC.

6. Orange Pi

Orange Pi is a single board computer that is open source. Orange pi is a mini computer with small dimensions and power.

7. Camera Webcam

Real-time cameras can be accessed via the World Wide Web. Webcams require a working internet connection to get the maximum frame rate.

8. Adapter

The adapter converts alternating current (AC) into direct current (DC) by reducing the AC voltage of 22 Volts to around 3 volts to 12 volts according to the needs of electronic devices.

9. LCD 16x2

LCD (Liquid Crystal Display) is a type of screen that uses liquid crystals to display data. In this circuit, the LCD functions as a monitoring display, output parameters of voltage and current produced by the generator, with the data processed by the microcontroller.

2.4 Software Components

1. Arduino IDE

Arduino IDE is a software that has a function to design Arduino microcontrollers. By the way the user writes a program code using the Arduino programming language, accesses the hardware that is connected to Arduino, and monitors the performance of the program that has been running.

2. XAMPP

XAMPP is useful for localhost servers as a translator for the PHP programming language. XAMPP is a web server program built using Apache and has a MySQL server supported by the PHP programming language which is used to create a website that continues to grow.

3. Website

A website is a page on the web with communication usually used with a collection of information, such as text, images, animations, audio, and video, or a

combination of all of these. These pages are usually created for individuals, organizations, and companies.

2.5 Testing Techniques

1. Stepper Motor Testing

This test serves to determine whether the stepper motor has moved in accordance with the programmed commands. This test was carried out using stepper motor nema 17.

2. Webcam Testing

This test serves to determine whether the camera can detect the user clearly. Testing is done through the web that has been provided.

3. ESP32 Testing

This test serves to determine whether the wifi module can operate as expected.

4. Liquid Crystal Display 16x2 Testing

This test serves to determine whether the LCD can display the text according to the desired program.

2.6 Data Analysis Technique

Based on explanation above, the author will design a tool to find a solution to the specified problem. The following is the analysis technique used.

1. Theme Determination

This stage of choosing a theme uses a theme that is relevant and interesting to the needs that you want to need.

2. Literature Review

The stages of the literature study study references about the design of the tool to be made, with coverage of the working principles of the tool and the components needed. Looking for information with previous research to be used as a reference on the topic to be used.

3. Tool Design

The stages in the design of the tool have important points such as determining the specifications of the tool to be loaded, including the Internet of Things program. Furthermore, making designs on mechanical devices, including making 3D images, selecting materials. Then make an electronic description of the tool, with a circuit scheme and select components then simulate.Testing and Data Processing.

4. Tool Making

The stages of making this tool have been prepared for each of the materials and tools needed to make this tool. Following the design that has been made carefully and thoroughly to test the tool which is useful to ensure that the tool can work optimally.

5. Data Testing and Processing

This stage tests the tool with various existing conditions. Data from the test results are then collected and analyzed to witness the performance of the tool. There is an evaluation obtained from the test results and compares with the stated research objectives.

6. Final Project Writing

This stage works on the final project report that covers the stages of the research, starting from the introduction to the conclusion. The final project report is expected to be written logically, systematically and easily understood.

3. RESULT

3.1 Motor Stepper Testing

This final project, the author will test the stepper motor according to the time that the author has set.

Figure 3. Testing Motor Stepper

This stepper motor circuit is used to drive a toolbox that is useful for the vending machine system. Starting from a stepper motor then controlled by Arduino Nano through a motor driver. The results of the stepper motor can be monitored through the Arduino IDE serial monitor.

Stepper motor testing is done with a time of 10 seconds, 60 seconds and 120 seconds in real-time. This test is monitored through the Arduino IDE. Through integration with the Arduino platform and the use of appropriate sensors, this program enables efficient and reliable control of the position and movement of the toolbox in various situations, increasing the effectiveness and safety of using the tool in everyday work environments. The following is the program contained in the Arduino IDE.

```
45  Serial.println("jalan 10 detik");
46  maju(1);
47  delay(10000); // Run for 5 seconds
48  stop();
49
50  // Stop motor for a moment
51  delay(1000); // 1 second pause
52
53  // Run motor for 10 seconds
54  Serial.println("jalan 60 detik");
55  maju(1);
56  delay(60000); // Run for 10 seconds
57  stop();
58
59  // Stop motor
60  delay(1000); // 1 second pause
61  // Run motor for 10 seconds
62  Serial.println("jalan 120 detik");
```

```
Output  Serial Monitor ×
Message (Enter to send message to 'Arduino Pro or Pro Mini' on 'COM3')
19:55:56.456 -> ◆ '◆◆◆◆◆◆◆jalan 5 detik
20:21:34.755 -> jalan 10 detik
20:23:40.279 -> jalan 10 detik
20:23:51.295 -> jalan 60 detik
20:24:52.542 -> jalan 120 detik
```

Figure 4. Program Motor Stepper

3.2 Face Recognize Testing

This test serves to test the feasibility of orange pi and camera in verifying faces in real-time.

Figure 5. Face Recognize Testing

The face recognize circuit includes a laptop and camera then orange pi and ESP32. ESP32 gives commands to orange pi, orange pi will take a photo of the face through a webcam and then process it with python for face recognition then orange pi will send a response back the results of reading the face to ESP32 in the form of a detected face name then ESP32 will process the face data obtained from orange pi. The results of face recognize testing by identifying faces then the program can proceed to the web that is available to run a program. The following are the results of face recognition testing with two test faces. The following samples can be tested on face recognize.

Nama	Tampilan Login	Wajah	Waktu
Rizqi			7 Detik
Brans			9 Detik

Figure 6. Sample Face Recognize

The sample named rizqi verified the face in 7 seconds and brans verified the face in 9 seconds. Orange pi and camera have an important effect on the timeframe for verifying faces.

```
Output  Serial Monitor ×
Message (Enter to send message to 'DOIT ESP32 DEVKIT V1' on 'COM4')
10:38:07.525 ->
10:38:07.525 ->
10:38:07.802 -> POST request response: 200
10:38:07.802 ->
10:38:07.802 -> recognize=rizqi
10:38:08.114 -> POST request response: 200
10:38:08.114 ->
10:38:08.114 ->
10:38:08.114 -> 2204
10:38:08.114 -> Free heap: 226616
10:38:08.297 -> recognizing face
```

Figure 7. Program Face Recognize

Experiments with two samples gave the program as above. When the face verification is started, the program shows recognize=rizqi which means that face recognize works as its function.

4. CONCLUSION

Based on the experiment and discussion, it can be concluded that:

1. Face recognize testing gets experimental results, namely with an average identification time of 10 seconds, after being identified correctly, it can successfully log in to the website.

2. Stepper motor testing is carried out with a time interval of 10 seconds, 60 seconds and 120 seconds, with the result that the stepper motor moves according to the instructions in the Arduino IDE program.

3. Testing the device on the toolbox produces an effective time output to identify the user's face so that toolbox retrieval becomes more efficient. The device testing system on this toolbox can be easier because it is integrated with the web server-based Internet of Things.

5. RECCOMENDATIONS

In the process of making this final project, the author realizes that this tool still has shortcomings and is not perfect. therefore, the author suggests several things that can be used for future development so that it becomes better and can be perfect in the future. The suggestions given are:

1. Orange pi microcontroller, can be developed with raspyberry with the latest type as accelerating face recognition.

2. Toolbox testing on the test results, can use a better camera to be better at processing facial recognition.

3. Developed using Artificial Intelligence (AI) face recognition methods such as Fisherface.

4. Developed using the RFID method for recognizing goods according to the location of the goods in the toolbox.

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