

Article

Design of an Electric Light Control Device Using Arduino Uno Microcontroller-Based Short Message Service

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Abstract:

This study aims to design a tool that can control electric lights remotely. The wastage of using lights often occurs due to the difficulty of the occupants of the house in controlling the lighting, especially when they have to leave the house due to various activities. Lighting needs to be controlled to turn on or not when you want to travel for a long time. In addition, lighting needs to be controlled to significantly reduce the service life of the lamp because it is on continuously. This remote light control system can make it easier for users to cut electricity usage. An electric light controller designed using SMS (Short Message Service) based on the Arduino Uno Microcontroller. This system only applies if the condition of the AC voltage originating from the local PLN is ON. System control is managed using the Atmega328 Arduino Uno Microcontroller. The language used for programming is C/Arduino language, and this tool works on GSM communication systems, especially SMS services. The result of designing this tool is that the user can control (ON/OFF) the lights without being limited by time and place as long as the cellular network is reachable.

Keywords: Electric Light, Sort Message Service, Arduino Uno Microcontroller, Global System for Mobile communication, Realtime-monitoring



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1. INTRODUCTION

Humans are always trying to create something that can ease activities using technology. Technology makes everything that is done easier [1]–[7], [8]–[15]. This drives the development of technology which has produced many tools for facilitating human activities and even replacing the role of humans in certain functions [16]–[23]. Limited energy resources require the government to increase the basic tariff for electricity usage. High electricity tariffs cause the use of electricity for daily needs to be minimized as little as possible. Various things related to electrical energy are encouraged, including reducing the use of electricity at 17.00-21.00 or the use of electricity that is not useful. Therefore, to start efficiency in the use of electrical energy can be created with the use of lights as lighting media as needed. Light is an essential component that is useful to be able to help humans in lighting. The use of lighting (electric lamps) is expected to follow the need to avoid wasting electrical energy.

One of the causes of wastage is when the house's occupants have difficulty controlling the lights, especially when they have to leave the house because of various electricity activities. The lights are often turned on first when you want to travel for a long time. Simple tools are needed to find ease in controlling lights. The remote control system also makes it easier for users to cut electricity usage. So that the distance that becomes an obstacle in controlling equipment, especially equipment with excessive electrical energy consumption, can be avoided. Based on the problems mentioned above, an electric light controller was designed using SMS (Short Message Service) based on the Arduino Uno Microcontroller. This tool is arranged together with the electric light to be controlled. A controller (on/off) will use a Smartphone/Mobile phone by utilizing a short message service or SMS (Short Message Service).

2. METHOD

The method in this research is detailed in the Block Circuit Diagram. The block diagram is a simple picture of the actual circuit because, in this diagram, there are only path connections between blocks. Each block has supporting components. The block diagram of the electric light controller circuit using SMS (Short Message Service) based on the Arduino Uno Microcontroller can be seen in Figure 1.

In general, how this circuit works can be seen in Figure 1; an explanation of each block of the image is as follows:

1. The SIM800L module functions as a recipient of the next SMS (Short Message Service) to be forwarded in the form of a signal and processed within the microcontroller.
2. The adapter serves as a component power supply on the Arduino Uno Microcontroller. In the study, an adapter suitable for the Arduino component was used, namely a maximum of 12V.
3. Arduino Uno functions as a data processing center or can be said as a CPU (Central Processing Unit), whose job is to process all incoming and outgoing data. This section will check the input from the SIM800L module in the form of a serial signal and give commands to the Relay section.
4. Step-Down Regulator functions as a lowering of the voltage supplied via Arduino to the SIM800L module.
5. The relay is a component to disconnect and turns on the electric current (digital switch).
6. Power 220 VAC is a source of PLN current in buildings or residences.
7. Electric lamps (Incandescent and LED) function as lighting output indicators.

Furthermore, The initial step of hardware planning in this study is to make a block diagram of the hardware to be made. The goal is to make it easier to analyze the relationship of components between one block and another block.

The design of the components for the electric light controller uses SMS (Short Message Service) based on the Arduino Uno Microcontroller, and the researcher uses Photoshop software to design the device by taking pictures of the device via internet references. More details can be seen in Figure 2.

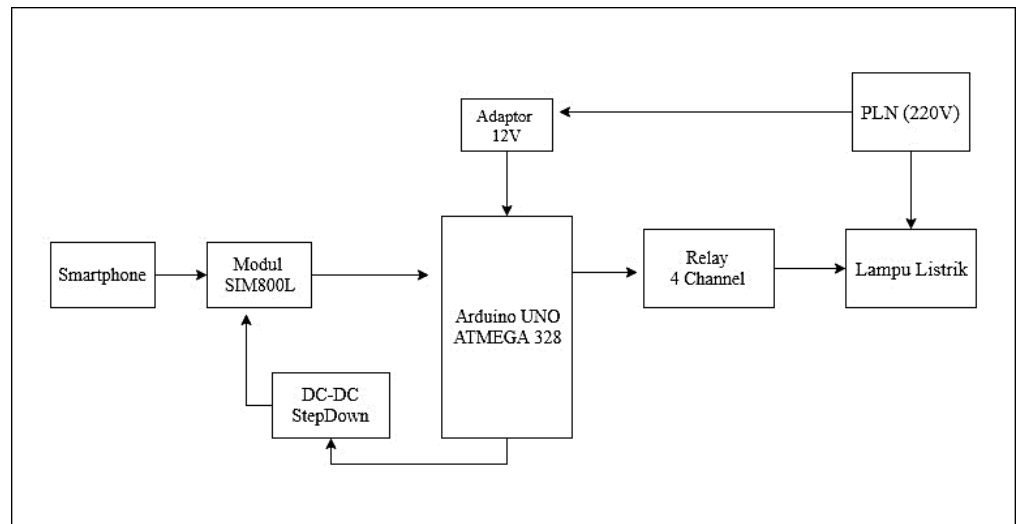


Fig.1 Circuit Diagram Block

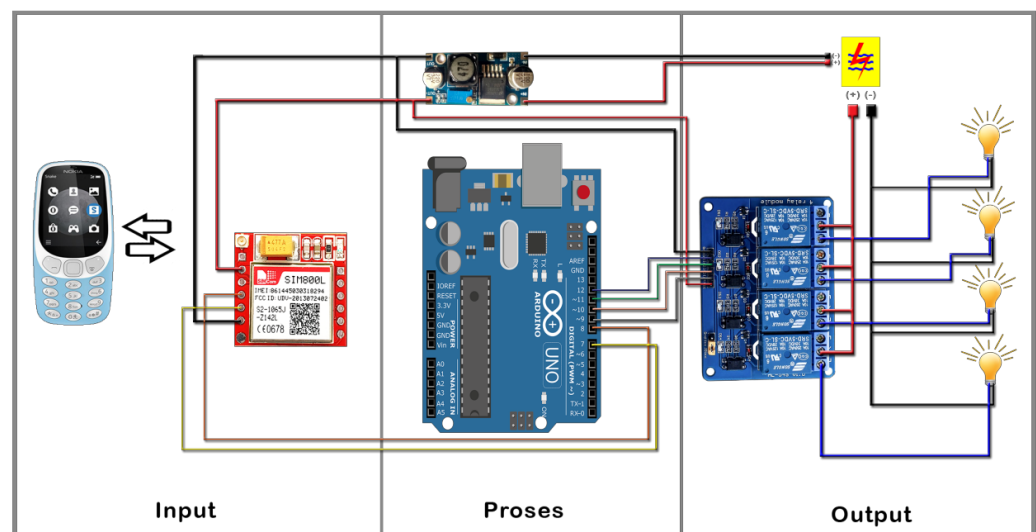


Fig.2 Overall Component Block

In Figure 2, we can see the path connections between the connected components between the pins used and marked with jumper wires. The following shows the pin connections between the components. The electric light control device using SMS (Short Message Service) based on the Arduino Uno Microcontroller is divided into three main parts: the input block, the process block, and the output block. This part of the block represents the parts of the whole circuit. The whole block can be seen in Figure 2. Furthermore, an analysis of the method is shown in a flowchart. The system flow diagram in this study describes the work process algorithm in programming. This process is inseparable from the parts of each component that are integrated. In the suitability of the design of this tool, the steps in the process determine the tool's function's effectiveness. As for the steps of the system flow diagram in the study, we can see Figure 3.

Table 1. Component Pin Connections

Component	Pin	Connection
SIM800L module	VCC	3,7 - 4,2 Volt
	GND	GND (OUT) Regulator Step-Down
	RX	PIN 7 Arduino
	TX	PIN 8 Arduino
Step Down DC-DC	VCC (IN)	VCC 5 Volt Arduino
	GND (IN)	GND Arduino
	VCC (OUT)	VCC Module SIM800L
	GND (OUT)	GND Module SIM800L
4 Channel Relays	VCC	5 VOLT Supply
	GND	Ground Supply
	In1	PIN 12 Arduino
	In2	PIN 11 Arduino
	In3	PIN 10 Arduino
	In4	PIN 9 Arduino

Based on the system flow diagram in figure 3, the steps can be described as follows.

- Typing the SMS format and sending it to the number that has been specified; in this case, GSM is entered into the SIM800L module.
- The SIM800L module will receive the SMS that has been sent.
- Arduino Uno will check the number according to what is registered. If it is registered, it will proceed to the next process, and vice versa; if the number does not match, the program will not run.
- Arduino Uno will analyze the SMS format. If the format is appropriate, it will be forwarded to the next process, and vice versa; if the format is not appropriate, then it will not be continued.
- Arduino Uno will give commands to turn off or turn on the relay.
- Arduino Uno will give commands to the SIM800L module to reply to SMS notifications to registered GSM numbers (notifications are turned off or on).

Moreover, a more detailed explanation is the Input Flowchart Subsystem; the flowchart subsystem here explains part of the overall flowchart precisely in the Input section. The input flow chart in question is as follows.

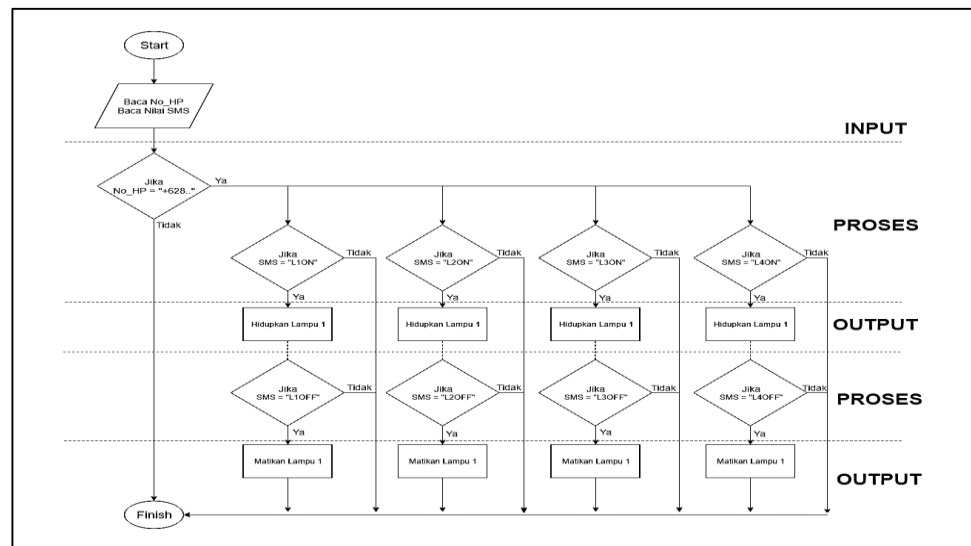


Fig.3 Flowchart System

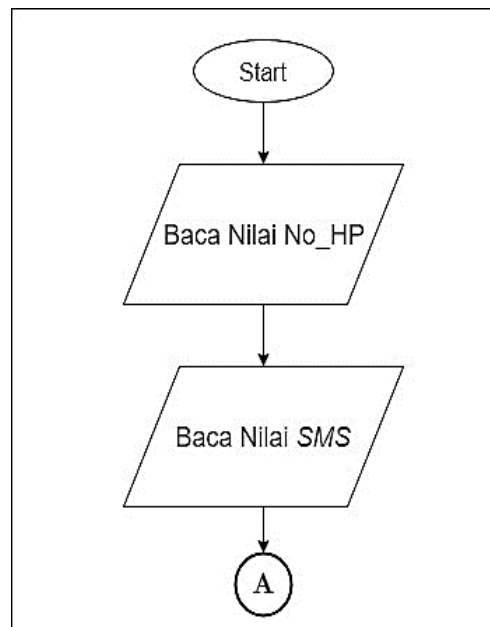


Fig.4 Input System Flowchart

Based on Figure 4, it can be seen that the division of work in the subsystem so that the researcher concludes that the reading of the value in the form of the incoming GSM number and the SMS format used must match what is programmed. If it does not match, then processing is not carried out. Furthermore, is the Process Flow Diagram Subsystem; this phase explains the occurrence of process flow to the system, where the conditioning of the commands follows the programming. If the SMS format or value matches, then the process will proceed to give the command to turn off or turn on the electric light. If not appropriate, then the command will not be continued. This phase can be seen in Figure 5.

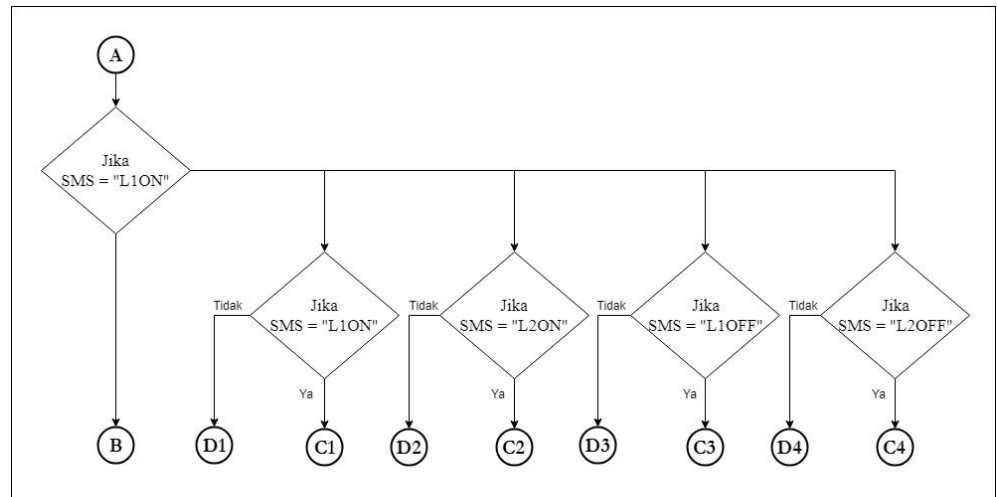


Fig.5 Process Flow Diagram Subsystem

The following analysis is the output Flowchart Subsystem, and This stage is the final phase of the subsystem flowchart. Where the output of this system is to turn off or turn on electric lights, the output flow chart subsystem can be seen in Figure 6.

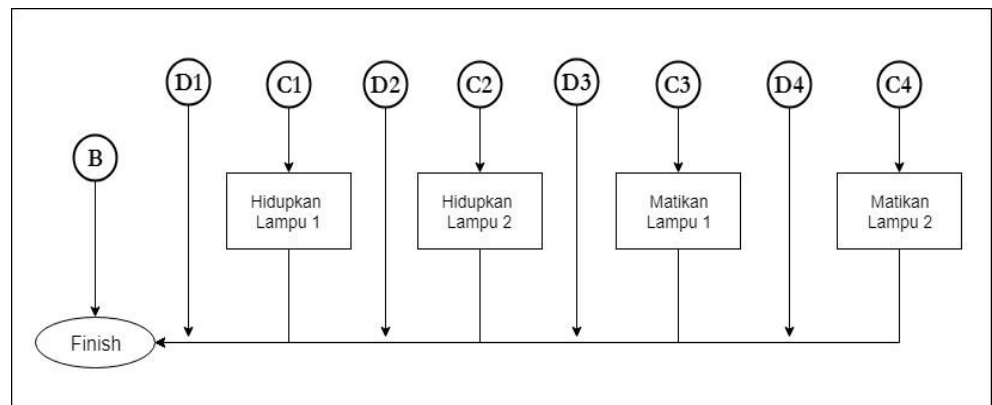


Fig.6. Output Flowchart Subsystem

3. RESULT AND ANALYSIS

The system hardware implementation results consist of Input Devices (Input) and Output Devices (Output). The implementation of the input hardware includes several main components, such as cellphones or smartphones as remote controls and the SIM800L Module series as SMS (Short Message Service) media recipients, as shown in Figure 7.



Fig.7 Input Devices

Implementation of the output device includes several components installed. The components include a 4 Channel Relay, a digital switch, and an electric light installation. We can see the output device in question in Figure 8 and Figure 9.

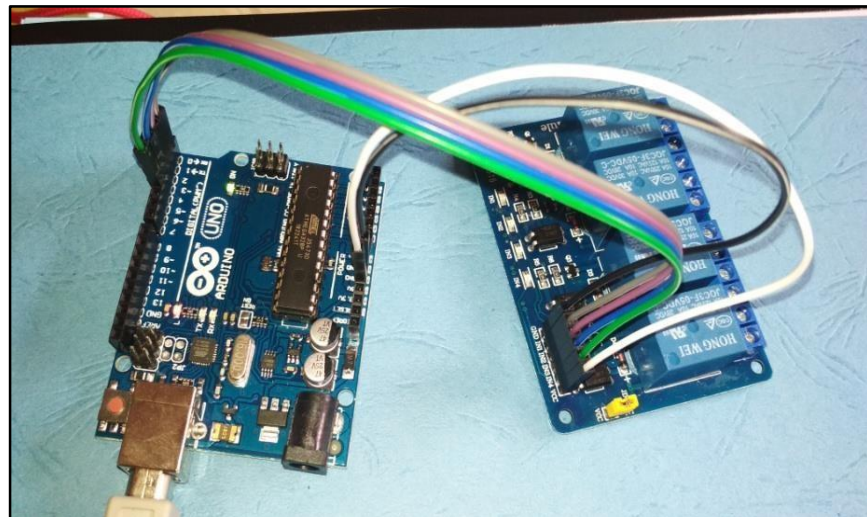


Fig.8 4 Channel Relays

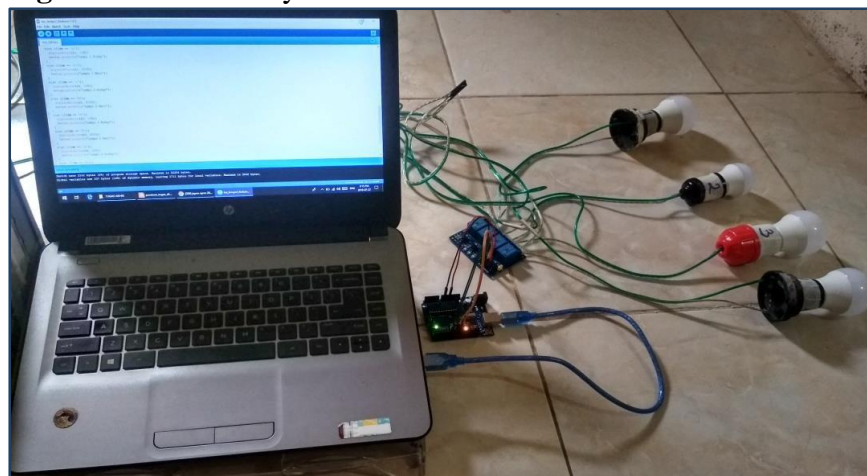


Fig.9 Electric Light Installation

Testing of the entire circuit system that has been made is carried out after all the circuits are assembled as a whole based on the planning on the system block

diagram. Testing is intended to obtain an evaluation of each circuit in the system in order to obtain better performance. Better performance is obtained by making improvements to each circuit component that has errors that are known during testing. Tests carried out on input devices need to pay attention to certain steps to reduce the risk of damage to the SIM800L module, which is vulnerable. What needs to be done is to determine the required DC for the SIM800L Module of 3.7 V – 4.2 V. This can be done by lowering the voltage using a DC Step Down Converter. In this case, researchers need tools such as Volt Meter. After the circuit is installed, the researcher lowers the voltage by turning the potentiometer on the device using the Electrical Test Pen until the indicator on the Volt Meter shows the expected number, which can be seen in Figure 10.

Moreover, the assembly of the SIM800L module is according to the guide instructions. In this case, researchers need tools such as solder and tin to attach the pin feet and antenna of the SIM800L module so that jumping pins between the SIM800L Module and Arduino Uno can be done quickly. In this case, researchers need accuracy, starting with soldering techniques and installing the appropriate pin feet. If the soldering of the pins is carried out for a long time, it will damage the IC on the SIM800L Module component. Picture of an input hardware circuit that has been assembled as shown in figure 11.

Furthermore, the implementation of Hardware Output here includes several main parts, such as 4 Channel Relays and Electric Lights (LED). There are two times the application of the researcher. The first is the application of the 4 Channel Relay directly using the help of Arduino Uno and a simple Listing Program which is uploaded to the system so that the output device can function by showing the indicator lights on the 4 relays on or off. The implementation of this stage itself needs to pay attention to the suitability of the connected jumper cables. It is highly recommended that there is no wrong jump between the VCC (5 Volt) and GND (Grounding) pins. The first application can be seen in Figure 12.

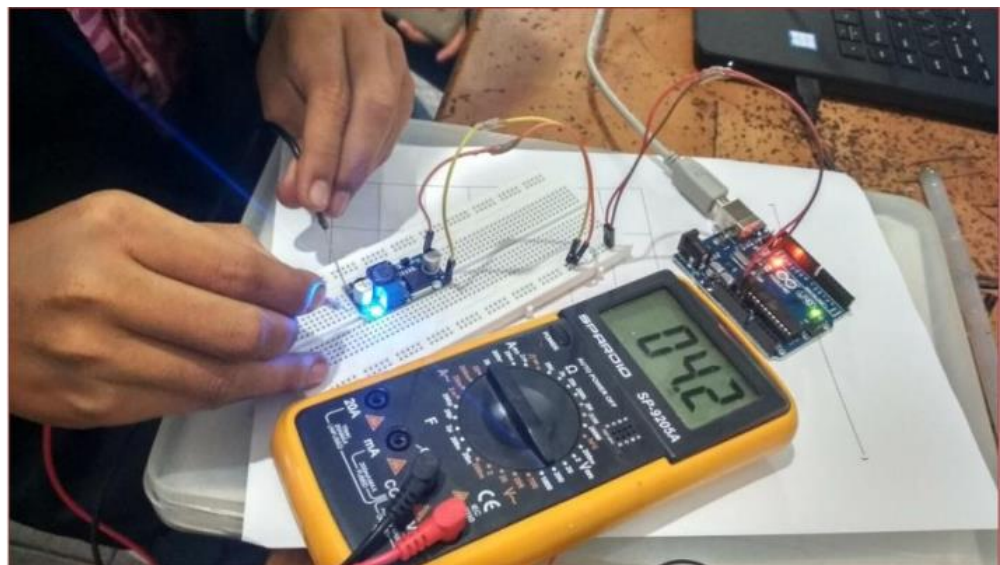


Fig.10 Testing the DC Step-Down Converter

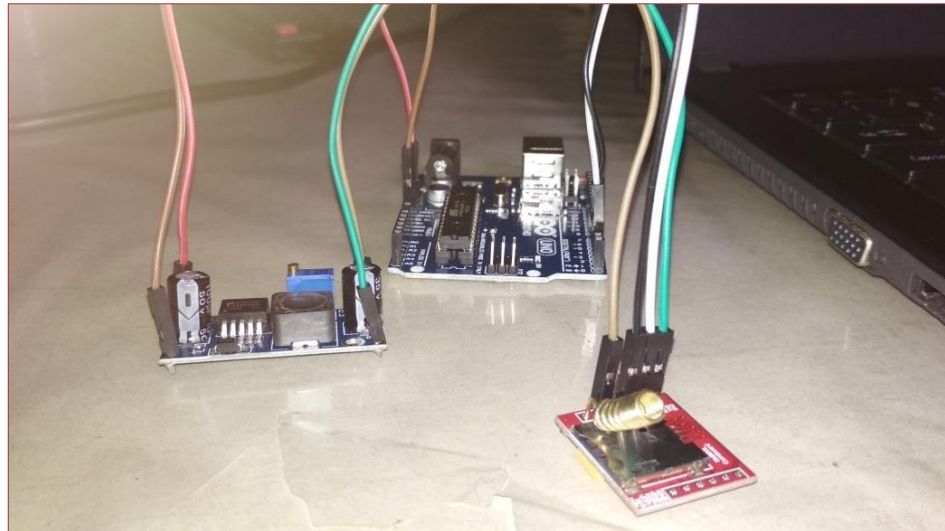


Fig.11 Testing the SIM800L Module

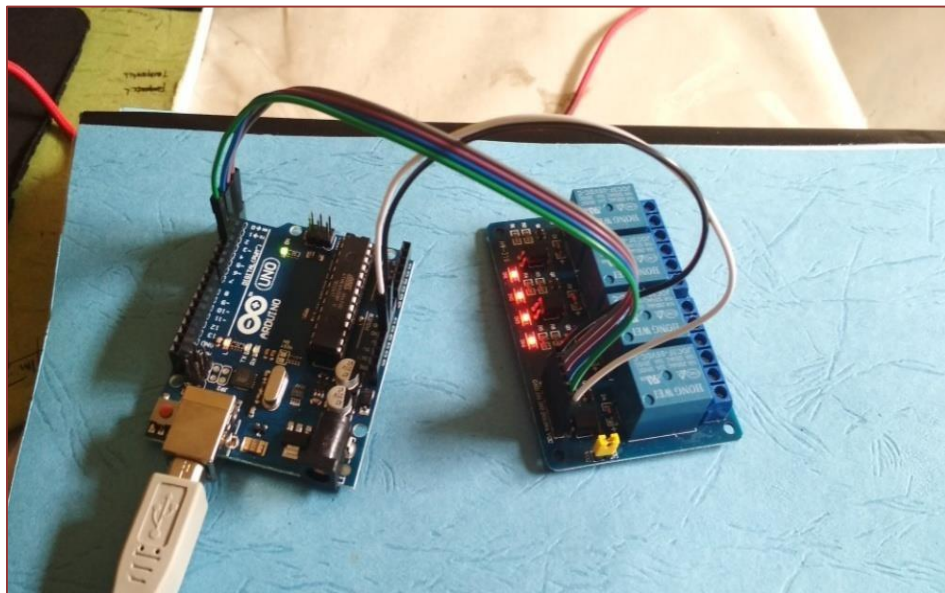


Fig.12 Testing 1 Hardware Output (Relay)

The second application is carried out to find out whether LED or Incandescent lamps also function according to the expected standards. This can be done directly by installing a lamp using a light fitting already installed at home or using a portable lamp fitting. The second application is made directly using a circuit designed directly by connecting the installation of electric lights, relays, and Arduino Uno. The program is simple to control (On/Off) from the Serial Monitor on the laptop. Figure 13 shows the test of the LED lamp.

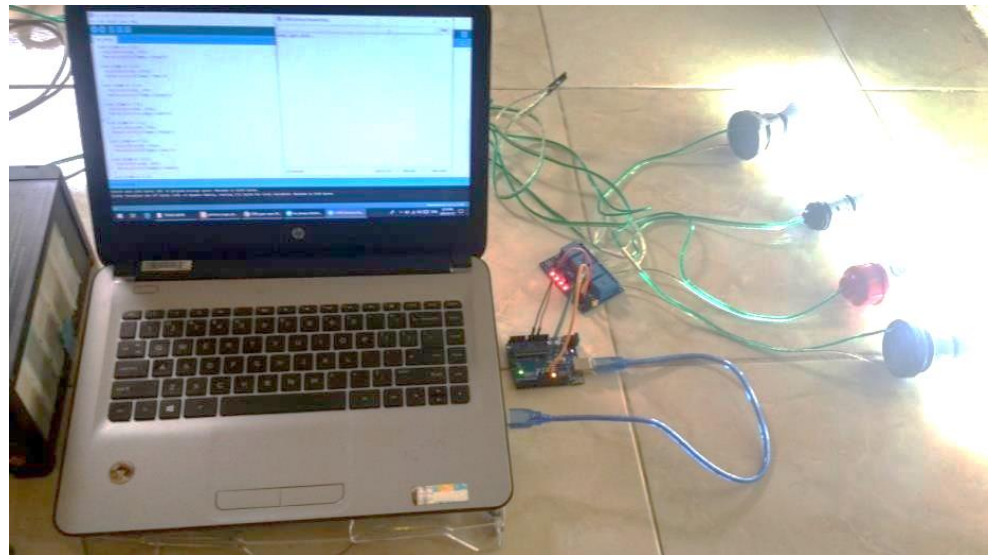


Fig.13 Testing 2 Hardware Output (LED Light)

The next step is Integrated System Testing; testing Electric Light Control Devices Using SMS (Short Message Service) based on the Arduino Uno Microcontroller is essential. The extent to which this tool can work and function as expected and planned. Because there is potential for damage starting from the components used to the use of power or the amount of electric current needed, Integrated system testing is shown in Figures 14 and 15, and the recommended SMS format is shown in Table 2.



Fig.14 Design Results (OFF)

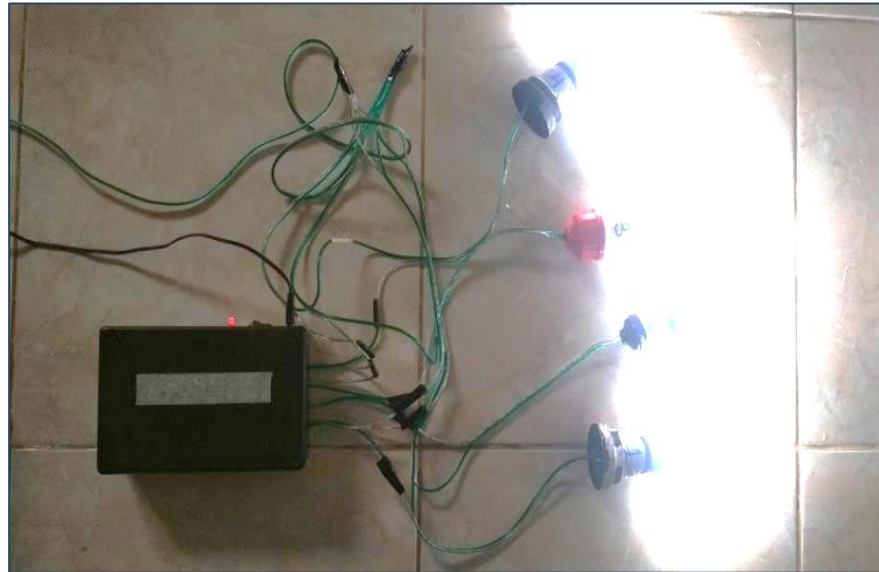


Fig.15 Design Results (ON)

There are several things that researchers do in testing the function of this tool system. Start typing the SMS (Short Message Service) format code and sending it to the Simcard number installed in the system circuit. Table 2 is a list of SMS format codes that will be recommended for accessing devices via telephone (smartphone).

Table 2. SMS Format Code

No	Format	Information
1	L1ON	Turn on the Light 1
2	L1OFF	Turning off the Lights 1
3	L2ON	Turn on the light 2
4	L2OFF	Turn off the light 2
5	L3ON	Turn on the light 3
6	L3OFF	Turn off the light 3
7	L4ON	Turn on the light 4
8	L4OFF	Turn off the light 4
9	ALL ON	Turn on All the Lights
10	ALL OFF	Turn on All the Lights

4. CONCLUSIONS

Based on the test results of the Electric Light Control Device that has been made, the following conclusions can be drawn: [1] The electric light controller uses SMS (Short Message Service) media and the Arduino Uno Microcontroller as a processing tool. [2] The C programming language is used as a programming language when running the system by connecting the program and the microcontroller. [3] This tool is very useful in everyday life because it helps

remotely control electric lights.[4] Electric lights can be controlled remotely as long as the cellular network can be reached or accessed. The efficiency of electricity costs, because electric lights can be fully controlled according to needs.

AUTHOR CONTRIBUTIONS

Conceptualization; Ivana Maretha Siregar [I.V.S], Nancy Florida Siagian[N.F.S], Marudut Mulia Siregar [V.M.M.S], methodology; [I.V.S],[N.F.S],[V.M.M.S]; validation; [I.V.S],[N.F.S],[V.M.M.S]; formal analysis; [I.V.S],[N.F.S],[V.M.M.S]; investigation; [I.V.S],[N.F.S],[V.M.M.S]; data curation; [I.V.S],[N.F.S],[V.M.M.S]; writing—original draft preparation; [I.V.S],[N.F.S],[V.M.M.S]; writing—review and editing; [I.V.S],[N.F.S],[V.M.M.S]; visualization; [I.V.S],[N.F.S],[V.M.M.S]; supervision [I.V.S],[N.F.S],[V.M.M.S]; project administration; [I.V.S],[N.F.S],[V.M.M.S]; funding acquisition; [I.V.S],[N.F.S],[V.M.M.S], have read and agreed to the published version of the manuscript.

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CONFLICTS OF INTEREST

The authors declare no conflict of interest.

REFERENCES

1. S. P. Tamba, D. R. Hia, D. Prayitna, "Pemanfaatan Teknologi Berbasis Mobile Untuk Manajemen Kontrol Nilai Dan Absensi Siswa Pada Mts Al-Ittihadiyah Medan," *J. Sains Dan ...*, vol. 2, no. 1, pp. 18–22, 2020.
2. S. P. Tamba, M. Sitanggang, B. C. Situmorang, and G. Laura, "APPLICATION OF DATA MINING TO DETERMINE THE LEVEL OF FISH SALES IN PT . TRANS RETAIL WITH FP-GROWTH METHOD," vol. 10, no. 2, pp. 905–913, 2022.
3. E. Saut Parsaoran Tamba, "Penerapan Data Mining Algoritma Apriori Dalam Menentukan Stok Bahan Baku Pada Restoran Nelayan," *JUSIKOM PRIMA (Junal Sist. Inf. Ilmu Komput. Prima)*, vol. 5, no. 2, pp. 97–102, 2022.
4. J. Banjarnahor, S. P. Tamba, and Y. Laia, "Pemanfaatan Teknologi Berbasis Android Dalam Pencarian Cepat Tempat Wisata Terdekat Pada Kabupaten Karo," *J. Nas. Inform. dan Teknol. Jar.*, vol. 5, no. 1, pp. 1–4, 2020.
5. W. Purba, D. Ujung, T. Wahyuni, L. Sihalo, and J. Damanik, "Perancangan Sistem Informasi Pemesanan Tiket Online Pada Kmp . Ihan Batak Berbasis," vol. 3, no. 2, pp. 65–75, 2020.
6. P. Aini, I. Purnama, and D. Irmayani, "Sistem Informasi Penjualan Handphone Dan Accessories Pada Toko Nisa Ponsel Berbasis Web," *J. Comput. Sci. Inf. Syst.*, vol. 1, no. 1, pp. 19–23, 2020, [Online]. Available: <http://jurnal.ulb.ac.id/index.php/JCoInS/article/view/1844>

7. D. Y. Siringoringo, V. Sihombing, and M. Masrizal, "Sistem Informasi Penjualan Dan Persediaan Produk Peralatan Pertanian Berbasis Web," *J. Tek. Inf. dan Komput.*, vol. 4, no. 1, pp. 54–59, 2021, doi: 10.37600/tekinkom.v4i1.232.
8. J. Simatupang and S. Sianturi, "Perancangan Sistem Informasi Pemesanan Tiket Bus Pada PO. Handoyo Berbasis Online," *J. Intra-Tech*, vol. 3, no. 2, pp. 11–25, 2019.
9. Kisno, M. R. Tampubolon, Calen, A. T. Marpaung, V. M. M. Siregar, and S. Sirait, "Triwaca dan Literacycloud : Ragam Membaca Menyenangkan selama Pandemi Virus Corona," *J. Surya Masy.*, vol. 4, no. 1, pp. 146–153, 2021.
10. F. Sinuraya et al., "WEB-BASED FOOD ORDERING INFORMATION SYSTEM STUDI," pp. 7–11, 2021.
11. V. M. M. Siregar, E. Damanik, M. R. Tampubolon, E. I. Malau, E. P. S. Parapat, and D. S. Hutagalung, "Sistem Informasi Administrasi Pinjaman (Kredit) Pada Credo Union Modifikasi (CUM) Berbasis Web," *J. Tekinkom*, vol. 3, no. 2, pp. 62–69, 2020, doi: 10.37600/tekinkom.v3i2.193.
12. E. Manalu, F. A. Sianturi, and M. R. Manalu, "Penerapan Algoritma Naive Bayes Untuk Memprediksi Jumlah Produksi Barang Berdasarkan Data Persediaan Dan Jumlah Pemesanan Pada Cv . Papadan Mama Pastries," *Effrida Manalu Fricles Ariwisanto Sianturi Mamed Rofendy Manalu*, vol. 1, no. 2, pp. 16–21, 2017.
13. F. A. Sianturi, "Penerapan Algoritma Apriori Untuk Penentuan Tingkat Pesanan," *Mantik Penusa*, vol. 2, no. 1, pp. 50–57, 2018.
14. H. A. Simbolon and V. M. M. Siregar, "Perancangan Sistem Informasi Berbasis E-Commerce Untuk Peningkatan Penjualan Produk Jersey Olah Raga," *J. Tek. Inf. dan Komput.*, vol. 1, no. 2, pp. 49–54, 2018.
15. V. M. M. Siregar, "Perancangan Website Sebagai Media Promosi Dan Penjualan Produk," *TAM (Technology Accept. Model.)*, vol. 9, no. 1, pp. 15–21, 2018.
16. P. Dani Prasetyo Adi and A. Kitagawa, "A performance of radio frequency and signal strength of LoRa with BME280 sensor," *TELKOMNIKA (Telecommunication Comput. Electron. Control.)*, vol. 18, no. 2, p. 649, Apr. 2020, doi: 10.12928/telkomnika.v18i2.14843.
17. S. Sirait et al., "Selection of the Best Administrative Staff Using Elimination Et Choix Traduisant La Realite (ELECTRE) Method," *J. Phys. Conf. Ser.*, vol. 1933, no. 1, p. 012068, Jun. 2021, doi: 10.1088/1742-6596/1933/1/012068.
18. V. Sihombing et al., "Additive Ratio Assessment (ARAS) Method for Selecting English Course Branch Locations," *J. Phys. Conf. Ser.*, vol. 1933, no. 1, p. 012070, Jun. 2021, doi: 10.1088/1742-6596/1933/1/012070.
19. P. D. P. Adi et al., "A Performance Evaluation of ZigBee Mesh Communication on the Internet of Things (IoT)," in *2021 3rd East Indonesia Conference on Computer and Information Technology (EIConCIT)*, Apr. 2021, pp. 7–13. doi: 10.1109/EIConCIT50028.2021.9431875.
20. P. D. P. Adi et al., "A Study of Programmable System on Chip (PSoC) Technology for Engineering Education," *J. Phys. Conf. Ser.*, vol. 1899, no. 1, p. 012163, May 2021, doi: 10.1088/1742-6596/1899/1/012163.
21. P. Adi, D. Prasetya, A. Setiawan, N. Nachrowie, and R. Arifuddin, "Design Of Tsunami Detector Based Sort Message Service Using Arduino and SIM900A to GSM/GPRS Module," *Proc. Proc. 2nd Int. Conf. Adv. Sci. Innov. ICASI 2019*, 18 July, Banda Aceh, Indones., 2019, doi: 10.4108/eai.18-7-2019.2288588.
22. P. D. P. Adi and A. Kitagawa, "Quality of Service and power consumption optimization on the IEEE 802.15.4 pulse sensor node based on Internet of Things," *Int. J. Adv. Comput. Sci. Appl.*, 2019, [Online]. Available: <http://www.scopus.com/inward/record.url?eid=2-s2.0-85066760495&partnerID=MN8TOARS>
23. V. M. M. Siregar and H. Sugara, Implementation of artificial neural network to assesment the lecturer ' s performance. 2018. doi: 10.1088/1757-899X/420/1/012112.