



***DESIGN OF VOICE CONTROL SYSTEM AN ANDROID AND ARDUINO-ASSISTED
AS A COMPONENT ACTIVATION ON VEHICLES***

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ABSTRACT

The purpose of this research was to design an Android and Arduino-assisted voice control system as a component activation on vehicles. The method in this study are; making initial design concepts, procuring tools and materials, manufacturing products, testing products, and analyzing product performance. The conclusion of this research is that this system has gone through the application design stage on android using MIT App Inventor 2 and making the program using Arduino IDE, and the last stage is product testing. The test results show that the application installed on an android smartphone is able to work properly. The design of the program on a microcontroller using Arduino was also successfully compiled. This voice control vehicle module achieves connectivity capability with Bluetooth as far as 14 meters. Accuracy of voice commands in the range of 73-95%, this result was obtained using clear voice articulation according to acceptance in google speech and using good internet network connectivity. Able to activate and turn off vehicle door locks, hazard, alarm, and engine.

Keywords: voice control, android, arduino, vehicle

INTRODUCTION

The world's automotive technology is developing very rapidly, ranging from interior-exterior design, electrical systems, ignition systems, engine construction and so on have experienced significant developments and changes from year to year. In the ignition system, the use of breaker point, CDI, and now the ECU are smarter to detect the character of the user and adjust any settings needed on the vehicle according to the user's character so that maximum performance is obtained. With the rapid development of the world automotive, innovations have begun on features that are based on electrical, including the voice control system that is currently being developed. Additional features such as voice commands began to be applied to vehicle infotainment systems. Thus, all the commands can be done without the need to press the button, just simply by saying it.

According to Kevin (2015) voice control technology on smartphones enables mobile device users to gain freedom to move and reduce the need to constantly glance at their screens. This is achieved by allowing users to verbally instruct their devices to perform ordinary tasks such as setting alarms, making calls, or even starting any application. Voice control technology can be combined with Android on a smartphone, that is by making a command program using Arduino which is implanted by wireless devices such as bluetooth, infrared and

wireless. The use of Android technology on smartphones can provide alternative solutions in modifying existing features on the vehicle, so that the control of activation of components on the vehicle can be done via a smartphone remotely.

From the background above, there are some interesting things to be examined including designing an Android and Arduino voice control system to activate the components on the vehicle, so that it can simplify the operation.

Voice sensor

A voice sensor is a device that can convert sinusoidal voice waves into sine waves of electrical energy (Alternating Sinusoidal Electric Current). The voice sensor works based on the size of the sound wave strength on the sensor membrane that causes the sensor membrane to move, which also has a small coil behind the membrane going up and down. The voice sensor works by changing the amount of sound into an electric quantity. The incoming signal will be processed so that it will produce a condition that is condition 1 or 0, where the signal is read by the microcontroller (Afi, 2015).

Voice control can use the Android Arduino application as a voice sensor replacement channel.



Figure 1. Voice control application on Android

According to Prerana (2015) voice control is a software that allows users to control computer functions and determine text with sound. This system consists of two components, the first component to process the acoustic signal captured by the microphone and the second component is to interpret the signal being processed, then map the signal to words.

Arduino UNO

Yahya (2017) explains that Arduino is an open source single board micro controller, derived from a wiring platform, designed to facilitate the use of electronics in various fields. According to Kadir (2013) Arduino is one of the products labeled as Arduino which is actually an electronic board containing an Atmega328 microcontroller (a chip that functionally acts like a computer). This device can be used to realize electronic circuits from simple to complex. LED control to robot control can be implemented using small boards. Even with the addition of certain components, this device can be used for remote monitoring via the internet.

Arduino UNO contains a microprocessor in the form of Atmel AVR and is equipped with a 16MHz oscillator that allows time-based operations to be carried out properly, and a regulator (voltage generator) 5 volts. Arduino has Pin 0 to Pin 13 which are used as digital cues. Next Pin A0 to A5 is used for analog signals. Equipped with 2KB of Static Random-Access Memory (SRAM) for holding data, 32KB of flash memory, and Erasable Programable Read-Only Memory (EEPROM) for storing programs.



Figure 2. Arduino UNO

Activation of components in vehicles

The components of the vehicle that can be activated using a voice control system namely; starter motor, car door, hazzard lights and horn.

Central door lock vehicle

Central door lock security system has the main function to lock all car doors simultaneously which can be controlled by locking on the driver's side door. If knopa or the lever on the driver's side is pulled or pressed, the door with this system will either lock or open simultaneously. Besides being able to be operated manually, this system

can also be operated using Remote Control for lock and unlock positions. This system has several main components, namely actuator (motor), main board module, siren, LED, and remote control (Suratman, 2009).

The working concept of the central door lock circuit is centered on the main board part as a signal regulator component to each of the other components. If in a car engine with an EFI system, the main board on this unit works the same as the ECU on the engine, which functions to receive the input signal from each sensor in the circuit and then forward the signal to the other components as Output.

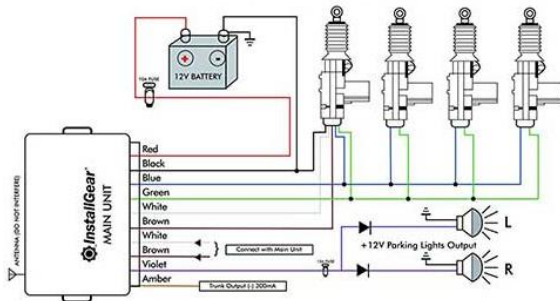


Figure 3. Central door lock system circuit

Hazard Lamp

Hazard lights or commonly referred to as emergency warning lights are the function mode of external lights on the majority of motorized vehicles that can be activated to make the left and right turn signal blinking simultaneously indicating that there is an emergency or notice to be careful of other drivers on the road.

Electronic flasher works by utilizing metal expansion and shrinkage to make contacts work on-off. When a current is

passed to the heating coil, the electric current will be transmitted to the contact point and the light then to the mass, when the light is on. Some time the coil will heat up the bimetal so that it expands and will break the contact point, as a result the current is cut off and the lights will turn off. When the heating coil is not electrified again, the temperature will go down and the bimetal will shrink back so that the contact points return to normal contact. and so on until the battery current is disconnected.

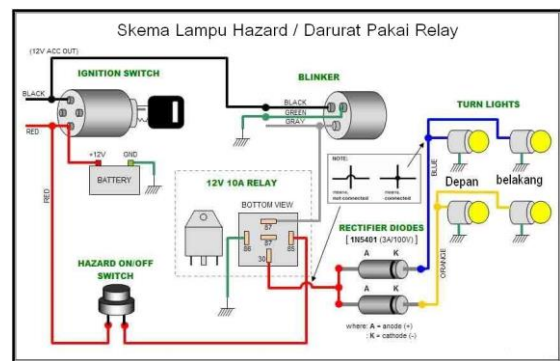


Figure 4. Hazard sequence

Horn

Horn or signal horn or also called flute works based on electromagnetism, an iron core is equipped with a coil connected in series to the contact breaker, in the non-working position. The contact is closed, the iron core becomes a magnet when the current is flowed into the horn.

The iron core pulls the armature which is connected to the elastic diaphragm, when pulled, the contact breaker is moved by the armature and the contact is cut off, the current stops to the coil, the armature returns because the diaphragm spring power

and tone disc produce sound (Daryanto, 2008).

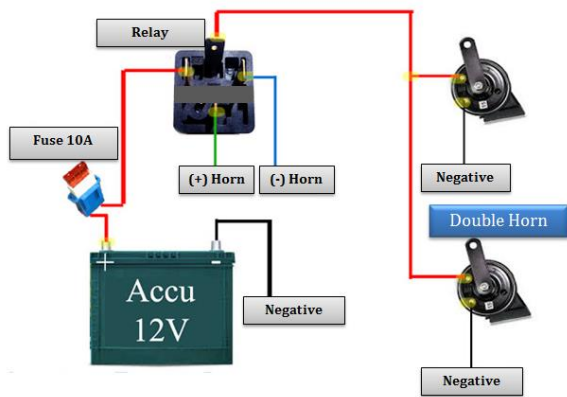


Figure 5. A series of horn systems

Starter Motor System

The starter system is part of the system in the vehicle to provide the engine with an initial rotation so that it can run its working cycle. By turning the fly wheel, the engine gets an initial spin and then it can work giving its own rotation through the combustion cycle in the combustion chamber (Kuswana, 2014)

Of the various types of starter systems in cars that are most often used, namely electrical starters.

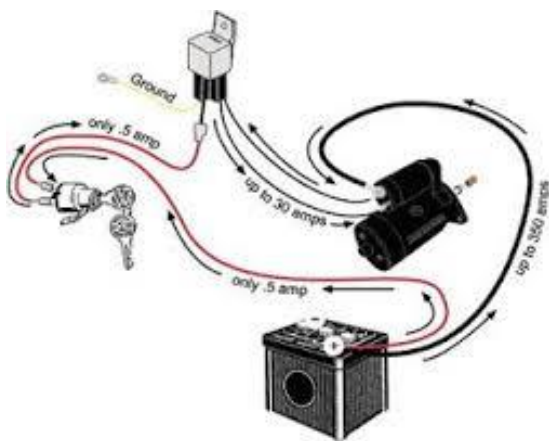


Figure 6. Starter system circuit

RESEARCH METHODS

This research was conducted at the Polytechnic Indonusa Surakarta Automotive Workshop. The following will explain the research flow in the design of Android and Arduino-assisted voice control systems to activate components in the vehicle.

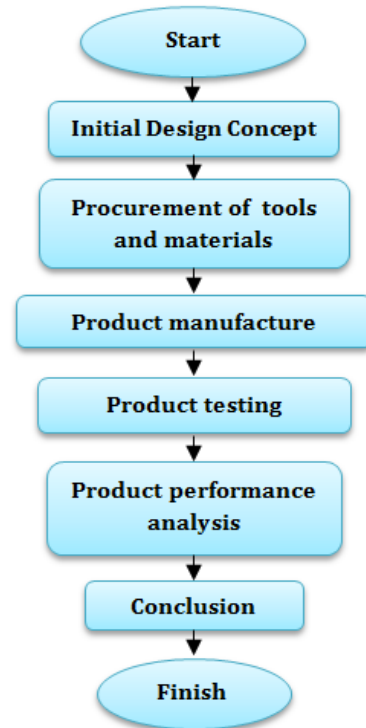


Figure 7. The flow of research

Design

In the process of designing this tool the first thing to do is to draw a prototype design first in order to obtain a more mature prototype planning. The design uses the help of proteus software version 7.7 SP2 Pro.

Initial design concept

All existing thoughts and ideas are expressed in an initial design or drawing sketch.

Procurement of tools and materials

Equipment needs to be provided in advance to support the work. Materials or components to be used are inventoried first, then grouped into electronic and mechanical components.

Product manufacture

After all the equipment and materials are available, the next step is making the product. Based on the finished design, the system began to work by programming the Arduino and Android microcontrollers.

Product testing

This step is done to determine the ability of the product performance that has been made. Trials are carried out several times to get results according to the plan.

Product performance analysis

In retrieving data we can find out whether the product can function properly through the data taken. The last stage is to draw conclusions from the results of testing and analysis based on data that has been collected.

RESULTS AND DISCUSSION

The design of voice control applications on android is made using MIT App Inventor 2 which is done online on the website <http://appinventor.mit.edu>.

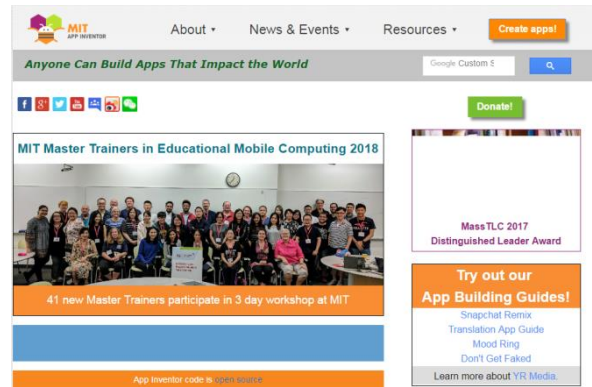


Figure 8. The home page of MIT App Inventor 2

How to use MIT App Inventor 2, namely by logging in using an email account. Click on "creat apps" and the MIT App Inventor 2 work sheet will appear. On that work sheet, the place to create the application will appear.

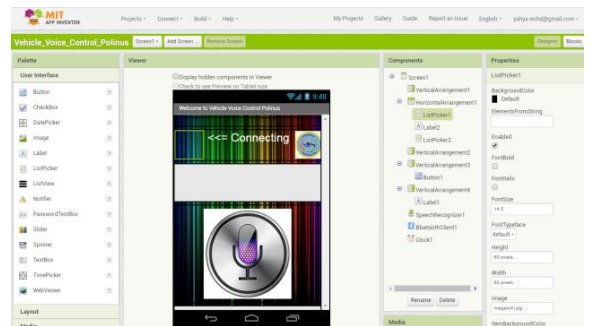


Figure 9. Worksheet MIT App Inventor 2

Software design in Arduino IDE is done by testing serial instructions for matching data with the control to be designed. The control is in the form of an order to turn objects on and off. If active it will be given the command "HIGH" and if turned off it will be given the command "LOW". Following is the coding made on the Arduino IDE:

Declaring output

The output declaration is used to call the output pin on Arduino, so it will automatically activate the pin.

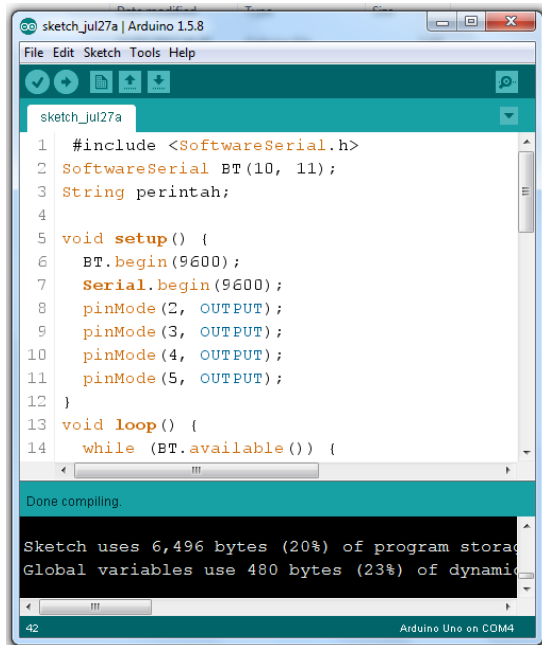


Figure 10. Voice control program

After the design is finished, the next step is to arrange and try to get the results that are in accordance with the plan. The results of the design of applications on android are then converted into a form of application files that can be installed on an android smartphone. Furthermore, the coding program from Arduino IDE is also uploaded on Arduino R3. The pins used are; PIN 2, PIN 3, PIN 4, PIN 5.

```

1  #include <SoftwareSerial.h>
2  SoftwareSerial BT(10, 11);
3  String perintah;
4
5  void setup() {
6    BT.begin(9600);
7    Serial.begin(9600);
8    pinMode(2, OUTPUT);
9    pinMode(3, OUTPUT);
10   pinMode(4, OUTPUT);
11   pinMode(5, OUTPUT);
12 }

```

Calling Bluetooth serial

Connectivity used is via Bluetooth. The pins used are PIN 10 and 11.

```

13 void loop() {
14   while (BT.available()) {
15     delay(10);
16     char c = BT.read();
17     perintah += c;
18   }
19   if(perintah.length() > 0) {
20     Serial.println(perintah);

```

Program commands

The command program used is to turn on and turn off the door lock (padlock), hazard lights, alarms, and engine.

```

21  if (perintah == "padlock on")
22  { digitalWrite(2, HIGH); }
23  else if(perintah == "padlock of")
24  { digitalWrite(2, LOW); }
25  else if(perintah == "Hazard on")
26  { digitalWrite(3, HIGH); }
27  else if(perintah == "Hazard of")
28  { digitalWrite(3, LOW); }
29  else if(perintah == "alarm on")
30  { digitalWrite(4, HIGH); }
31  else if(perintah == "alarm off")
32  { digitalWrite(4, LOW); }
33  else if(perintah == "engine on")
34  { digitalWrite(5, HIGH); }
35  else if(perintah == "engine of")
36  { digitalWrite(5, LOW); }

```

In addition, the program is also made by activating and shutting down all components in the following way.

```

37 else if(perintah == "all on")
38 { digitalWrite(2, HIGH);
39   digitalWrite(3, HIGH);
40   digitalWrite(4, HIGH);
41   digitalWrite(5, HIGH); }
42 else if(perintah == "all of")
43 { digitalWrite(2, LOW);
44   digitalWrite(3, LOW);
45   digitalWrite(4, LOW);
46   digitalWrite(5, LOW); }
47 perintah="";}
    
```

Tool design

Here is a product design image of Android and Arduino-assisted voice control system design to activate components in the car. In product design there are two stages, the first is designing electrical system hardware circuit designs and the second is designing programs through sketching on the Arduino IDE.

Next is the circuit design and sound control system program assisted by Android and Arduino to activate components in the car.

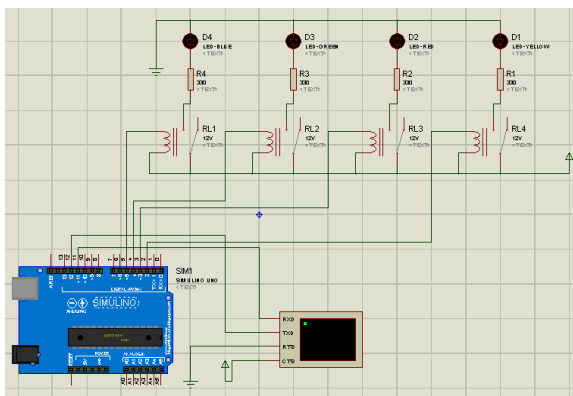


Figure 11. A series of sound control systems

Application testing

This test is done by activating the touch screen button item on the smartphone. In this test, the application was successful through pairing on bluetooth.



Figure 12. Testing the application on Android smartphone

Testing bluetooth connectivity on the module

Trial of this module is by finding Bluetooth connection capabilities with a maximum connection distance.

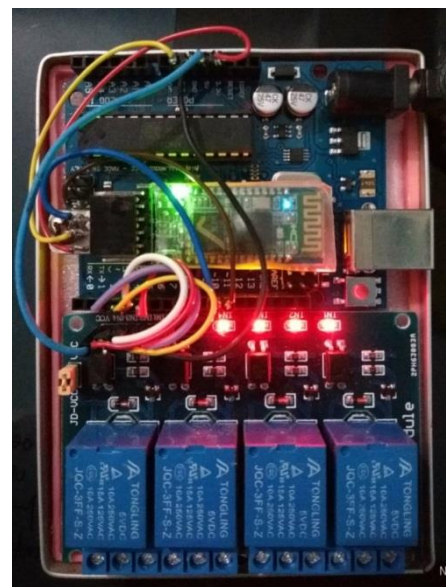


Figure 13. Testing Bluetooth connectivity

The test results found that the connection capability within 14 meters still has good connection capabilities. At a distance of 14.5 meters to 16 meters connectivity becomes unstable and at a distance of more than 16 meters the connection is no longer good.

Sound accuracy testing of the application

Voice accuracy is done to test the effectiveness of voice commands on the reception of sound wave signals on smartphone applications. Application connectivity utilizes Google Speech tools. The results of the accuracy of voice commands are shown according to Table 1.

Table 1. Results of accuracy of voice commands

Sound Command	Accuracy Results (%)
Padlock ON	85
Padlock OF	92
Hazard ON	73
Hazard OF	73
Alarm ON	90
Alarm OFF	90
Engine ON	95
Engine OFF	95
All ON	90
All OF	90

Based on the table above shows that the results of the measurement of the accuracy of voice commands in the range of 73 - 95%. This result is obtained by using clear articulation of sound according to acceptance in google speech.

CONCLUSION

Based on the research and testing results described above with reference to the problem formulation, it can be concluded that the design of an android and arduino-assisted voice control system as component activation on this vehicle has gone through the application design stage on android using MIT App Inventor 2 and making a program using Arduino IDE, and the last step is to do product testing. The test results show that the application installed on an Android smartphone is able to work properly. The design of the program on the microcontroller using Arduino was also successfully compiled. This voice control vehicle module has the ability to connect with Bluetooth as far as 14 meters. The results of accuracy of voice commands in the range of 73-95%. These results are obtained by using clear voice articulation according to the acceptance on google speech. Able to activate and deactivate the vehicle door lock (padlock), hazard, alarm, and engine.

REFERENCES

- Afi. 2015. Sensor Suara. Accessed on 2 June 2017. Available at <http://afielektronika.blogspot.com/2015/01/makalah-sensor-suara.html>.
- Daryanto. 2007. *Motor Bensin Pada Mobil*. Bandung : Yrama Widya.
- Daryanto. 2008. *Memahami dan Merawat Sistem Kelistrikan Mobil*. Bandung : Yrama Widya.
- Das, P., Acharjee, K., Das, P. and Prasad, V. 2015. 'Voice Recognition System: Speech-To-Text'. *Journal of Applied and Fundamental Sciences* 1(2):2395-5562. Available at : <https://www>.

- researchgate.net/profile/Vijay_Prasad
8/publication/304651244_VOICE_REC
OGNITION_SYSTEM_SPEECH-TO
TEXT/links/5775f84708ae1b18a7dfe
584/VOICE-RECOGNITION-SYSTEM-
SPEECH-TO-TEXT.pdf
- Kadir, Abdul. 2013. Panduan Praktis
Mempelajari Aplikasi Mikrokontroler
dan Pemrogramannya Menggunakan
Arduino. Yogyakarta: Penerbit ANDI.
- Kevin, O and Kasamani, B. 2015. The
Application of Real-Time Voice
Recognition to Control Critical Mobile
Device Operations, International
Journal of Research Studies in Science,
Engineering and Technology Volume 2,
Issue 7, July 2015, PP 174-184 ISSN
2349-4751 (Print) & ISSN 2349-476X
(Online)
- Kuswana, Wowo Sunaryo. 2014. Sistem
Kelistrikan Kendaraan Ringan.
Bandung : Remaja Rosdakarya.
- Suratman. 2009. Servis dan Teknik Reparasi
Sepeda Motor. Bandung: Pustaka
Grafika.
- Widodo, Edi. 2011. *Otomotif Sepeda Motor*.
Bandung: Yrama Widya.
- Romadhon, W.E. 2017. Cara Memasang Relay
Klakson Motor / Mobil. Accessed on 2
June 2017. Available at
<http://www.wahyueko.id/2016/08/cara-memasang-relay-klakson-motor-mobil.html>.
- Skyнет, Z. 2015. Koleksi Skema Lampu
Darurat Hazard. Accessed on 2 June
2017. Available at
<http://mitrabaterai.blogspot.co.id/2015/11/koleksi-skema-lampu-darurat-hazard.html>.
- Yahya, Wachid. 2017. 'Sistem Kontrol
Otomotif'. Yogyakarta : Deepublish.