JURNAL EDUNITRO
JURNAL PENDIDIKAN TEKNIK ELEKTRO
HTTPS://EJURNAL.UNIMA.AC.ID/INDEX.PHP/EDUNITRO
E-ISSN 2776-284X
P-ISSN 2776-2920
Vol. 3, No. 1, April 2023

Wireless Residential Electric Controller Using Arduino Uno and Bluetooth Module HC-05

Allan Ibrahim Hanoch Nelwan[1*], Pinrolinvic Manembu[2], Alfrets Wauran[3], Franky Manoppo[4], and Calvin Mamahit[5]

[1,5] Department of Electrical Engineering Education, Faculty of Engineering, State University of Manado
[2] Department of Electrical Engineering, Faculty of Engineering, University of Sam Ratulangi
[3] Department of Electrical Engineering, State Polytechnic of Manado
[4] Department of Informatics Engineering, University of Parnaraya
[*]Corresponding author, e-mail: allannelwan@gmail.com [1]

Received: **November 14th, 2022.** Revised: **January 13th, 2023.** Accepted: **January 20th, 2023**
Available online: **February, 2023.** Published: **April, 2023**

Abstract— This research aims to design electrical installations in residential homes that apply Internet of Things (IoT) technology. An Arduino Uno mini system is the controller whose interface uses the HC-05 Bluetooth module. At the same time, the control uses a cellphone with the Android operating system. The design is based on a research development model, but it is not fully standardized by development research because there are some limitations to the problem. The focus is only on tool design, namely planning, manufacturing, and testing the resulting tool or device. The design results obtained an electrical installation control device with an Android phone. The device is capable of connecting and disconnecting load points remotely and automatically. The control distance is approximately 20 meters according to the Bluetooth specifications used.

Keywords: wireless residential electric controller, Arduino Uno, HC-05 bluetooth

I. INTRODUCTION

Electrical power installation is the installation of electrical equipment components to serve changes in electrical energy into mechanical and chemical energy. A better electrical installation is an installation that is safe for humans and familiar with the surrounding environment (Adiarta, 2021).

For the installation of electricity, lighting, and power for the house, we must first see the drawings of the installation plan that has been made by the planner based on the floor plan of the house/building where the installation will be installed. In addition, the specifications and work requirements received from the building/house owner and these conditions are inseparable and the regulations that must be met by the authorities issuing regulations, namely the local PLN.

In 2016, Internet of Things (IoT) technology began to be recognized as a system that can facilitate human affairs because it adopts interconnectedness with each other. The growth of devices using IoT systems also increased last year. Now entering 2023, the technology trend is considered to have developed. Still, the Internet of Things is a concept where an object can transfer data over a network without requiring human-to-human or human-to-computer interaction.

Several studies on IoT that have been carried out include automatic control and monitoring systems for electrical equipment over long distances with a combination of sensor technology, wireless technology, and internet technology (Prihatmoko, 2017). Remote controlled residential security system, where the ATMEGA 8535 microcontroller is being used and is currently being developed, the microcontroller used is the Rasberry Pi.

In this study, a scheme was developed to control electronic devices and provide information about the condition of electronic devices through sensors integrated into the microcontroller and connected to wireless based on mobile devices or smartphones.

The design of this system is no longer standard among electronics and IT practitioners. With a variety of existing amenities, this design technique may make maintenance easier for the owner while also providing comfort for everyone who lives in it. These

facilities are obtained because several sensor devices can later detect a situation that is not following the expected conditions, namely comfortable, safe and efficient.

Many social problems occur in the community. Problems of social problems that often occur in urban or rural communities, it cannot be denied that the current development of the era will cause some problems in the community, especially in the construction of houses. Seeing the condition of some people's homes who have daily activities and do not have household assistants, the control is not practical.

Therefore, concerning the above provisions, all electrical work, including lighting and power installations in a building/ house, will work properly. It is also beneficial for us as students, in this case as researchers, to research the design of electrical installations in IoT-based residential homes so that later they can become skilled planners.

This problem was identified in two ways, namely: (i) how to design an electrical installation in a simple multi-storey house with the General Regulations for Electrical Installation (PUIL, 2000), based on IoT; and (ii) how to install electricity in a simple multi-storey house with the General Regulations for Electrical Installation (PUIL, 2000), based on IoT. This research is only limited to the design of multi-storey residential installations—namely, a simple multi-storey house (only two floors) based on IoT.

The purpose of this research consists of the main objectives, namely: (i) to find out how to design a multi-storey residential installation following the General Regulations for Electrical Installation (PUIL, 2000) based on IoT; (ii) to find out how to install IoT-based multi-storey houses; and (iii) to find out how to apply the IoT concept to household electrical appliances using a microcontroller.

Electrical installation components are the most basic equipment in an electrical installation circuit. Electrical installation components must follow and meet the following requirements:

1. Reliability, ensuring the continuity of electrical installation work under normal conditions.
2. Security, the installation components installed can ensure the safety of the electrical installation system.
3. Continuity, components can work continuously under normal conditions.

(Lesmana, 2017).

Designing the electrical network of a building must first be assessed for the total load of the entire building (Kilis & Mamahit, 2021). Groups of electrical loading in a public building are as follows: electric lighting; sockets for household appliances and small motors; building ventilation and Air Conditioning (AC); plumbing/ sanitary (water pump and others); vertical transportation (lift); special equipment (laboratory, computer); and security systems (fire fighting, etc.) (Akbar et al., 2017).

Internet of things (IoT) technology has begun to be known as a system that can facilitate human affairs because it adopts interconnectedness with one another. Internet of Things is a concept where an object can transfer data over a network without requiring human-to-human or human-to-computer interaction (Umam & Yuri Efenie, 2016).

An Android operating system is software that has developed rapidly at this time. Therefore, many software developers make Android a breakthrough in software or operating systems on Android smartphones. This application is used as a medium to extinguish and turn on household electrical appliances (Panduardi & Haq, 2016). By using Android to control household appliances automatically and being controlled remotely using a mobile application that is integrated with the wifi module and supports Java programming as an interface, it can also be used for more than one electrical device. The smartphone used has an Android operating system. According to the development of Android that is currently developing, the mini system controller used is the Rasberry Pi.

Arduino is an open-source electronic kit specially designed to make it easier for artists, designers, and anyone interested in creating objects or developing electronic devices that interact with various sensors and controllers (Badamasi, 2014). Arduino UNO is a microcontroller board fully controlled by the ATmega328 (Binsar et al., 2021). The Arduino UNO contains 14 digital input/output pins, six analog inputs, a 16 MHz crystal oscillator, a USB connection, a power connector, an ICSP header, and a reset button. (Adriansyah & Hidyatama, 2013). The Arduino UNO includes everything required to support the microcontroller. To get started, just connect it to a computer through a USB cable, provide it with an AC to DC converter, or use a battery. (Nebath et al., 2014).

Bluetooth is a communication media equipment that can connect a communication device with other communication devices (Shinde et al., 2018). Bluetooth is generally used in cellphones, computers or PCs, tablets, and others (Mayasari et al.,

2017). The function of BlueTooth is to make it easier to share or share files and audio and replace the use of cables and others (Mayasari et al., 2017). Currently, many devices use Bluetooth. Alternatively, another definition of Bluetooth is a wireless or wireless communication technology that operates in the 2.4 GHz frequency band (between 2.402 GHz to 2.480 GHz) using a frequency hopping transceiver that can provide data and voice communication services in real-time. The time between BlueTooth hosts with a limited-service range (Sadi & Mulyati, 2019). This BlueTooth technology was created not only to replace or eliminate the use of wired media in exchanging data or information but also to offer excellent or good features for wireless or wireless mobile technology, with relatively low costs and low power consumption, interoperability, which is very promising, easy to operate and also able to provide a wide range of services (Nasher, 2014).

A relay is a switch that is operated electrically and is an electromechanical (electromechanical) component consisting of 2 main parts, namely an electromagnet (coil) and a mechanical (a set of switch/switch contacts) (Romoadhon & Anamisa, 2017). Relays use electromagnetic principles to move the switch contacts so that with a small electric current (low power), they can conduct higher voltage electricity (Risanty & Arianto, 2017). For example, a relay that uses a 5V and 50 mA electromagnet can move the armature relay (which functions as a switch) to conduct 220V 2A electricity.

Android is an operating system for mobile devices initially developed by Android Inc. One of the creators of Android is Andy Rubin, who is now often referred to as the "Father of Android." In 2005, Google officially bought Android. So since then, Android development has been entirely in the hands of Google until now. Nevertheless, Google still releases the source code (source code) openly to include Android in open-source software. This means that everyone around the world can also contribute to developing Android. So if we conclude, according to experts, Android is an operating system developed specifically for smartphones and tablets.

Android was initially developed not for smartphones but digital cameras. However, because the digital camera business was still sluggish, then Android Inc. changed the direction of Android development for mobile devices. Until now, Android is known as a unique operating system for smartphones and tablets. However, because of its open-source nature, many developers are developing Android to run on laptops and computers.

The Wemos Microcontroller is a development microcontroller based on the ESP 8266 microcontroller module. The Wemos Microcontroller was created to solve the high cost of other Microcontroller-based wireless systems. Using the Wemos Microcontroller, the costs incurred to build a Microcontroller-based WiFi system are very cheap, only one-tenth of the cost incurred when building a WiFi system using the Arduino Uno Microcontroller and WiFi Shield (Yuliza & Pangaribuan, 2016).

II. METHOD

The methodology used in this study consists of three steps, namely:

1. Study literature, a literature search that comes from books, media, experts, or other people's research, aims to develop the theoretical basis that we use in conducting research. One source of reference that researchers can use as an information point in tracing reading material is to use reference books. These reference books may contain brief descriptions or name designations of specific readings. The material from reference books is not to be read from the first page to the end, only the important and desired parts.
2. Observation is a way of collecting data by making direct observations of an object within a certain period and systematically recording certain observed things. The number of observation periods that need to be carried out and the length of time in each observation period depend on the collected data type. In this observation, the author makes measurements and direct observations in the field to obtain the data needed.
3. Design is a stage that aims to design a new system that can solve the problems encountered. The data in the design are taken from the results of literature studies and field observations. In this design, a design drawing will be made along with its analysis and used as a guide for installing electrical installations. In order to be understood by technicians or installers, the design must be straightforward and meet predetermined standards.

The time used in collecting data for this final project was carried out on March, 2021. The location used to design the lighting installation was carried out in a multi-storey residential house located in Tanggari Village, Airmadidi District. The design procedure can be seen in Figure 1.

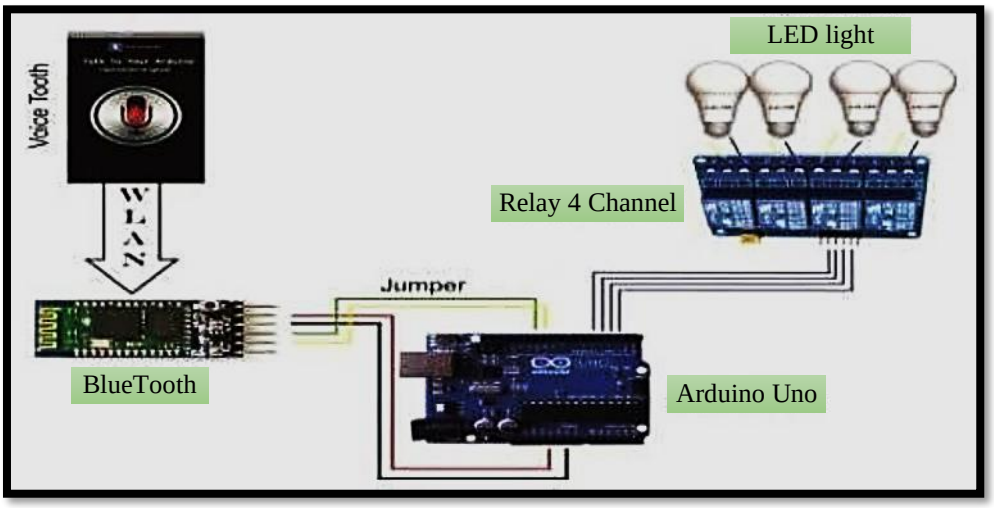

Figure 1. Design Procedure

Figure 1 describes the needs analysis needed as follows:

1. Android is an operating system of a smartphone (smartphone). The android phone used in this tool is a cell phone that uses the Android operating system L1074L1.6.02.03.ID11. This Android phone has been set to turn the lights on and off.
2. Power Supply is a tool used to drain AC from the source to Arduino.
3. Arduino Uno R3 is used to receive and send test data from Gooive Voice to Bluetooth that has been processed.
4. Bluetooth HC-05 is used to receive commands sent from Bluetooth android to be processed by Arduino Uno r3.
5. This four-channel relay gives commands from BlueTooth to the lights.
6. This LED light is the lamp used in the device.

The working principle of the designed system is that the voltage sensor becomes the medium for providing input to the Arduino (Sanggola et al., 2022) (Mamahit et al., 2022). When Arduino reads input from the application, that input becomes the basis for Arduino to run the program. The data sent via the BlueTooth module will enter the microcontroller's minimum system on the Arduino's serial port. The data is converted in the circuit to be continued to the pin via the Rout Max pin. 232, and the data is processed on the Arduino and then sent a logic 0 or 1 on the I/O pin, namely Port C.10 and Port C.11, to control the relay on or off with AC. This procedure can be simpler seen in the flow chart in Figure 2.

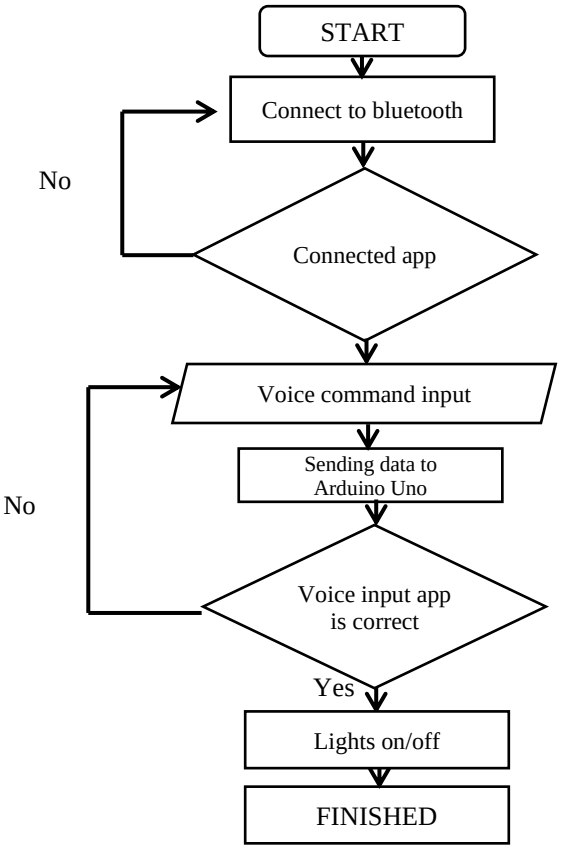

Figure 2. Design Flowchart

Testing this tool begins with a Bluetooth connection of the Arduino HC-05 Bluetooth module with Bluetooth Android. Furthermore, Voice translation by Google Voice / Speech Recognition/

Speech to Text from voice to Text. Then the Text is sent from Android to Arduino, and then decision making is done by Arduino Uno according to the input program, which processes logic based on the Text received (Müller et al., 2015).

At the data collection stage, we control turning the lights on and off with voice commands, which must have precise intonation and correct pronunciation. However, if the intonation and pronunciation are wrong, the application does not respond or has an error and measures the distance.

The electrical installation design is a design drawing file and technical description, which is used as a guide for carrying out the installation of an electrical installation. Electricians must make electrical installation designs clear and easy to read and understand. For this reason, applicable provisions and standards must be followed. The electrical installation design consists of:

A. Field survey

1. Measure the area of the location where the electrical installation will be designed.
2. Determine the distance from the installation location to the nearest substation.
3. Draw a layout that will make the electrical installation.

B. Situation drawing: layout design that clearly shows the location.

C. Installation planning

1. Determine the number of lamps and poles.
2. Determine the type and size of the cable.
3. Determine the required safeguards.
4. Make a PHB diagram complete with information on the size and amount of component identifiers.

The hardware needed to make the tool: laptop, android smartphone, Arduino Uno, Bluetooth module HC-05, Relay module, 220 V lamp, light fittings, plug, jumper cable for Arduino, and 1 mm cable. Windows 10 OS, Arduino Ide 1.8.2, and the Arduino application are used.

III. Results and Discussion

A. Hardware Design Results

The hardware design consists of Arduino Uno, HC-05 Bluetooth module, four-channel relay, and 5-watt lamp. The implementation is shown in Figure 3. This tool requires a transmitter module or a connector from the controller to the Arduino microcontroller via the Bluetooth HC-05 network as the transmitter. The command signal from the controller, namely from a smartphone connected to Bluetooth, will be transmitted by the Bluetooth module HC-05 to the Arduino Uno serial to receive commands from the controller. The HC-05 Bluetooth module can transmit data from the controller to the Arduino. It must first be connected to a Bluetooth network.

Figure 3. Smart Light Implementation Simulation

The device requires a transmitter module or a connection from the controller to the Arduino via the Bluetooth HC-05 network as the transmitter. The command signal from the controller, namely from a smartphone connected to Bluetooth, will be transmitted by the Bluetooth module HC-05 to the Arduino Uno serial to receive commands from the controller (Zhang et al., 2018). The HC-05 Bluetooth module can transmit data from the controller to the Arduino. It must first be connected to a Bluetooth network.

The Bluetooth module HC-05 is connected to the Arduino Uno by:

1. The VCC pin on the Bluetooth is connected to the 5V pin on the Arduino.
2. The GND pin on the Bluetooth is paired with the GND pin on the Arduino.
3. The TX pin on Bluetooth is connected to pin ~ 10 on the Arduino.
4. The Bluetooth RX pin is connected to pin ~11 on Arduino.

The four-channel relay is connected to the Arduino Uno by:

1. The VCC pin on the relay is connected to the 5V pin on the Arduino.
2. The GND pin on the Bluetooth is connected to the GND pin on the Arduino.
3. The IN1 pin on the relay is connected to pin A1 on the Arduino.
4. The IN2 pin on the relay is connected to pin A2 on the Arduino.
5. The IN3 pin on the relay is connected to the A3 pin on the Arduino.
6. The IN4 pin on the relay is connected to the A4 pin on the Arduino.

The lights are connected to each relay, and the model of the house is used as a simulation place that replaces the space in the house. In order for the tool to work fully, it is necessary to connect all the circuits that have been made so that the components and modules can be connected (see Figure 4).

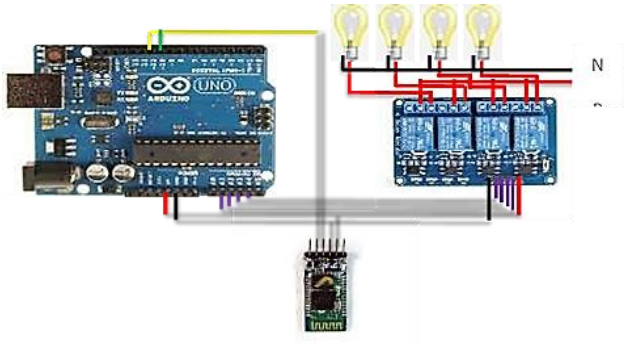

Figure 4. Overall Circuit

B. *Results of Programming (Coding Process)*

The Arduino Uno microcontroller can only work and process data sent from the android application if a program listing has been included. The program entered into the Arduino is created and uploaded using the Arduino IDE programming tools, which functions to initialize which pins will be output or input, changes the salt data sent from Android into a logical "HIGH" or "LOW" command, which will activate or deactivate the relay and initialize the Bluetooth IP address, which will be the destination address for sending data from Android (Mori & Swaminarayan, 2021).

The Arduino programming language itself uses the C programming language. This Arduino program listing, known as a sketch, has two essential functions, namely "void setup(){}" and "void loop(){}" (see Figure 5). Making this Arduino program begins by initializing which pins will be used by the system.

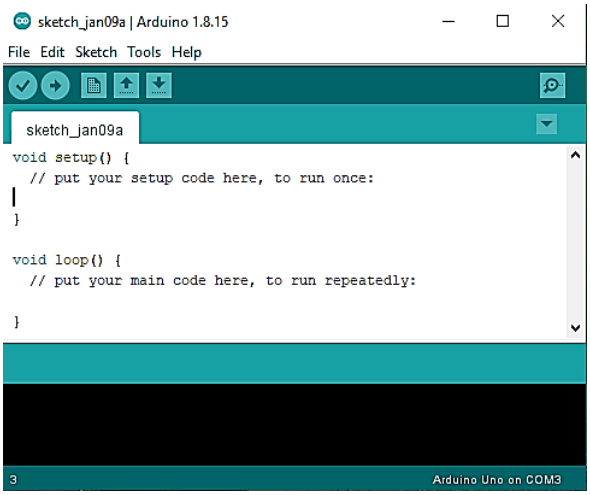

Figure 5. Sketch the main Arduino program

After the program/coding has been made, the program decompiles first to find out whether the program created has been successful or not. The program needs to be uploaded to Arduino Uno if it is successful. If the program has been uploaded successfully, check the Arduino serial monitor to check whether the Arduino is connected to the Bluetooth module (Puri & Nayyar, 2016). It can be checked by giving a command on the smartphone. If successful, the tool will work according to the program provided.

C. *Full System Control Test*

The development of this system testing aims to test the performance and the relationship between hardware and software as a system application program. With this test, it can be seen whether the tools and programs created can work as desired. The way the test is carried out is in hardware and software testing. This test aims to determine the ability of Arduino to process incoming commands from Android at different distances.

Table 1 describes data retrieval within a specified distance in an open room (without wall obstructions) with a reasonable success rate from a minimum of 0 meters up to a maximum distance of 25 meters. If we cross the limit of a maximum distance of 25 meters, the application will error.

Table 1. Testing Control Distance Without Obstacle (Wall)

Experiment to-	Distance (meter)	Person to-				
		1	2	3	4	5
1	1 m	√	√	√	√	√
2	4 m	√	√	√	√	√
3	7 m	√	√	√	√	√
4	10 m	√	√	√	√	√
5	12 m	√	√	√	√	√
6	15 m	√	√	√	√	√
7	18 m	√	√	√	√	√
8	20 m	√	√	√	√	√
9	22 m	√	√	√	√	√
10	25 m	χ	χ	χ	χ	χ

Note: √= succeed
χ = not successful

Table 2 describes indoor data retrieval (obstacles against walls) with a good level of testing from a minimum distance of 0 meters to a maximum distance of 20 meters. If it exceeds the limit of a maximum distance of 20 meters, an error will appear in the application.

Table 2. Testing Control Distance with Obstacles (Walls)

Experiment to-	Distance (meter)	Person to-				
		1	2	3	4	5
1	1 m	√	√	√	√	√
2	4 m	√	√	√	√	√
3	7 m	√	√	√	√	√
4	10 m	√	√	√	√	√
5	12 m	√	√	√	√	√
6	15 m	√	√	√	√	√
7	18 m	√	√	√	√	√
8	20 m	√	√	√	√	√
9	22 m	χ	χ	χ	χ	χ
10	25 m	χ	χ	χ	χ	χ

Ket: √= succeed
χ = not successful

Table 3 determines the accuracy of the control system and whether the lamp control system has been successful. If successful, the program uploaded to Arduino has been successful. If not, the program needs to be re-checked because the control system cannot process the given program. It means that the problem is in the program.

Table 3. Light Control Test with Voice Command

No	Place of lamp	Light Status	Voice commands	Observation	Conclusion
1	Porch light	On	Matikan lampu teras	Lights off	Succeed
		Off	Hidupkan lampu teras	Light on	Succeed
2	Bedroom light	On	Matikan lampu kamar	Lights off	Succeed
		Off	Hidupkan lampu kamar	Light on	Succeed
3	Living room light	On	Matikan lampu utama	Lights off	Succeed
		Off	Hidupkan lampu utama	Light on	Succeed
4	Kitchen light	On	Matikan lampu dapur	Lights off	Succeed
		Off	Hidupkan lampu dapur	Light on	Succeed
5	All lights	On	Matikan semua	Lights off	Succeed
		Off	Hidupkan semua	Light on	Succeed

Table 4. Testing Voice Commands with Distance

Experiment to-	Bluetooth Range (meters)	Voice command										Desc.
		Turn on the porch light		Turn on the room light		Turn on the main light		Turn on the kitchen light		Turn all		
		Y	N	Y	N	Y	N	Y	N	Y	N	
1	1 m	√		√		√		√		√		The light is on
2	4 m	√		√		√		√		√		
3	7 m	√		√		√		√		√		
4	10 m	√		√		√		√		√		
5	12 m	√		√		√		√		√		
6	15 m	√		√		√		√		√		
7	18 m	√		√		√		√		√		
8	20 m	√		√		√		√		√		
9	22 m		√		√		√		√		√	Didn't turn on
10	25 m		√		√		√		√		√	

In Table 4, to determine the level of accuracy of the flight control system, testing the user's range with a voice control system with a range of 1 meter to 25 meters is carried out. The control system and tools will respond to voice command up to 20 meters. If the distance exceeds 20 meters above, the control system cannot respond to voice commands.

IV. CONCLUSION

The design of electrical installations (turning on or off the lights) based on IoT (voice commands via Android using Bluetooth) has been successfully made. The application can function adequately, replacing the switch function in turning on or off the light. Programming for Arduino Uno using the Arduino IDE application as a source code generator has been successfully created. The results for the work of the brilliant light with the Arduino application via Bluetooth are already working according to their function.

Tools and programs were made to replace the switch function and make android smartphones a control medium for controlling lights at home wirelessly using Bluetooth communication media. With the limitations of the control distance and the number of controls, the author hopes that it will be developed in the future. Such as expanding the control distance, which is not only the house's scope but can also use the internet as a control medium.

REFERENCES

Adiarta, A. (2021). *Dasar-Dasar Instalasi*. PT. RajaGrafindo Persada.

Adriansyah, A., & Hidyatama, O. (2013). Rancang Bangun Prototipe Elevator Menggunakan Microcontroller Arduino Atmega 328P. *Jurnal Teknologi Elektro*, *4*(3), 100–112. https://doi.org/10.22441/jte.v4i3.753

Akbar, J., Notosudjono, D., & Machdi, A. R. (2017). Studi Evaluasi Perencanaan Kebutuhan Daya pada Instalasi Listrik di Gedung Harco Glodok Jakarta. *Jurnal Online Mahasiswa (Jom) Bidang Teknik Elektro*, *1*, 1–10. https://jom.unpak.ac.id/index.php/teknikelektro/article/view/505

Badamasi, Y. A. (2014). The working principle of an Arduino. *Proceedings of the 11th International Conference on Electronics, Computer and Computation, ICECCO 2014*, 1–4. https://doi.org/10.1109/ICECCO.2014.6997578

Binsar, R., Simanjuntak, P., Safii, M., Anggraini, F., & Gunawan, I. (2021). *Rancang Bangun Inverter Mengubah Arus Listrik DC ke AC Berbasis Arduino Uno*. *2*(4), 295–299. https://doi.org/10.47065/josyc.v2i4.838

Kilis, B., & Mamahit, C. (2021). Penerapan Sistem Proteksi Arus Bocor pada Instalasi Listrik Rumah Tinggal. *JURNAL EDUNITRO: Jurnal Pendidikan Teknik Elektro*, *1*(2 SE-), 43–52. https://ejurnal.unima.ac.id/index.php/edunitro/article/view/2650

Lesmana, D. (2017). *Pembaharuan Teknologi Instalasi Listrik Rumah Tinggal Dan Gedung Anti Kebakaran*. 105–109.

Mamahit, C., Ticoh, J., Memah, V., & Angmalisang, H. (2022). Studi Sistem Pengisian Cepat Baterai Kendaraan Listrik Berbasis Papan Pengendali OpenEVSE. *JURNAL EDUNITRO: Jurnal Pendidikan Teknik Elektro*, *2*(1), 61–70. https://doi.org/10.53682/edunitro.v2i1.3909

Mayasari, T., Widasari, E., & Fitriyah, H. (2017). Desain Interaksi Aplikasi Pengendali Smart Home Menggunakan Smartphone Android | Jurnal Pengembangan Teknologi Informasi dan Ilmu Komputer. *Jurnal Pengembangan Teknologi Informasi Dan Ilmu Komputer*. https://j-ptiik.ub.ac.id/index.php/j-ptiik/article/view/54

Mori, G. N., & Swaminarayan, P. R. (2021). *Measuring IoT Security Issues and Control Home Lighting System by Android Application Using Arduino Uno and HC-05 Bluetooth Module BT - Data Science and Intelligent Applications* (K. Kotecha, V. Piuri, H. N. Shah, & R. Patel (eds.); pp. 375–382). Springer Singapore.

Müller, L., Mohammed, M., & Kimball, J. W. (2015). Using the Arduino Uno to teach digital control of power electronics. *2015 IEEE 16th Workshop on Control and Modeling for Power Electronics (COMPEL)*, 1–8. https://doi.org/10.1109/COMPEL.2015.7236487

Nasher, F. (2014). Perbandingan Teknologi

Bluetooth Dengan WLAN DSSS. *Media Jurnal Informatika*, *6*, 1–4. https://doi.org/10.35194/mji.v6i1.460.g331

Nebath, E., Pang, D., & Wuwung, J. O. (2014). Rancang Bangun Alat Pengukur Gas Berbahaya Co Dan Co2 Di Lingkungan Industri. *Jurnal Teknik Elektro Dan Komputer*, *3*(4), 65–72. https://doi.org/10.35793/jtek.3.4.2014.6012

Panduardi, F., & Haq, E. S. (2016). Wireless Smart Home System Menggunakan Raspberry PI Berbasis Android. *Jurnal Teknologi Informasi Dan Terapan*, *03*(01), 320–325. https://pdfs.semanticscholar.org/402a/ce8d6629211519bc524830408a5c9c825574.pdf

Prihatmoko, D. (2017). Pemanfaatan Raspberry Pi Sebagai Server Web Untuk Penjadwalan Kontrol Lampu Jarak Jauh. *Jurnal Infotel*, *9*(1), 84.

Puri, V., & Nayyar, A. (2016). Real time smart home automation based on PIC microcontroller, Bluetooth and Android technology. *Proceedings of the 10th INDIACom; 2016 3rd International Conference on Computing for Sustainable Global Development, INDIACom 2016*, 1478–1484.

Risanty, R. D., & Arianto, L. (2017). Rancang Bangun Sistem Pengendalian Listrik Ruangan Dengan Menggunakan Atmega 328 Dan Sms Gateway Sebagai Media Informasi. *Jurnal Sistem Informasi*, *7*(2), 1–10.

Romoadhon, A. S., & Anamisa, D. R. (2017). Sistem Kontrol Peralatan Listrik pada Smart Home Menggunakan Android. *Rekayasa*, *10*(2), 116. https://doi.org/10.21107/rekayasa.v10i2.3613

SADI, S., & MULYATI, S. (2019). *Monitoring Suhu Ruangan Menggunakan Modul Hc 05 Berbasis Android*. *8*(2), 2–7.

Sanggola, M., Mamahit, C., Seke, F., & Ponto, H. (2022). Pengembangan Sistem Gerak Robot Berkaki Enam. *JURNAL EDUNITRO: Jurnal Pendidikan Teknik Elektro*, *2*(1), 53–60. https://doi.org/10.53682/edunitro.v2i1.3644

Shinde, A., Kanade, S., Jugale, N., Gurav, A., Vatti, R. A., & Patwardhan, M. M. (2018). Smart Home automation system using IR, bluetooth, GSM and android. *2017 4th International Conference on Image Information Processing, ICIIP 2017*, *2018-January*, 512–517. https://doi.org/10.1109/ICIIP.2017.8313770

Umam, B. A., & Yuri Efenie. (2016). Rumah Cerdas Berbasis Internet Of Things. *Ilmu-Ilmu Teknik*, *9*(2), 1–6. https://anzdoc.com/download/proposal-program-kreativitas-mahasiswa-rumah-jamur-cerdas-be.html

Yuliza, Y., & Pangaribuan, H. (2016). Rancang Bangun Kompor Listrik Digital Iot. *Jurnal Teknologi Elektro*, *7*(3), 187–192. https://doi.org/10.22441/jte.v7i3.897

Zhang, H., Li, G., & Li, Y. (2018). A Home Environment Monitoring Design on Arduino. *2018 International Conference on Intelligent Transportation, Big Data & Smart City (ICITBS)*, 53–56. https://doi.org/10.1109/ICITBS.2018.00021