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Analysis of the Motor Control System for Moving Goods Using Google Assistant

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A B S T R A C T

Developments in robotics science have positive impact in the industrial sector. One example is the process of moving an item/object from one place to another. This study aimed to test the motion system, namely a DC motor that functions as a motor for carrying goods. The method used is input from commands given by the user via a smartphone with voice access. As an intermediary, a bluetooth connection is used so that commands can be sent from a smartphone to the control circuit. The controller used is the AVR type, namely atmega 328 on the Arduino Uno board. At the output, there are relays and current amplifiers that function as motor drivers. The user will give orders via a smartphone where on the smartphone runs an application, namely a voice to text converter. The application will convert the human voice into text and send via bluetooth to the controller. The Arduino controller will identify the command code and execute it, namely controlling the robot's motion in the direction desired by the user, for example forward, backward left and right or towards a predetermined point. In conclusion, the analysis of the drive motor control system was successfully carried out by calculating and measuring the power of the DC motor. The control system program was successfully created in C language using arduino. The program successfully runs and controls the motor motion properly according to the user's command via the Google assistant.

1. Introduction

Modern technology today, especially in the world of robot technology, has developed very rapidly. Many developed countries are competing to make robots that are increasingly sophisticated. In Indonesia, robots have also begun to develop. The development of the robot is not only in its mechanical sophistication but also its control system using a computerized system. The manufacture of robots with special features is closely related to the needs in the modern industrial world, which demands the existence of a tool with higher capabilities in order to help complete human work or to complete work that cannot be completed by humans. One type of robot with special abilities that has recently attracted a lot of interest from robot lovers to be developed is a wheeled robot with voice control. From the development of voice signal processing technology, a new idea emerged to create an effective robot control system using human voice commands.[1-3]

Developments in the field of robotics are also able to have a positive impact on the industrial sector. One example is the process of moving an item or object from one place to another.[4,5] If, in the past, moving goods/objects from one place to another required a large amount of human labor, at this time, it is considered less efficient. The use of mobile robots that can move goods/objects can reduce production costs and increase time efficiency. In reality, robots that move goods/objects are often encountered, one of which is by giving orders to the mobile robot using more than one button or in the form of a joystick.[6,7]

This still has a drawback, namely that there is still human physical assistance, which means that the robot is still not independent. So we need a tool that can replace the role of humans in carrying out their duties. One of them with the manufacture of robots. The robot is a mechanical device that can perform physical tasks, either using human supervision and control or using predefined programs (physical intelligence). Usually, robots are used in heavy-duty, dangerous, repetitive, and toxic jobs that humans cannot do alone.[8]

Therefore, a smartphone based on Android OS is used to control the movement of the mobile robot. The use of smartphones in controlling mobile robots can take advantage of the features that exist on smartphones, one of which is the voice processing feature (speech recognition).[9,10] Speech recognition is a development of techniques and systems that allow computers to receive input in the form of spoken words.[10] This technology allows a device to recognize and understand the words spoken by way of digitizing the word and matching the digital signal with a specific pattern stored in a device. The results of the identification of spoken words can be displayed in written form or can be read by technological devices as a command to do a job. This study aims to test the motion system, namely a DC motor that functions as a motor for carrying goods.

2. Methods

This research is a descriptive study that presents the results of the design and workings of the prototype moving goods using google assistant. The research was carried out at the UMSU Engineering Laboratory, Medan, Indonesia. The tools and materials used to analyze and process the data from this research are as follows; arduino uno, two 12 V DC motors, big wheel, small wheel, lithium battery, one ultrasonic sensor SR- 04, one bluetooth module HC-05, one relay driver circuit module, one mosfet amplifier circuit module, connecting cable, smartphones, measuring instruments such as tacho meters, volt meters, and ampere meters. The control program design consists of several main components, such as an arduino uno, a bluetooth HC05 module, an SR04 ultrasonic sensor, and a relay driver module that functions as a current amplifier. The amplifier is needed because the arduino microcontroller output cannot control a larger load directly, so it needs to be amplified first. The power amplifier is used to amplify a larger current, namely the motor current. The power amplifier type is a mosfet type with IRF Z44 type.[11]

In this design, the input comes from the commands given by the user via a smartphone with voice access. As an intermediary, a bluetooth connection is used so that commands can be sent from a smartphone to the control circuit. The controller used is the AVR type, namely atmega 328 on the arduino uno board. At the output, there are relays and current amplifiers that function as motor drivers. The user will give orders via a smartphone where the smartphone runs an application, namely a voice-to-text converter. The application will convert the human voice into text and send it via bluetooth to the controller. The Arduino controller will identify the command code and execute it, namely controlling the robot's motion in the direction desired by the user, for example, forward, backward, left and right, or towards a predetermined point.

3. Results and Discussion

In this study, the design and manufacture of a cargo carrier robot with voice access were carried out. The robot functions as a machine for moving goods with voice commands. The designed robot is driven by 2 dc motors and an arduino controller. To determine the performance and function of components in the designed system, it is necessary to carry out several tests, which include hardware testing (hardware) and software testing (software). To make it easier for the author to carry out the tool testing process, several separate tests were carried out, and overall tests were carried out.

Hardware testing, namely the main components used, aims to determine the function and performance of each component, whether it is in accordance with

the criteria required by the system or not. If it does not match, then the component cannot be used in the system and must be replaced. Here are the results of the tests carried out on each major component.

DC motor testing aims to determine the output of a DC motor when given different inputs. The test is carried out by providing input voltage and measuring the speed of the motor and the current of the motor working on the motor. Testing DC motor 1 is carried out to determine the motor power for each increase in voltage. The greater the voltage, the greater the current that flows, and the faster the motor rotates. Thus, regulating the speed of the motor can be done by adjusting the voltage of the motor. If the voltage is low, then the motor will rotate slowly, and if the voltage is increased, then the motor will increase its speed. Based on the test, as the voltage increases, the rotation speed will increase, as well as the current and power will increase. At a voltage of 12V, the speed is 115 rpm, the current is 2.23 A, and the power is 26.76 watts.

In this study, the DC 2 motor test was carried out to determine the motor power for each increase in voltage. The greater the voltage, the greater the current that flows, and the faster the motor rotates. Thus, regulating the speed of the motor can be done by adjusting the voltage of the motor. If the voltage is low, then the motor will rotate slowly, and if the voltage is increased, then the motor will increase its speed.

To find out the performance of Arduino, it is tested first, namely by making a program and running it. The program created is to control an LED. The LED is mounted on pin 8, which is programmed as an output pin. In this program, it can be analyzed that the program command created a variable ledPin with an integer type with a value of 8. In the void setup() section, the variable is set as output with the pinMode command (ledPin, OUTPUT). In the main program, void loop() by giving the command digitalWrite (ledPin, HIGH), then the LED on the Arduino Uno board lights up. The delay command (500) gives the LED a delay of 500 mS. The next command digitalWrite (ledPin, LOW) then the LED will go out. The delay command (500) gives the LED a delay of 500 mS. From the observations made, it can be concluded that the test gives results that are in accordance with the program, so it can be stated that the test on Arduino is successful.

Bluetooth serial communication

Communication on Arduino Uno with Bluetooth is done by connecting the RX/TX pin on the HC05 bluetooth adapter on the Arduino Uno serial port. The test is carried out aiming to find out the value of the data sent via the bluetooth adapter according to what is given or not. Steps were taken; run the Arduino application on the laptop screen. Next will appear the initial display "new sketch" automatically. On this page, start writing the program. Hover over the Tools menu, then select Port, then select Com4 (arduino Uno), then click Serial Monitor. After that, connect the smartphone to the HC05 bluetooth. Then test bluetooth by typing text on the smartphone. Based on the above test, the data sent by the user via the bluetooth adapter will be received by the Arduino circuit. Then the data will be sent to the computer to be displayed on the monitor screen through the standby serial monitor application.

Ultrasonic sensor testing

The purpose of ultrasonic sensor testing is to determine whether the HC-SR04 Ultrasonic Sensor circuit used can work as desired or not. The equipment needed to perform this test is; a minimum Arduino uno system, Arduino uno data cable, HC-SR04 Ultrasonic Sensor circuit, computer or laptop, and arduino software version 1.8.10.

Ultrasonic sensor circuit testing procedure; open the Arduino IDE application; Next, the initial “sketch_xxxxxx” screen will appear automatically as in the previous step; Type in program listings for sensor testing; Upload the program on arduino; Attach the sensor to the Arduino on the pin according to the program that was made.

In this test, the Arduino uno circuit is connected to a computer, namely the Serial Monitor software, a

Serial.begin (9600) setting is needed, which is useful for initial initialization, namely determining the baud rate used.

```
void setup()
{Serial.begin(9600);
pinMode(trigger,OUTPUT);
pinMode(echo,INPUT_PULLUP); }
```

Value 9600 in Serial.begin(9600); is the data communication speed used between the bluetooth HC-05 and the computer. The initial setting of the ultrasonic sensor is on the trigger pin, which is the output, and the echo pin is the input. The program for reading the HC-SR04 sensor is shown in the following program listing.

```
void read_sensor_SR04()
{digitalWrite(trigger,HIGH); delayMicroseconds(2);
digitalWrite(trigger, LOW); counter = pulseIn(echo,
HIGH); jarak = (counter/2) / 29.1;}
void loop()
{ read_sensor_SR04(); Serial.print("Distance=");
Serial.println(distance,2); delay(300);
```

On the first line is the name of the sensor read routine. Then lines 2 to 4 are commands to trigger sensors. Line 5 is a command to record the time it takes the ultrasonic to reach the sensor, and line 6 is to calculate the distance between the object and the sensor. The number 2 is the distance traveled divided by 2, while 29.1 is the constant for the calibration. To write sensor data to the serial monitor, use the program command;

```
Serial.print("Distance=");
Serial.println(distance,2); delay(300);
```

Testing voice access command

Testing aims to determine if the function of the voice control application works or not. This testing equipment is; android smartphones, computers, or laptops; Arduino and bluetooth circuit HC05; Arduino soft software on the computer; Arduino voice control software or application on a smartphone. The command test procedure follows the following steps; activate the computer and arduino soft; connect arduino uno to the computer via usb interface cable; Run the serial monitor as in the previous test; on the smartphone, activate the Arduino voice control application; connect bluetooth smartphone with circuit; once connected, voice commands can be spoken after pressing the tap to speak button; Observe the display on the computer screen, namely the serial monitor.

After being run and tested according to the above procedure, the test results provide output on the monitor screen in accordance with the speech given via the smartphone. For example, the words "Hello" will be written on the monitor screen "hello" as well. Likewise, with other voice commands such as Go, left, right, and so on. The output given is in accordance with the voice input, although sometimes errors or delays occur. This is because the pronunciation of speech is less clear or other noise disturbances around it.

Overall system testing

System testing aims to determine the work of the hardware and software as a whole. The design of the system is a robot carrying goods. Thus, the test is to provide input according to its function, namely carrying goods and moving them from one place to another with voice commands. The following is the testing procedure performed on the robot. First, turn on the robot via the switch under the robot; Connect the bluetooth smartphone to the bluetooth HC05 as in the previous test. Activate the arduino voice control application that is pre-installed on the smartphone. Giving luggage on top of the robot such as books or other objects. In the Arduino voice control application, click the tab to speak button as in the previous test, then say a voice command such as "go" and so on. In this design, the programmed voice utterances are "Go" to go forward, "left" to turn left, "right" to turn right, and "go back" to go backwards. Observe the movement of the robot in every voice command given.

From the tests that have been carried out as in the procedure above, it can be concluded that the robot works according to voice commands and in accordance with the expected goals. Although there is a delay problem when spoken with the robot's response, it can

be overcome by making the robot's motion slower so that the delay between the command and the response of the robot's motion is not too far away. After that, the robot is tested by carrying a heavy load. In an empty state, the robot moves normally and is agile left, right, forward, and backward. Then the load is added gradually up to a maximum. The robot will appear to start to slow down at maximum weight, making it less responsive to commands. In this test, there is also the robot's response if it encounters obstacles in front of the robot. The robot will stop 30 cm before hitting the object. Overall, it can be said that the robot has been successfully built and executed according to the expected goals.

4. Conclusion

The analysis of the drive motor control system was successfully carried out by calculating and measuring the power of the DC motor. The control system program was successfully created in C language using arduino. The program successfully runs and controls the motor motion properly according to the user's command via Google Assistant. Testing the motion system was successfully carried out on a DC motor, namely the motion of the two motors on the goods-moving robot. The maximum load that can be driven by the motor is 8 kg.

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