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Automatic Car Control Prototype With Sound Application In Android Arduino Uno-Based

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ABSTRACT

A car control device has been made with a voice application on an Android smartphone based on Arduino UNO. This tool uses HC-05 as a Bluetooth transmission media, Arduino Uno as the main controller and 2 DC motors as output. App Inventor is used to make a sound application on a smartphone, if the application receives a "forward" sound then both DC motors will advance. There are 5 voice commands that can be executed namely "forward", "backward", "right", "left" and "stop". From the results of trials that have been determined that this tool can control the car by giving voice commands that have been configured with a microcontroller with a considerable distance 3-5 meters.

1. Introduction

Moreover, if the work is done repeatedly so that it becomes ineffective. Information technology now requires speed and short time in doing work. In carrying out a control of human electronic equipment requires a technology. Here the authors apply a technology that is a microcontroller which is a chip that functions as an electronic controller and generally can store programs and receive input signals, manage them and provide output signals according to them. In a simple microcontroller can be likened to the brain of a device that is able to interact with the surrounding environment.

The development of microcontrollers has become an important part of human life which certainly presents interesting and effective technological developments. One of them is that many robots are controlled both automatically and manually. Previous research discusses the design of an arduino and android-based gate access control [1]. discuss about arduino uno microcontroller that can control the working system of the automatic gate system by working in the order of programming instructions using C language and the gate controller command is given through an application on an android smartphone made using the java program language. Based on the results of measurements and tests, the system on the device that is made is able to open and close the gate automatically at a maximum distance of 11 meters with a maximum response time of 1 second in the state of open space. Here the authors develop from previous research using the Arduino Uno microcontroller with the voice application on Android for car control.

2. Literature Review

2.1 Arduino uno

[2]"Arduino Uno is a series developed from ATmega328 based microcontrollers. Arduino Uno has 14 feet of digital input / output, of which 6 digital feet of which can be used as a PWM (Pulse Width Modulation) signal ". PWM signal serves to regulate the motor rotation speed. Arduino Uno has 6 analogue input legs, a crystal oscillator with a clock speed of 16 MHz, a USB connection, an electrical connector, a header foot from the ICSP, and a reset button that functions to repeat the program.

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Fig 1. Board Arduino Uno
(Source: arduino.cc)

2.2 Mikrokontroller

"Microcontroller is a chip that functions as an electronic circuit controller and generally can store programs in general consisting of CPU (Central Processing Unit), memory, certain I / O and supporting units such as Analog-to-Digital Converter (ADC) which has been integrated in therein "[3] "Microcontrollers generally consist of CPU (Central Processing Unit), memory, certain I / O and supporting units such as Analog-to-DigitalConverter (ADC) which are integrated in it. AVR is an 8-bit CMOS microcontroller series made by Atmel, based on the RISC (Reduced Instruction Set Computer) architecture "[4].

2.3 Bluetooth Wireless Communication

[5] Bluetooth is a wireless (wireless) communication technology that operates in the 2.4 GHz unlicensed ISM (Industrial, Scientific and Medical) frequency band using a frequencyhopping transceiver that is able to provide voice and data communication services in real-time between bluetooth hosts with limited service range. Bluetooth itself can be a card whose form and function is almost the same as the card used for wireless local area network (WLAN) which uses IEEE 802.11 standard radio frequencies. Bluetooth used on this device uses Bluetooth HC-05.

Fig 2. Bluetooth HC-05
(Source: tokopedia.com)

2.4 DCMotor

MotorDC is a machine that functions to change direct current electric power into motion power, where the motion power is in the form of motor rotation. DC motor driver circuits are called half-bridges because the configuration / arrangement of the transistors is like forming the letter H. These transistors are used as switching so that the motor can rotate clockwise and counter clockwise. If the current flow is reversed, the DC motor will rotate in the opposite direction [6].

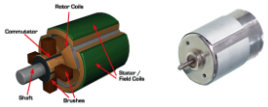

Fig 3.DC Motor
(Source: arduino.cc)

2.5 HC-SR04

[7] Ultrasonic sensors are sensors that have a frequency of 40 khz and are widely used for applications or intelligent robot contests. This proximity sensor uses sonar (ultrasonic waves) to determine the distance from the object in front of it. HC-SR04 has a good performance in detecting distances, with a high level of accuracy and stable detection.

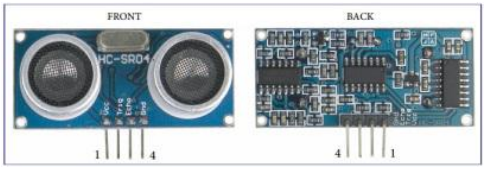

Fig 4. HC-SR04
(Source: https: //depokinstruments.com)

2.6 Android

Android is an operating system platform favored by the community because it is open source so that

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it allows users to develop" [8]. Android is an operating system for cellular phones based on Linux. And Android is a mobile device which includes an operating system, middleware. Android provides an open platform for developers to develop for their own applications for use on a variety of mobile devices.

Fig 6. Android OS
(Source: https://www.android.com/)

3. Methodology

3.1 An Overview of Full Car Prototypes

Car control using the voice application is a system created in the form of an application that is installed into a smartphone that uses the Android operating system which functions to control the car through the Arduino UNO-based Bluetooth wireless transmission media.

3.2 Block diagram analysis

Figure 7 explains the circuit analysis of a car control device in a block diagram. The block diagram is divided into three blocks and each block has a different function from each other. The input block consists of a smartphone that has a voice application installed and the BluetoothHC-05 module as a transmission media, the process block consists of Arduino UNO as the main controller and the output block consists of two DC motors. Each block is activated using an activator in the form of a voltage of 12 volts.

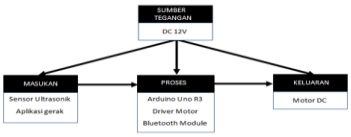

Fig 7. Block Diagram Block

a. Input Block

In this block there is a sound application that has been installed into an Android smartphone that functions to control the car through the Bluetooth transmission media that is on the smartphone. This application will recognize the giving of human voice commands and sent to Google's server and then translated into data in the form of text that is understood by the microcontroller.

The Bluetooth module HC-05 functions as a data transmission medium between the android application and the Arduino uno microcontroller. Bluetooth is mounted on the microcontroller by connecting the Bluetooth Rx foot with the Arduino Tx pin and the Bluetooth Tx foot with the Arduino Rx pin while the ground and V cc feet are connected with the regulator IC, the physical form of the Bluetooth module is shown in Figure 8.

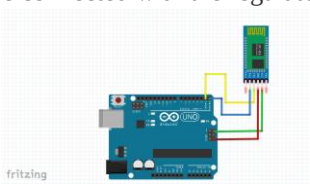

Fig 8. Input Block (Bluetooth HC-05)

Ping HC-SR04 ultrasonic sensor is an ultrasonic wave-based distance measuring sensor. The working principle of this section is similar to ultrasonic radar. Ultrasonic waves are transmitted and then received back by ultrasonic receivers. The distance between the transmit time and the receive time is a representation of the distance of the physical form object from the Ping HC-SR04 ultrasonic sensor shown in Figure 9.

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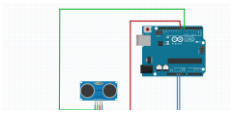

Fig 9. Ping HC-SR04 Ultrasonic Sensor

b. Process Block

This process block consists of Arduino uno ATMega328 which has been planted with an initialization program that functions as a declaration or introduction of what ports are used as well as any external hardware that will be used in this device the hardware used is Bluetooth and DC motors.

Microcontroller will process all the input received from the input given by the voice application sent via Bluetooth in the form of electromagnetic waves that are translated into a data bit and then forwarded to the microcontroller through the trasmiter and reciver legs, then the program will execute the commands it receives in accordance with instructions provided with a program that has been created.

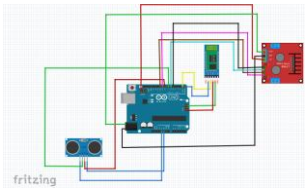

Fig 10. Arduino Uno Process Block

c. Output Block

This output block consists of four dc motors where two DC motors are paralleled and connected to the motor shield where when the voice application on an android smartphone is run to control the car, the input that enters the bluetooth will be sent to Arduino UNO, so outputting the form of the car will advance, backward, turn left or right or the car will stop if pressed the voice button while saying the commands "forward", "backward", "left", "right", or "stop" in the voice application.

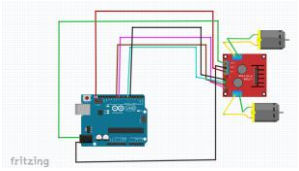

Fig 11. DC Motor Output Block

3.3 Detailed Circuit Analysis

In Figure 12 shows in detail the configuration or a series of electronic motor devices that are connected to the microcontroller and Bluetooth module.

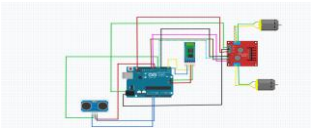

Fig 11. Circuit schematic

Figure 11 shows a schematic circuit where this circuit uses several input components and a DC (Direct Current) voltage of 12 volts originating from the adapter to activate the existing automation. The activator voltage is connected to the Arduino UNO which will supply a voltage to the bluetooth module of 5 volts and a motor shield of 12 volts to run.

In the input component there is the Smartphone application and the Bluetooth HC-05 module where the application and the Bluetooth module must be connected first by pressing the connect button and if the Bluetooth module is connected then the label below becomes "Connected". When the voice button on the application is pressed while saying the specified voice command the Smartphone will send data in the form of electromagnetic waves which are then received by the Bluetooth module HC-05 and translated into an instruction which will then be forwarded to Arduino UNO via the RX and TX legs on the bluetooth module into Arduino UNO.

3.4 Stages of Making an Application Project

Making this application is done on a website with the link http: //ai2.appinventor.mit.edu after logging into the website it automatically enters into the google mail account which functions as a private

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entrance so we don't need to create an account again on the appappinventor website, after entering The email and password will then open the initial display of the app inventor website.

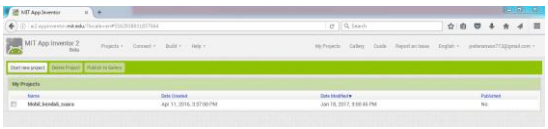

Fig 13. App Inventor initial display

After entering, the project is ready to be created by selecting start new project to create an android application so that a new project will open.

Fig 14. Creating a New Project

after the project is created it will automatically enter the screen project, here the programmer will design the appearance of the program with the various tools available at the left corner.

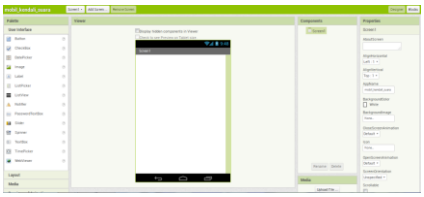

Fig 15. Project view

After the display screen opens there is a large box in the middle that we know the viewer. make the desired program design Make a background design on the sound application display by selecting the background image in the properties then uploading the image from the computer.

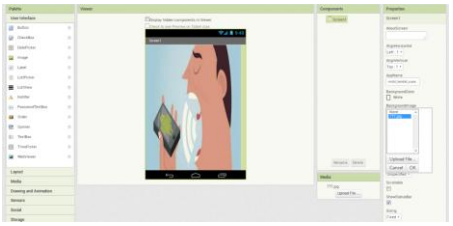

Fig 16. Making background designs

To insert a component into the application view, click the component that you want to add to the Viewer slide in DesaignView. All components in AppInventor can be changed in the Properties column. The Properties column is a collection of properties or views of the components that we have clicked or selected in the Viewer.

Fig 17. Sound Application Design

To start coding in AppInventor, click Open The Block Editor. Then on the blockeditor page, create an application system design using the visualblock programming language.

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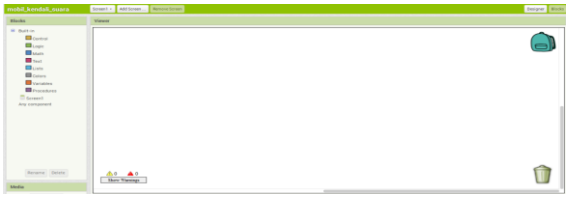

Fig 18. Display BlockEditor

Then after BlockEditor is clicked, the block editor display to make the code ready is made with the code provided by dragging and compiling program logic similar to puzzel that has been provided as desired by the programmer's appearance. After the program is created, we download the apk file by clicking build and then selecting App (save .apk to my computer) then the website will create an apk file and will download the application.

Fig 19. Application Making Process

3.5 Tool Installation or Operation

Here will be explained how to operate a car control device using the voice application on an Android-based smartphone Arduino UNO. In this tool the activation uses a power source with a voltage of + 5V from ArduinoUNO and + 12V from the Adapter.

The steps of operating the tool:

A DC voltage of + 12V using the Adapter will be connected to Arduino UNO and when Arduino UNO and Bluetooth are active the device is ready to use. After this tool is ready to use, first open the voice application on Android smartphone, then turn on Bluetooth on the smartphone, after Bluetooth is turned on, then do the next search by clicking the connect button on the voice application then select BluetoothDevice with the name HC-05. The condition when Bluetooth is not connected is that the program on SmartphonelblStatus will contain the words "Bluetooth hasn't connected with a device" and the LED lights on the Bluetooth module will continue to blink continuously and if it is connected then lblStatus will be "connected" and the lamp LEDs on the Bluetooth module will flash slowly, then if the application on the smartphone is connected, the car controller application is ready to use with voice commands. When clicking buttonvoice and saying the command "forward" the car will go forward and vice versa if you say "backward" then the car will reverse. Likewise to turn right by saying the command "right" then the car will automatically turn right and vice versa if you say the command "left" then the car will turn left automatically, and if we say "stop" then the car will stop. Because this tool functions as a control system, this tool will continue to operate as long as it gets voltage from the activator and will not operate if it does not get voltage.

3.6 Testing tool

When testing the instrument and taking observational data on the design made, it can be seen that the tool is in good working condition and in accordance with the program flow that is made.

4. Implementation

4.1 Tool Implementation Results

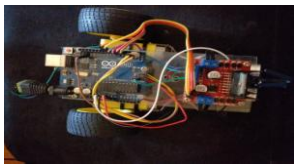

Fig 20. Tool Implementation Results

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Figure 20,is a picture of a tool that is designed as a whole. The tools made consist of 2 important things, which are receiving commands given by the user via smartphoneandroid and stopping automatically when there are obstacles in front. The ultrasonic sensor used is HC-SR04. Smartphoneandroid that is used is the type of Samsung J6 + with the Android operating system version of Pie 9.0.

4.2 Bluetooth Testing HC-06

Arduino Uno is connected with Bluetooth Hc-06 via a digital pin. For the input pins TX and RX HC-06 are connected to pins D0 and D1 on Arduino. Here are pictures of Bluetooth pairing testing along with the results:

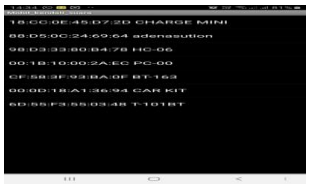

Fig 21. Bluetooth Pairing Testing

4.3 HC-SR04 testing

The results of tests that have been carried out on ultrasonic can be seen in the following table:

Table 1.
Testing HC-SR04

No	Setting Values in Programs	Tool Condition
1	0.5 cm distance	Off
2	1 cm apart	Off
3	Distance of 2 cm	Off
4	Distance of 3 cm	On
5	Distance of 4 cm	On

Discussion of ultrasonic sensor test results:
From the experimental results it is intended that the ultrasonic sensor works at a distance of 0.5 cm to 2 cm. From these results it can be seen that the sensor can work according to program instructions on Arduino.

4.4 Testing Tool

After all devices are connected to Arduino then at this stage the device will be tested. Following is the display of the testing tool:

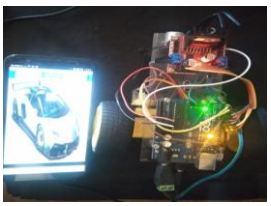

Fig 22. Testing Tool

a. Testing the Success Rate of Giving Voice Commands to the Voice Application with the Same Person

The purpose of this test is to prove the success rate of detecting voice commands received on voice applications with the same voice. In table 1 below is the result of testing voice commands 10 times each command with the voice of the same person.

Table 2.
Test Results for Giving Voice Commissions that Have Been Determined

No	Voice Commands	The level of success of pronunciation	Condition
1	Up	7 times	Up
2	back off	8 times	back off
3	left	6 times	left
4	right	9 times	right
5	Stop	8 times	Stop
Percentage of success		**76,00%**	

b. Testing of Voice Commanding from Different People

The purpose of this Test is to determine the level of success of voice applications in receiving voice commands from different people. The order was given by three different people.

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Table 3.
Test Results of Giving Orders from Different People

No	People to	Voice Commands				
		Up	Back off	left	right	Stop
1	First	7	8	6	9	8
2	Second	8	9	5	10	7
3	Third	8	8	7	8	9
Total		23	25	18	27	24
Average percentage of success		78,00%				

To determine the percentage rate of success in giving voice commands to control the car is determined by two reasons, the first of the smartphone internet network is faster and more stable the network then the voice application will quickly detect the pronunciation given, secondly in the pronunciation of the user's command must pronounce it clearly.

c. Distance Testing for controlling tools

The purpose of this test is to find out what is the ideal distance on the HC-06 bluetooth module transmission media in this test given a distance from 1 meter to 10 meters.

Tabel 4.
Distance Testing

No	Voice Commands	Jarak									
		1m	2m	3m	4m	5m	6m	7m	8m	9m	10m
1	Up	√	√	√	√	√	√	√	√	√	√
2	Back off	√	√	√	√	√	√	√	√	√	√
3	Left	√	√	√	√	√	√	√	√	√	√
4	Right	√	√	√	√	√	√	√	√	√	√
5	Stop	√	√	√	√	√	√	√	√	√	√

In this test the maximum distance of 10 meters, but the response of the device to the sound tends to be slow and the success rate of pronunciation is also reduced. Therefore, it is recommended at a distance of 3-5 meters to get maximum results.

5. Conclusion

A car control device has been created using a voice application that has been installed on an Android Smartphone with Bluetooth transmission media as a link between the Smartphone and an electronic device. This controller has been well tested in controlling a car that has been configured with a microcontroller and has also been tested with three tests including: Testing the giving of voice commands on voice applications with the same person with a percentage of success of 76.00%, Testing the giving of voice commands on voice applications from different people with an average percentage of success of 78.00%, Testing the distance to control the tool to find out what is the ideal distance on the bluetooth module transmission media with the tested distance from 1 meter to 10 meters, Testing the distance to determine the ideal distance on the ultrasonic module transmission media with different media and tested at a distance of 1 centimeter to a distance of 10 centimeters

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