PalArch's Journal of Archaeology of Egypt / Egyptology

SMART BUILDING WITH SPEECH RECOGNITION THROUGH ANDROID AND RCWL-BASED BLUETOOTH HC05 (CASE STUDY: SMKS PELITA BUNGA BANGSA ARJASARI)

Rian Eka Putra[1], Kurniawan Rosadi[2], Asep Kurniawan[3], Wafi Firgiwansyah[4], Ase Suryana[5]

[12345]Widyatama University, Indonesia

[1]rian.eka@widyatama.ac.id,[2]1818123003@widyatama.ac.id,[3]asep.kurniawan@widyatama.ac.id,[4]wafi.firgiwansyah@widyatama.ac.id, [5]ase.suryana@widyatama.ac.id

Rian Eka Putra, Kurniawan Rosadi, Asep Kurniawan, WafiFirgiwansyah, AseSuryana. Smart Building With Speech Recognition Through Android And Rcwl-Based Bluetooth Hc05 (Case Study: SmksPelita Bunga BangsaArjasari)--Palarch's Journal Of Archaeology Of Egypt/Egyptology 17(4), 3316-3335. ISSN 1567-214x

Keywords:smart building, Arduino Uno, Bluetooth HC05, RCWL 0516 Sensor

ABSTRACT

The Need for Technological Progress that increases human brilliance has become a matter of consideration and has become a source of pride for everyone for the happiness of educational institutions, institutions or institutions that are interested in providing convenience, comfort and safety provided for the needs of electrical equipment, the authors take the title " Smart Building With Speech recognition Via Bluetooth HC05 Based on Android and Rcwl Sensor ". in discussing this research report the author discusses how to control existing equipment in the room can be used and controlled with a Bluetooth-based smartphone that is distributed by everyone and should be translated according to the functions and uses of the micro controller Arduino Uno based commonly used to control other electronic equipment. and using RCWL 0516 sensor with the aim of connecting with humans. This makes the building to regulate electrical equipment via a smartphone and only activates electrical equipment if there is activity in the room, and will die if there is activity in the room. A tool created and designed for testing this first smart building. The test results indicate being able to install electrical equipment automatically based on requests from smartphones to the electrical system in the building.

Keywords: smart building, Arduino Uno, Bluetooth HC05, RCWL 0516 Sensor

INTRODUCTION

The development of increasingly sophisticated technological innovations is now one of the demands of many countries. This is due to innovation as a form of technological progress in a country. The progress of a country's technology signifies an effort in that country to create the latest technology that can benefit many audiences. Smart Building is a system that has been programmed and can work with the help of an Android smartphone to integrate and control a device or electrical

equipment automatically and efficiently. The purpose of the creation of this technology is to facilitate saving energy, improve security, get comfort, and so forth.

So far, there are a lot of people with disabilities who have limitations every day in their activities, both in the environment and in their own homes because they certainly want to be able to do these activities without the help of others (Tarigan, 2017). As lighting a lamp is sometimes limited to the distance of the light switch that is far from its reach so that the speech recognition technology is expected to help and overcome the problems of people with disabilities.

Turning off the lights so far is also still done manually or still using the switch, this certainly can take more time just to walk towards the light switch that will be turned off. Besides the low supervision of students does not rule out the possibility of students with wet hands playing with a light switch and is very dangerous if electrocuted by the switch. Therefore, speech recognition technology is needed as a substitute for manual switches to be more practical.

Speech recognition technology is a technological breakthrough that is currently widely used. The operation of speech recognition is only by saying a command to control the device that is integrated with the user as a tool to facilitate human activities and even replace the role of humans in a particular function. The emergence of digital sound storage devices encourages mix technology.

Android smartphones are now widely used in the global era because the operating system used is already familiar to the public (Alfrey, 2016). The use of smartphones in everyday life is inseparable from the function for communication other than that the use of Android smartphones now can control household appliances because the development of the Android operating features are increasingly sophisticated and can even be used as a remote control because there is now a smartphone equipped with IR (Infra Red) as a controller of electrical equipment such as air conditioners, TV, projectors, DVD players and many other electrical equipment.

Bluetooth communication on smartphones has been widely used especially as a medium for file transfer communication between smartphone users. The advantage of file transfer communication using Bluetooth is because its operation is quite easy just by connecting the two devices that are connected to each other. This is what makes the writer to make voice control via Bluetooth with an android smartphone.

In this thesis the author chose to control the lights and sockets because this electrical equipment is very often used in everyday life and is very important in its function as lighting that supports activities in a closed room. In addition, the authors also choose to control the lights by adding motion sensors and light sensors related to the LCD display so that we can find out the problem of the lights on or not on each lamp and socket (SAPUTRA, 2018).

Based on the above background the author intends to make devices that can be operated with a voice control system. With voice control is expected to facilitate human activities in doing something and in controlling the automation can be applied. The device can later be used to control lights and electrical equipment through voice

commands with the title "SMART BUILDING WITH SPEECH RECOGNITION THROUGH ANDROID-BASED BLUETOOTH AND RCWL SENSORS".

LITERATUR REVIEW

Smart Building

Smart Building is a system that has been programmed and can work with the help of an Android smartphone to integrate and control a device or electrical equipment automatically and efficiently. The purpose of the creation of this technology is to facilitate saving energy, improve security, get comfort, and so forth.

One of the habits of students who want to be simple and straightforward as well as the habit of leaving class without turning off electrical equipment becomes one of the dangers for the room and the electrical equipment. The Principal of Pelita Bunga Bangsa School, Arjasari, revealed that the level of damage to electrical equipment in classrooms is more vulnerable to damage if the electrical equipment is not turned off.

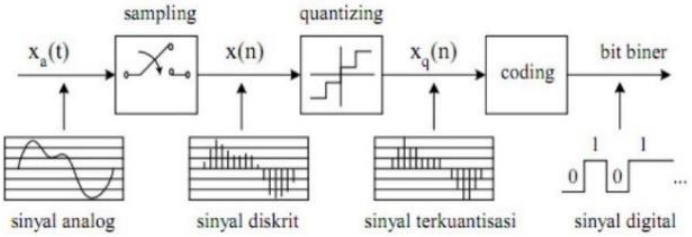
For example, forgetting to turn off electrical equipment in classrooms that can cause electrical short circuit / short circuit and can cause a fire, then we need a system that is able to control the electrical equipment automatically. Based on the explanation of the problem above, it is necessary to build an application with the theme of the title "Smart Building to control Electrical equipment" using Arduino microcontrollers and Android smartphones using Bluetooth Devices ".

Smartphone

A smartphone is a mobile phone that has a high level of ability to make and receive calls from the network. There are no factory standards that determine the meaning of a smartphone. For some people, a smartphone is a phone that works using all operating system software that provides standard and basic relationships for application developers. For others, a smart phone is just a phone that presents advanced features such as electronic mail, internet and the ability to read electronic books. In other words, a smartphone is a small computer that has the capabilities of a telephone.

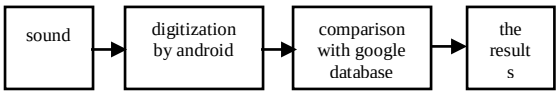
Speechrecognition

speech recognition is the conversion of an acoustic signal, which is captured by a microphone or telephone, to compose words. In line with the opinion added that speech recognition not only involves the process of converting acoustic signals into text but also the process of identifying what the speaker / user is saying. Therefore, the words spoken by the speaker / user will be recognized and are the final result for an application such as command and control, input data, and document preparation.
The commands uttered by the user are then transformed into digital signals by changing sound waves into a specific set of codes. The process of converting analog signals to digital converters through three stages (SAPUTRA, 2018)



Picture 2.1. The process of converting analog signals into digital signals
(Source:SAPUTRA,2018)

This set of code is used to identify the command that has been said. The results of the identification of the command are then displayed in written form that can be recognized by technological devices as a command to take action, for example in the Google OK application that can search for things through search engines that we want such as searching for locations, images, and navigation. Thus, it can be concluded if speech recognition has the primary purpose as a machine to "hear", "understand", and "respond in the form of actions" verbal information spoken by the user.
Speech recognition also has a sound sampling or digitizing system. This system works by taking the right size of the sound waves produced by the user. This sampling system will filter out the digitized sound and remove noise in the form of noise. This sampling system also serves to normalize the sound with a fixed volume and flatten the sound. As for the speech recognition system itself starting from voice recognition to the results in the form of text illustrated in the flow chart below (Irawan, 2014).



Picture 2.2. Speech Recognition Flow Chart(SAPUTRA, 2018)

Arduinouno

Arduino Uno is an ATmega328 microcontroller based circuit board. This IC (+ integrated circuit) has 14 digital inputs / outputs (6 outputs for PWM), 6 analog inputs, 16 MHz ceramic crystal resonator, USB connection, adapter socket, ICSP header pin, and reset button. This is what is needed to support a microcontroller, simply, just by connecting it to a computer with a USB cable or AC-DC adapter voltage source and battery (Prawoto, 2015). In addition, using ATmega328 is much cheaper than ATmega16. So this ATmega328 is used to process input and output on this tool.

Picture 2.3. Arduino Uno
(Source : Prawoto, 2015)

Bluetooth Module HC-05

According to Y.Fahruroji, 2017, Bluetooth module HC-05 is a wireless communication module on the 2.4GHz frequency with a choice of connections can be

as a slave, or as a master. Very easy to use with a microcontroller to create wireless applications. The interface used is the serial RXD, TXD, VCC and GND. Built in LED as a connection indicator on the Bluetooth module. Input voltage is between 3.6 ~ 6V, do not connect with a power source of more than 7V. Current when unpaired is around 30mA, and when paired (connected) is 10mA. 4 3.3V interface pins can be directly connected to various types of microcontrollers (specifically Arduino, 8051, 8535, AVR, PIC, ARM, MSP430, etc.). The effective range is 10 meters, although it can reach more than 10 meters, but the quality of the connection decreases (Rumopa, 2015).

Picture 2.4. Bluetooth module HC-05
(Source: Robotic, 2020)

RCWL Module 0516

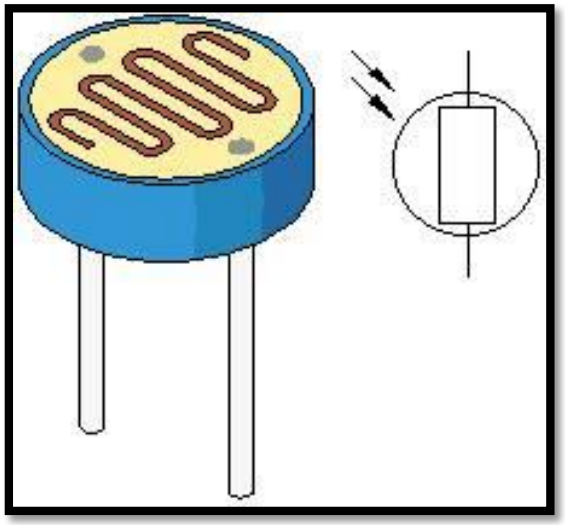
RCWL 0516 module is a Doppler radar microwave motion sensor module, works by reading the surrounding sound waves and this sensor can read movements up to 5 meters distance from the object to the sensor. The physical form of the RCWL 0516 Module is shown in the Ficture below.

Picture 2.5. RCWL Module 0516 (Source:(Aini, Rahardja, Madiistriyatno, & Fuad, 2018)

Light Dependent Resistor (LDR)

Light Dependent Resistor is one type of resistor that can experience changes in resistance if it changes in light reception. The magnitude of the resistance value on the Light Sensor LDR (Light Dependent Resistor) depends on the size of the light received by the LDR itself. LDR is often referred to as a device or sensor in the form

of a resistor that is sensitive to light. Usually LDR is made of cadmium sulfide which is a semiconductor material whose resistance changes according to the amount of light (rays) about it. LDR resistance in a dark place usually reaches around 10 MΩ, and in bright places the LDR has a resistance that drops to around 150 Ω. Like conventional resistors, the installation of an LDR in a circuit is exactly the same as an ordinary resistor installation. The LDR symbol can be seen as shown below.



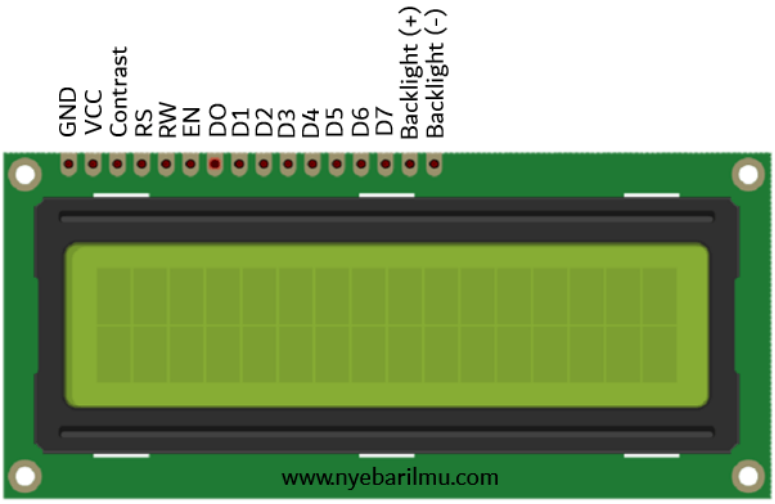
Picture 2.6. Light Dependent Resistor (Source : (Margiono, 2017)

Liquid Crystal Display (LCD) 16 x 2

Liquid Crystal Display (LCD) 16 x 2 is a type of media that uses liquid crystal as the main viewer. And a media that is very effective and efficient data appearance in displaying a character on the LCD screen

The features of the 16 x 2 LCD :

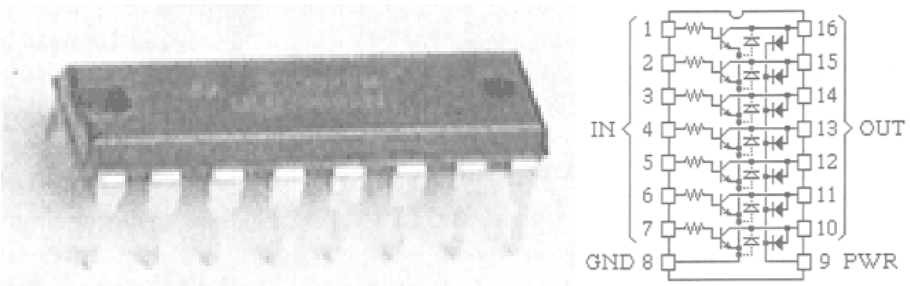
1. Consisting of 16 characters and 2 lines
2. Has 192 saved characters
3. There is a programmed character generator
4. Can be addressed with 4-bit and 8-bit modes
5. Equipped with a back light



Picture 2.7. Liquid Crystal Display 16 x 2 (Source : (Nyebar, 2017)

IC Driver ULN 2003

IC ULN 2003 is an IC characterized by having a 7-bit input, a maximum voltage of 50 volts and a current of 500mA. This IC is TTL type. Inside this IC there is a darlington transistor. Darlington transistors are 2 transistors arranged in a special configuration to get a double gain so as to produce a large current gain.



Picture 2.8. IC Uln 2003 (Source: (Widiyanto, 2010)

Relay

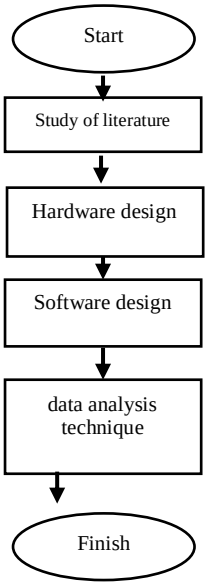
According to relays are basically switches that connect or disconnect the voltage contact mechanically if given a voltage, the relay will work and the relay will immediately close the connection), if the relay does not get voltage then the relay cannot operate (disconnected) . Because the relay is normal close (NC) and normal (NO).

Picture 2.10. RELAY - HANAYA
(Source: (Elektronik, 2020)

RESEARCH METHODS*Methode*

Research carried out is a type of engineering research or design, the design in question is a space in the field of electricity.

The design of this research tool will generally be completed in stages such as in the Figure below:



Picture 3.1. Research Design Block Diagram

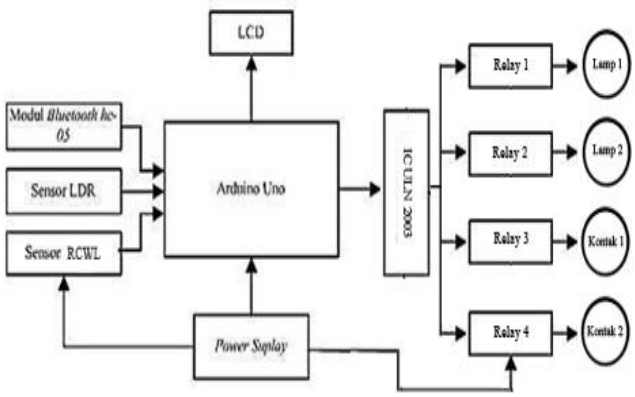
Literatur Study

Before working on this study, researchers examined several studies that are still in good relations. From some of these studies a problem statement will be found. Submitting research questions whose answers must be sought using relevant data. Then the researcher needs to establish the information needed to answer the questions that have been formulated. As literature, researchers study manuals and journals about

controlling electrical equipment using Arduino UNO based on Bluetooth, or journals on Smart Building.(Fauzi, Rijanto, & Wardana, 2019)

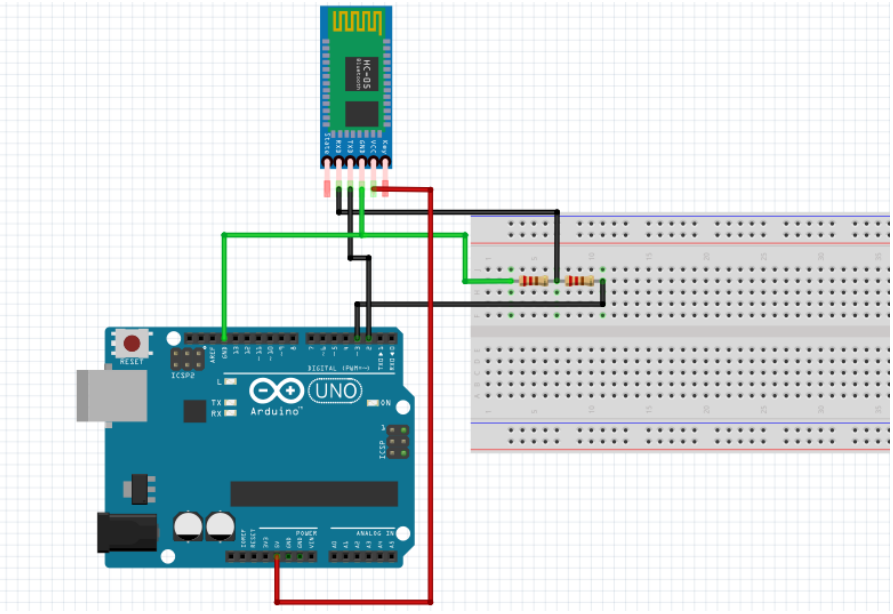
Hardware Design

The process of making hardware tools, controlling electrical equipment. Uses Arduino uno based Bluetooth. This smart building control and security study implements several components such as the RCWL 0516 sensor, LDR sensor, Bluetooth HCO5, 16 x 2 LCD and Relay which are connected to Arduino Uno as the control center. RCWL 0516 sensor to detect human movement, LDR sensor serves to detect the dark or bright lights. While Bluetooth HCO5 functions to connect to a smartphone and LCD 16 x 2 to display information that is being controlled. To regulate turning on and off electrical equipment at home, a Relay controlled via a smart phone is used. In this study, researchers used four relays that were used to turn on and turn off lights and different electrical equipment.



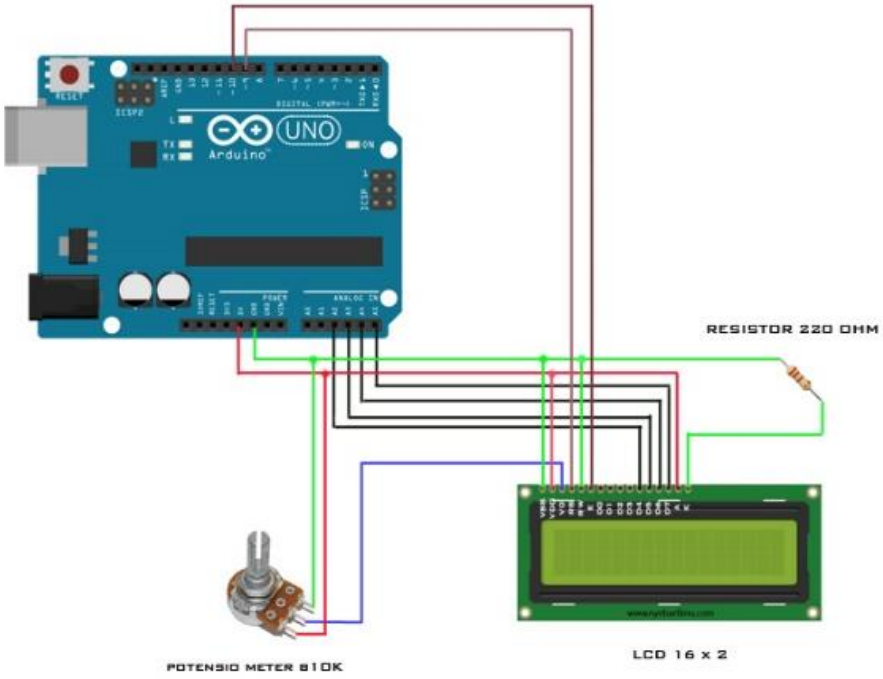
Picture 3.2. Block hardware diagram

After seeing the block diagram above, we will try to directly make a schematic of how the Arduino Uno Accessing HC-05 Bluetooth Module can be seen from the Schematic below.



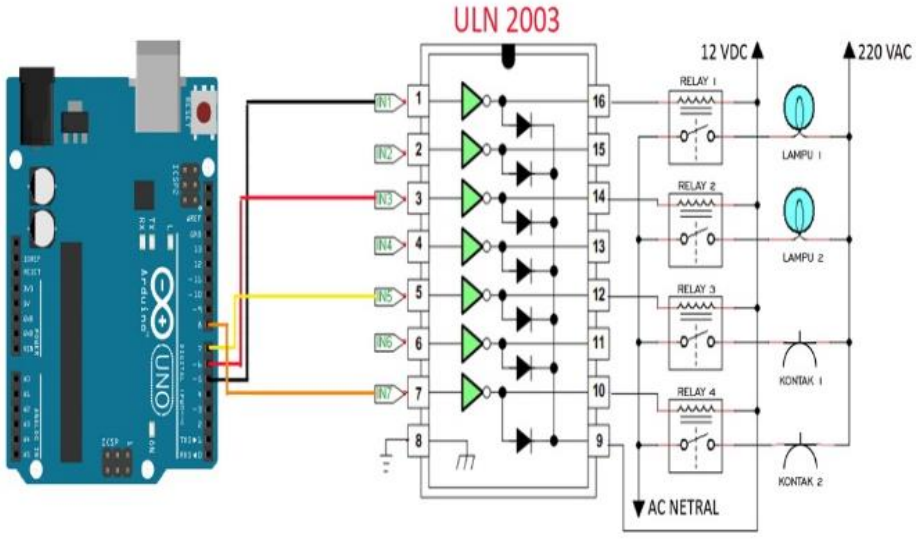
Picture 3.3. Arduino Uno's schematic access Bluetooth Module HC-05

After completing accessing Arduino with the Bluetooth module, the next step is accessing the 16 x 2 LCD on Arduino Uno like Schematic below.



Picture 3.4. Arduino Uno's schematic access
16 X 2 LCD

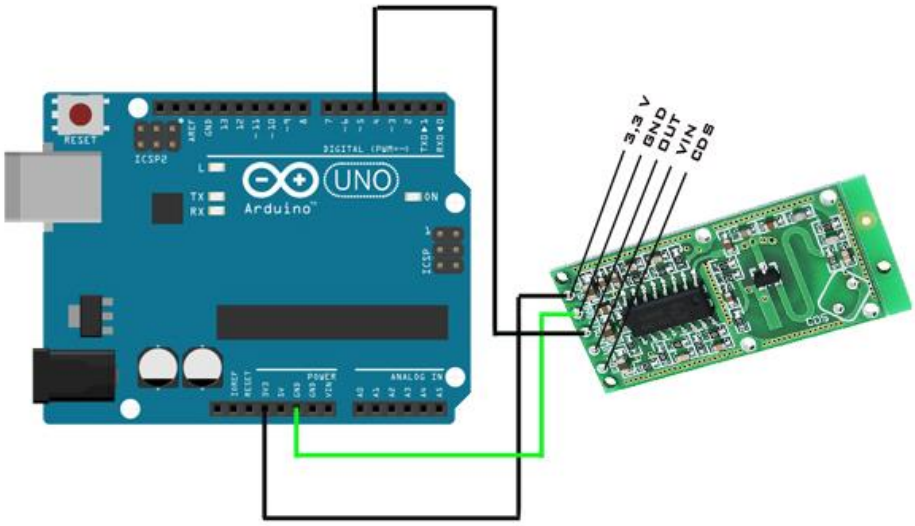
The next step is accessing the 2003 ULN IC and Relay on Arduino as Schematic below.



Picture 3.5. Arduino Uno's schematic access

ULN2003 IC and Relay

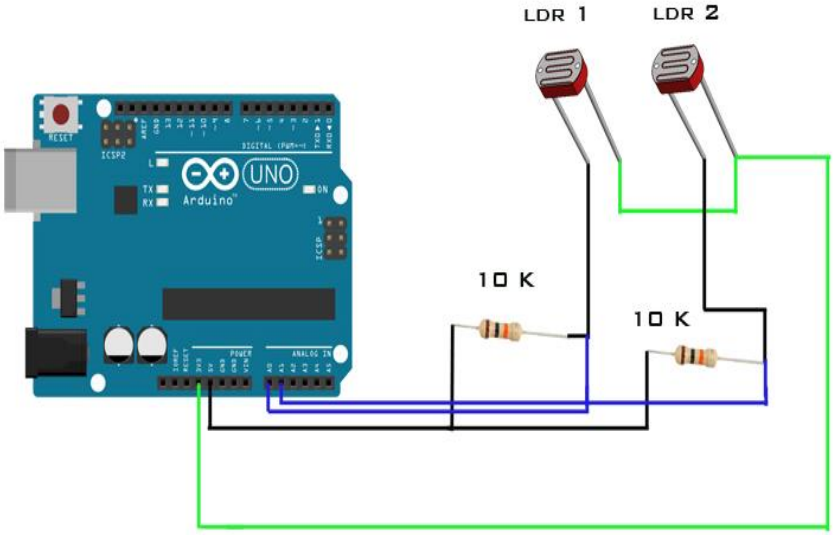
After accessing the ULN IC and the relay on Arduino the next step is to access the RCWL Module on Arduino like the Schematic below



Picture **3.6.** Arduino Uno's schematic access

RCWL Module

The final step in this schematic is to access the LDR sensor on Arduino like the Schematic below.



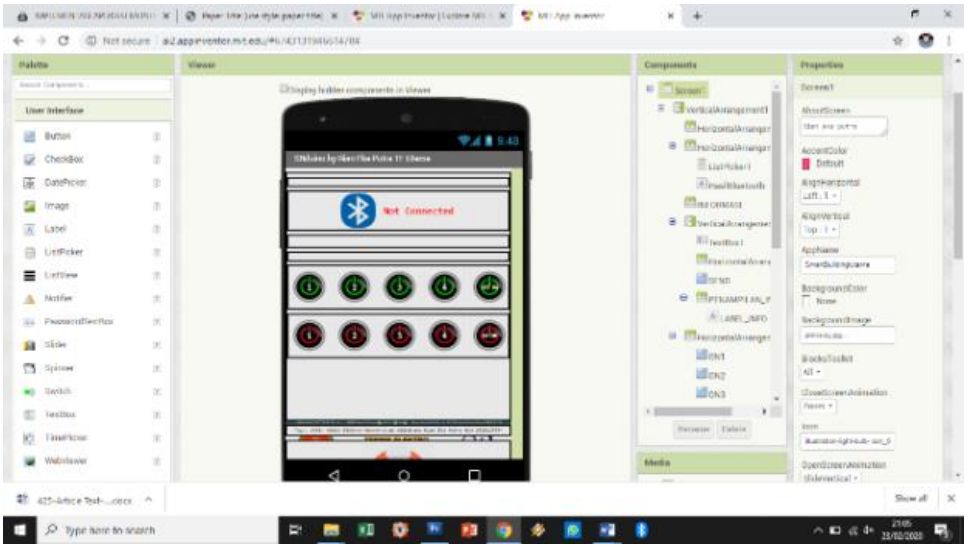
Picture 3.7. Arduino Uno's schematic access

LDR sensor

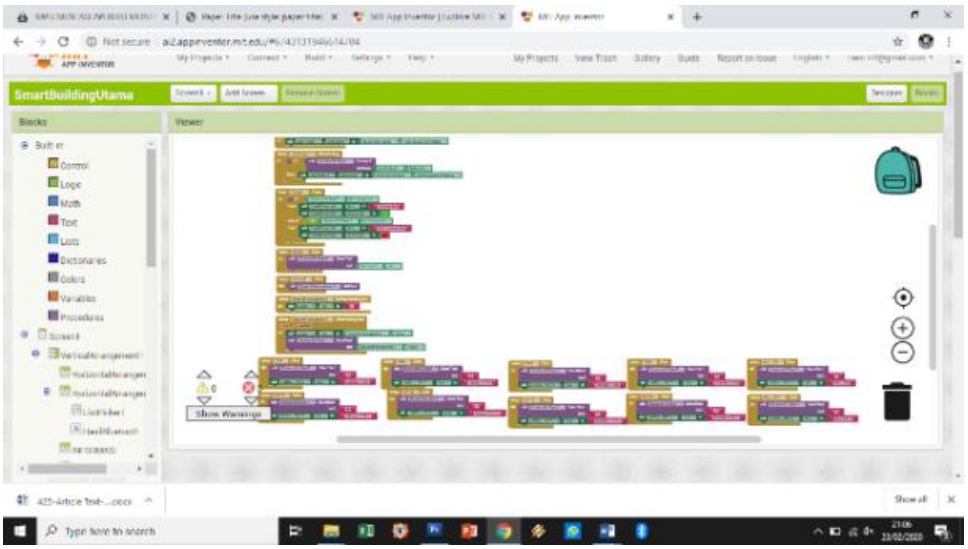
Software Design

Design Android Application Software

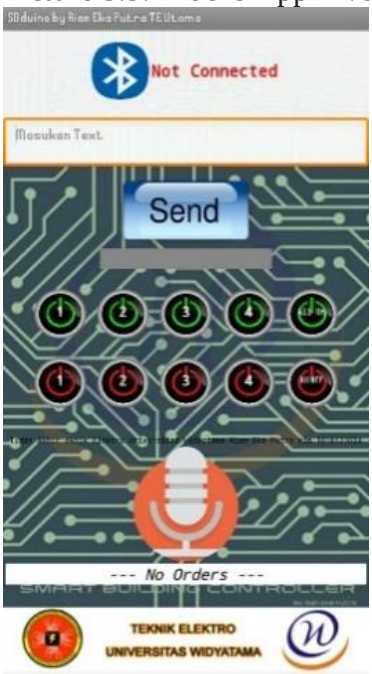
Android applications for mobile phones as controllers and receivers created using App Inventor are open source web applications originally developed by Google, and currently managed by the Massachusetts Institute of Technology (MIT). App Inventor allows new users to program computers to create software applications for the Android Operating system. Examples of the appearance of the App Inventor application as shown below:



Picture 3.8. Designer App Inventor



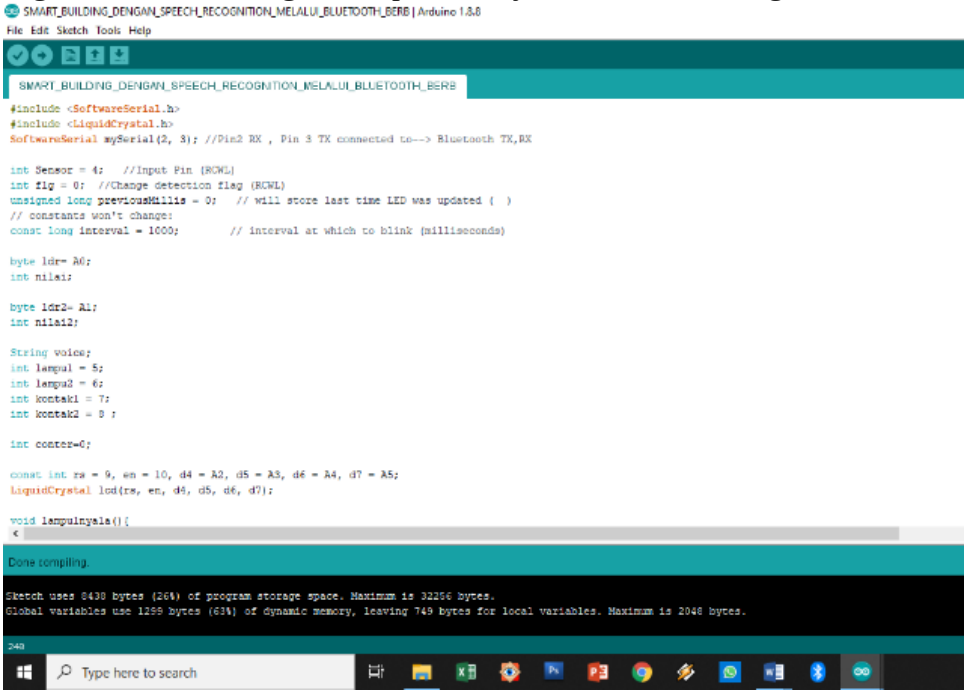
Picture 3.9. Blocks App Inventor



Picture 3.10. Display On Applications On Smartphones

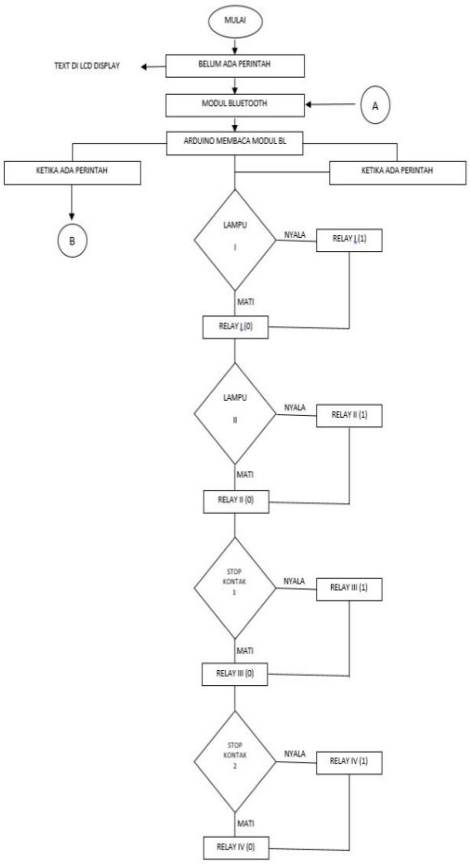
Arduino Uno Software Design

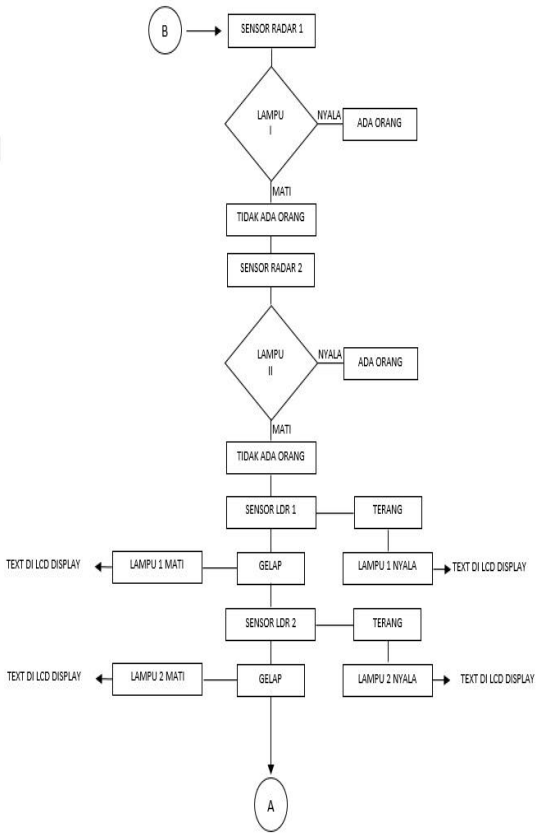
In the Arduino programming itself uses the C programming language. The Arduino programming Lising is known as sketch. Each Sketch has two important functions, namely "void setup () {}" and "void loop () {}". Making the Arduino program itself begins with initializing which pins the system will use, along with the coding snippet:



Picture 3.11. Pin Initialization In Arduino Uno Program

From Ficture 3.11 is the initialization of the pin in the Arduino Uno Program in the design of Smart Building with Speech recognition through Bluetooth-based Android and RCWL sensor. Prior to the initialization work above, the writer made a flowchart of this overall design. Following is the Flowchart of the Arduino Uno Software design above:





Picture 3.12. Flowchart Part 1Picture 3.13. Flowchart Part 2

RESULTS AND DISCUSSION

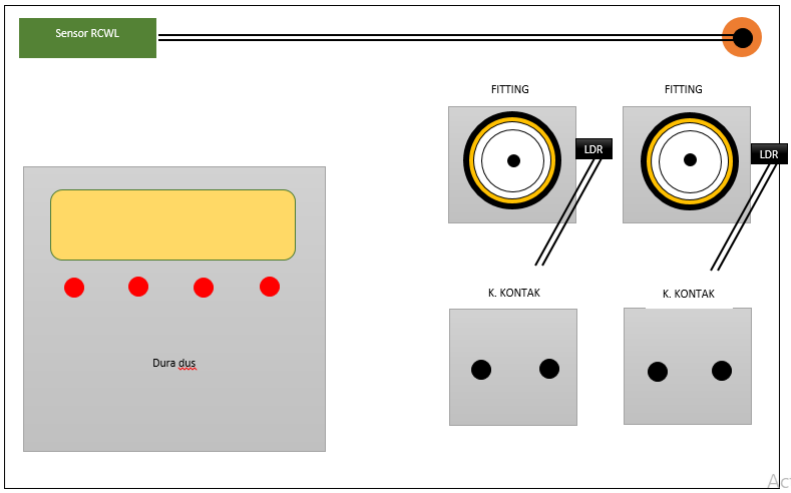
Smart Building Prototype

The prototype of a smart building or is the initial form, for example an electrical building control system (smart building). The prototype was made using a board with a length × width × height = 40 cm × 20 cm × 2 cm with the following material:

1. 2 lamp fittings
2. 2 contact boxes
3. 2 LDR sensors
4. 1 RCWL Sensor
5. 1 doradus size 15 x 15 x 6 cm

NYAF 0.75 mm cable to taste

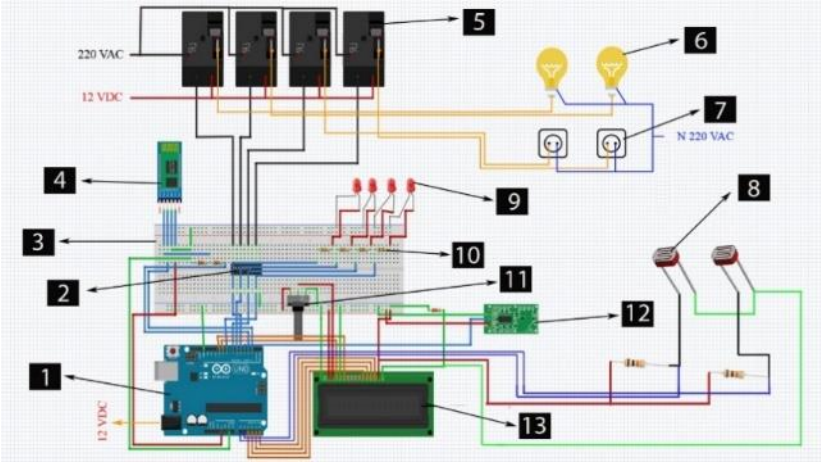
The following are the results of making a prototype of the above materials in the picture above view as follows



Picture 4.1. Top View Prototype

Making and Building Smart Building Systems

The series of electrical equipment control systems in the Smart Building Prototype are in accordance with the Ficture below:



Picture 4.2. Smart Building Schematic Series

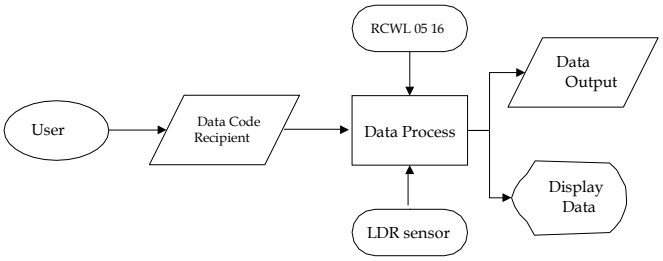
Information:

1. Arduino Uno
2. IC ULN 2003
3. Breadboard
4. Bluetooth HC -05
5. 12 volt relay
6. 220 volt lights
7. 220 volt contact box
8. LDR (Light Dependent Resistor)
9. LED

10. 150 Ohm resistor
11. Potentiometer
12. RCWL 0516 Sensor Module
13. 16 x 2 LCD

How the Smart Building System Works

Here is the flow of how to work on the Smart Building Prototype in the Figure below:



Picture 4.3. How to Building Smart Performance

Testing of Bluetooth HC-05

Table 1. Bluetooth range testing

No.	Condition	Distance	Transmission result	
			Received	Rejected
1	Without a barrier	1-10 meters	√	
		11 meters	√	
		12 meters	√	
		13 meters		√
2	There is a barrier	1-10 meters	√	
		11 meters		√
		12 meters		√
		13 meters		√

Voice Command Testing

Table 2. Voice Command Testing

No	Spoken Command		Respondent			Command response result	Delay	Average
			1	2	3			
1	Lights 1	On	√	√	√	ON	5,02	4,81
		Off	√	√	√	OFF	5,03	
2	Lights 2	On	√	√	√	ON	5,14	
		Off	√	√	√	OFF	5,22	
3	Contact box 1	On	√	√	√	ON	4,05	
		Off	√	√	√	OFF	4,19	
4	Contact box 2	On	√	√	√	ON	4,31	
		Off	√	√	√	OFF	4,68	

5	All	On	√	√	√	All ON	5,41	
		Off	√	√	√	All OFF	5,00	

* Remarks: (√ = received)

Test Testing Displayed OnLcd 16 X 2

Display below is the initial position display after the device is ON

|	**L**	**1**	|	**L**	**2**	|	**-**	**-**	|	**K**	**1**	|	**K**	**2**	|
|		**M**	|		**M**	|	**-**	**-**	|		**M**	|		**M**	|

The display below is the display after being operated when all electrical equipment is turned on

|	**L**	**1**	|	**L**	**2**	|	**-**	**-**	|	**K**	**1**	|	**K**	**2**	|
|	**H**		|	**H**		|	**-**	**-**	|	**H**		|	**H**		|

Information:

1. L 1 = Lamp to one
2. L 2 = The second lamp
3. K 1 = Contact box to One
4. K 2 = Second contact box
5. M = Off
6. H = On
7. | = Delimiter
8. - = delimiter
9. The first column is the name of the Load
10. The second column is information on the state of the load

Table 3. 16 x 2 LCD Text Testing (Saputra, 2018)

No	Spoken Command		Respondent			Command response result	Text displayed on the LCD	System Delay Time (seconds)	Average response time
			1	2	3				
1	Lights 1	ON	√	√	√	ON	H	5,02	4,81
		OFF	√	√	√	OFF	M	5,03	
2	Lights 2	ON	√	√	√	ON	H	5,14	
		OFF	√	√	√	OFF	M	5,22	
3	Contact box 1	ON	√	√	√	ON	H	4,05	
		OFF	√	√	√	OFF	M	4,19	

4	Contact box 2	ON	√	√	√	ON	H	4,31	
		OFF	√	√	√	OFF	M	4,68	
5	All	ON	√	√	√	All ON	H	5,41	
		OFF	√	√	√	All OFF	M	5,00	

RCWL 0516 Sensor Testing

Table 4. Rcwl Sensor Testing

No	Room Condition	Sensor Reading Results	Sensor reading time
1	There is Movement	The light stays on	30 seconds
2	There is no movement	Lights off	>30 seconds

The RCWL sensor test above shows that as long as there is movement in the room, the light will stay on with the sensor reading starting 30 seconds from no movement read by the sensor, as long as the movement is still within 30 seconds, the lamp will not turn off. And when the sensor reads past 30 seconds there is no movement then the lights will turn off automatically.

LDR Sensor Testing

Table 5. LDR Sensor Testing

No	Lamp Conditions	Sensor Reading Results	Text displayed on the LCD
1	L1 (On)	Light	H
2	L1 (Off)	Dark	M
3	L2 (On)	Light	H
4	L2 (Off)	Dark	M

LDR sensor test above is a detection of lights that turn on or turn off which will be displayed on the LCD 16 x 2. From the data above explains that the LDR is only to detect the Light or Darkness of a Lamp.

CONCLUSIONS AND RECOMMENDATIONS

Conclusion

Based on the formulation of the problem so that:

1. How the system works in controlling this electrical equipment using Arduino Uno as a microcontroller controlled by a smartphone using Bluetooth hc-05 media. The maximum distance that can be connected by the two devices as far as 12 meters with testing conditions without obstructions.

2. The results of testing the sensitivity of the RCWL 0516 sensor to a human movement in the room that is as far as 5 meters with a time of 30 seconds.

3. LDR sensor test results to detect lights that are on or not to be displayed on the LCD 16 x 2, namely LDR with a value of> 900, then the LDR will read with the results of the lamp Off, if <900 then the LDR will read with the results of the On State lamp.

Recommendations

Based on the limitations of time, ability and funds, there are still many shortcomings in the workmanship of this tool, therefore the authors suggest as follows:

1. To develop smart buildings it is better to use GSM or IoT modules so that control can be done with long distance and not limited.
2. Improvement of applications installed on Android, so information on the state of electrical equipment is visible on the application screen
3. Made the switch ON and OFF for this device, so as not to unplug the power cable when an error occurs.

BIBLIOGRAPHY

Aini, Q., Rahardja, U., Madiistriyatno, H., & Fuad, A. (2018). Rancang Bangun Alat Monitoring Pergerakan Objek pada Ruangan Menggunakan Modul RCWL 0516. *Jurnal Teknik Elektro*, *10*(1), 41–46.

Alfrey. (2016). *Karya Ilmiah "Pengaruh Handphone Terhadap Masyarakat."* Retrieved from https://alfreysite.wordpress.com/2016/01/25/pengaruh-handphone-%0Aterhadap-masyarakat/%0A

Elektronik, K. (2020). Relay Hanaya. Retrieved from https://www.tokopedia.com/862616/relay-hanaya-12vdc-5-pin-t73-022-relay-hanaya-5-kaki

Fauzi, A., Rijanto, T., & Wardana, H. K. (2019). PENGENDALIAN PERALATAN RUMAH TANGGA MENGGUNAKAN ARDUINO UNO BERBASIS BLUETOOTH. *Reaktom*, *4*(1), 39–44.

Irawan, A. (2014). *Implementasi Speech To Text Dan Text To Speech Pada Aplikasi Traveling Conversations Assistance Berbasis Mobile*.

Margiono, A. (2017). Sensor Cahaya (Light Dependent Resistor). Retrieved from http://margionoabdil.blogspot.com/2015/03/sensor-cahaya-light-dependent-resistor.html

Nyebar, I. (2017). *Liquid Crystal Display 16 x 2*. Retrieved from https://www.nyebarilmu.com/cara-mengakses-modul-display-lcd-16x2/

Prawoto, I. (2015). *Pengertian arduino uno mikrokontroler atmega328*. Retrieved from https://www.caratekno.com/pengertian-arduino-uno-mikrokontroler/

Robotic, A. (2020). Arduinoku Robotic. Retrieved from https://www.tokopedia.com/arduinoku/bluetooth-module-hc-05-master-slave-for-arduino

Rumopa, V. W. (2015). *Kontrol penerangan ruangan menggunakan sensor suara (speech recognition) berbasis android*. Retrieved from Tugas akhir politeknik negeri manado.

SAPUTRA, P. (2018). SMART HOME DENGAN SPEECH RECOGNITION MELALUI BLUETOOTH BERBASIS ANDROID. *Elektronik Pendidikan Teknik Elektronika*, *7*(2), 38–55.

Tarigan. (2017). Pemikiran kemerdekaan dalam kebangsaan bersama kaum disabilitas dan lepra. Retrieved from http://www.pedulidisabilitas.org/

Widiyanto, M. (2010). *IC ULN 2003, Darlington*. Retrieved from http://antomtr.blogspot.com/2010/02/ic-uln-2003.html

Y.Fahruroji. (2017). *Perancangan sistem kontrol ruang menggunakan arduino.* Retrieved from eprints.umpo.ac.id/2992/3/BAB II.pdf