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Smart House With Voice Control Lights Using Arduino R3

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INDEXING
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Keyword 1; Sound Sensor
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Keyword 5 ; Sound Waves

ABSTRACT
Advances in science and technology have improved human life; Now we live in the era of electric voice commands, with a smart home management system that allows people to control home electrical devices such as lights with voice commands, so they don't have to move to turn off or turn on the lights. When the sound wave user turns on the light or runs the system, the FC-04 sound sensor sends a signal to the microcontroller. The microcontroller then processes the signal into voltage to turn on the light. The FC-04 sound sensor can only produce a digital signal with a value of 1 and 0, which can be collected to the Arduino through the uploaded software to be used as a 5-volt input to turn the lights on or off. Many things can affect the lights when turned on from a certain distance such as the sensitivity of the sound sensor and the noise level around the lights. This research employs an experimental method by designing and testing a system based on the FC-04 sound sensor and Arduino. Testing was conducted to evaluate the sensor's sensitivity, the impact of noise, and the system's accuracy under various conditions. The findings are expected to enhance the efficiency of smart home technology.

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INTRODUCTION

In the present era, the number of control systems continues to increase. Ordinary control systems help people perform tasks more efficiently; In this case, the microcontroller functions as a control system with sound sensors as input to actuate additional supporting devices (Arianti et al., 2022). A microcontroller is a chip-based computer system that combines a CPU core, input and output devices, and memory (RAM, program memory, or both). Some with microprocessors as versatile as PCs, and microcontrollers do not require much of the system to process or run; The only electrical circuit needed to coordinate a microcontroller IC is a microcontroller system (Emidiana et al, 2023). This basic system can be connected to various circuits to perform specific functions. In conversations and online forums, microcontrollers are often called "C" or "Uc" (Tamboenan *et al*., 2024).

In loose translation, a microcontroller is a micro-sized computer located on an IC chip, or integrated circuit, which has a processor, memory and programmable interface (Uriawan *et al*, 2018). Because IC chips, or microcontroller circuits, have a CPU, memory, and programmable I/O. I/O is also known as GPIO (General Purpose Input Output Pins), which means pins that can be programmed as input or output as needed *(*Mamahit, 2024).

Alternatives that can be used to overcome problems. In home lighting technology, lights can be turned on and off via voice input (Agnesia *et al*., 2024). Therefore, you must need a device that can control the lights automatically and is integrated with a microcontroller to control them. Sound wave technology may be a future home mode that allows voice control to control various household facilities, such as televisions, fans, lights and fans (Prayogi *et al*., 2024). Using voice commands, you can turn on various household facilities by speaking a voice rather than simply tapping a button to turn the device on and off. The problem can be formulated based on the context: how is sound input processed by the microcontroller? Apart from that, developing a microcontroller program using Arduino IDE software. The limitations of this system design mentioned by the author include:

1. Only Arduino IDE input data processing software is used.
2. Only foda control system.
3. Is there a statement about the capacity used?
4. Check only the performance of the microcontroller sound sensor.

1. The following is the basic concept of microcontroller operation.
   The microcontroller uses the address given in the program Counter register to retrieve data from ROM based on the value in the register (Puspito *et al*., 2020). The contents of the program counter register are automatically increased by one or increment. The program instructions created and entered by the user are the source of data taken from ROM.
2. The microcontroller reads and executes instructions.
   Instructions can read, modify the contents of registers, RAM, and ports, or read and continue with data modifications.
3. The program counter value has changed due to an addition in step 1 or a change in step 2. Next, the microcontroller repeats steps 1 and 2 until the power goes out.

Microcontrollers are a very important part of a computer system, but they are much smaller than those of a personal computer or mainframe. A computer will receive input and run a program to produce a certain output (Fahlevi and Gunawan, 2020). In general, a computer, or microcontroller, is a device that does what it is instructed to do. In other words, the program itself is the main component of a computerized system, instructing the computer to perform a long series of simple actions to perform the more complex tasks that the programmer desires (Suprayadi *et al*., 2020).

LITERATURE REVIEW

Mikrocontroler

It is present in almost all equipment related to our activities, such as digital cameras, cars, motorbikes, LCDs, cell phones, and many more. Every electrical device with a “remote control” must have a microcontroller (Akbar *et al*., 2024). Many people don't know about microcontrollers even though we use them every day. How does this tool work? A microcontroller is a device that combines various components as microprocessor components into a small chip called a microchip (Naga and Widiatmoko, 2023). The three main components of a microcontroller are the CPU processor, memory, and input/output (I/O).

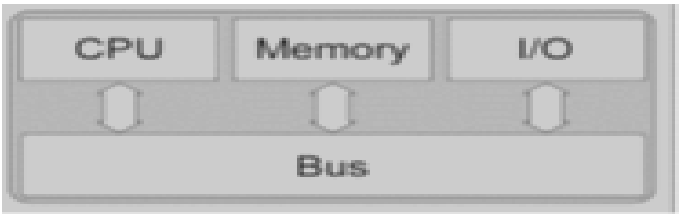


Figure.1 Three Main Components of a Microcontroller
Source : Naga and Widiatmoko (2023)

Electronic Equipment

Such as hearing aids, voice recorders, radios, and other communication devices, as well as telephones, telephones, walkie-talkies, intercoms, and home entertainment systems such as karaoke, have microphones (Saputra *et al.*, 2020). A weak electrical signal is generated by the microphone. Therefore, a signal booster is necessary to find out more about the microphones we usually use.

Microphone operation is briefly detailed in the following lines.

1. The sound waves we speak are sent to the microphone.
2. Sound waves hit a thin plastic membrane that functions as the microphone diaphragm. As a result, the diaphragm vibrates.
3. The back of the diaphragm will vibrate along with the voice coil or wire.
4. Small permanent magnets around the coil create a magnetic field as they move.
5. When the voice coil moves in this magnetic field, an electrical signal is generated.
6. The electrical signal is sent to the amplifier or sound recorder.

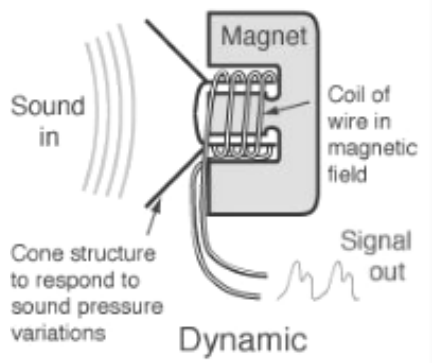


Figure 2 Principle of operation of the microphone
Source : Saputra *et al*., (2020)

The converter supplies power to the dynamo motor with direct current after converting the alternating current into a regulating current and then returning it to alternating current. All this can be achieved by adjusting the potentiator embedded in the device (Figure 3) (Sugiarta *et al*., 2024). Additionally, we can easily change the amount of power required. The inverter not only changes the current but also stabilizes the output voltage. This is different from a stabilizer, which only stabilizes the current but cannot change the voltage. Inverters, on the other hand, can change voltage (Worden and Zuercher-Martinson, 2009).

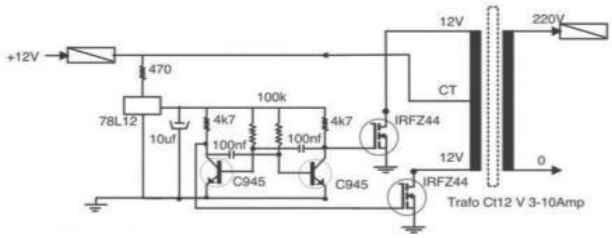


Figure 3. Physical Characteristics of Inverters
Source : Dhian (1921)

Accumulator

Accumulator or battery, also called accu, is an electric cell in which electrochemical processes can be repeated with high efficiency (Syahid *et al*, 2022). When a battery or accumulator stores chemical energy to be used to drive the starter system, lamp ignition system, and other electrical components, the discharge process converts the electrical energy into chemical energy (Pratiwi and Fatchiya, 2021). The recharging process is carried out by regenerating the electrodes in the cell, which flow an electric current of opposite polarity (Figure 4).

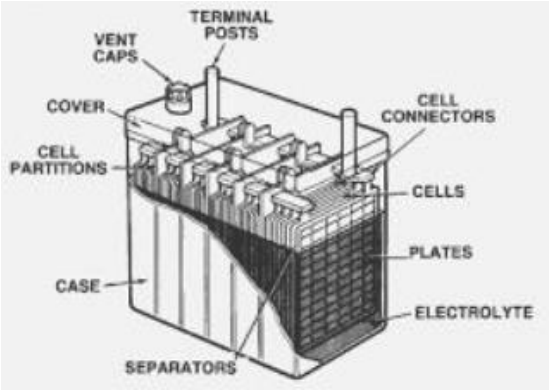


Figure 4. Battery/ACCU equivalent circuit
(Source : Pratiwi and Fatchiya, 2021)

Relay

When a coil receives an electric current, it is called a coil. Contact is a type of switch whose movement is determined by whether the coil receives electric current or not. When activated, the open contact (NO) is normally in the initial state, while the normally closed contact (NC) is in the initial state (Widiatmoko *et al*., 2024). Here is how the relay works. When the coil is activated, the electromagnetic force pulls the spring-loaded armature, causing the contacts to close. The Com plate will move to ensure that the Com and No terminals are connected correctly when C1 and C2 are not passing current, and when C1 and C2 are passing current, the Com plate will move to ensure that the Com and No terminals are connected correctly. Figure 5 illustrates the operation of this relay (Setiawibawa *et al*., 2023). To assemble a SPDT relay for use with an Arduino, the following components must be prepared or purchased:

1. SPDT 5v/12v Relay
2. 1k Ohm Resistor
3. Transistor 2n2222
4. Diode 1n4007

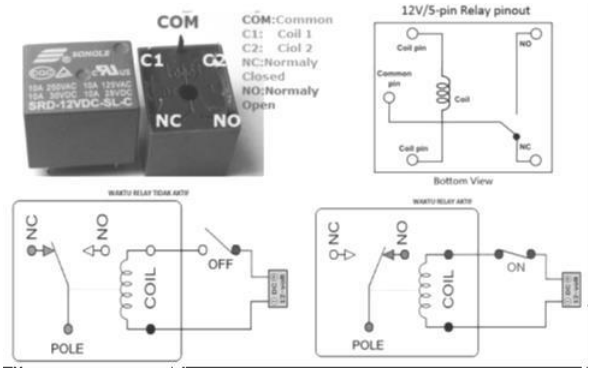


Figure 5. Relay working principle
Source : (Widiatmoko *et al*., 2023)

RESEARCH METHOD

This research carries out development research. The goal of this research is to create a usable home control. In other words, the Arduino will be in standby state and wait for commands from the sound sensor to be forwarded to the relay so that it can turn on the load when a power outage occurs. The focus of this development research is system design, which includes software and hardware design.

The following tools and materials (Table 1) are used in the manufacture of a microcontroller-based control system via a sound sensor:

Table 1. List of tools and materials

Equipment	Ingredients
Plus screwdriver	Sound sensor
Tespen	Sound Sensor
Cutting pliers	Battery
Needle-nose pliers	Inverter
AVO-meter	Lamp
Solder	Modul Relay 1 channel 5 Volt
Solder tin	Steker
Computer	Battery Charge
	Cables
	Claws
	PCB Board

Source : Author (2024)

The energy that has been reserved and stored in the battery for this system will be distributed later. However, the author uses a sound sensor as input for the microcontroller in this system to control when the electricity goes out from the State Electricity Company (PLN). The author will connect the AKI to the inverter to supply 220 Volt voltage while the Arduino is in standby mode, which can then work to switch the relay from normally open to closed with the help of a sound sensor that has been previously programmed and uploaded to the Arduino. If you are given a sound code instruction, the light will turn on, if the light is turned off, if you are given a sound code, the light will go off. It contains various components in general, which are illustrated in the block diagram of Figure 6

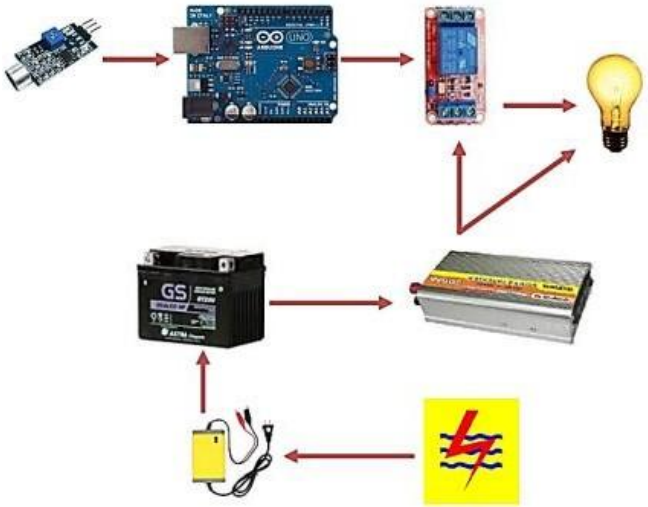


Figure 6. General Block Diagram
Source : Author (2024)

Input sensors, current converters, output devices, and PLCs as controllers are usually some of the system components.

Microphone sound sensor

This sensor system uses a microphone as a sensor and transmits the waves to the microcontroller to give commands.

Device for output

Computers, televisions, fans, lights, and other equipment that require electricity are among these devices that are controlled directly by controllers.

Converter tool

The use of this device is to convert energy. The two involved in this process are the inverter and converter current converter

Controller

The Arduino R3 Atmega 328 microcontroller is a controller device with six 10-bit A/D converter channels, 23 I/O lines, 32 registers, internal and external interrupts, and three timers with comparison mode.

Figure 7 illustrates the design strategy of this tool.

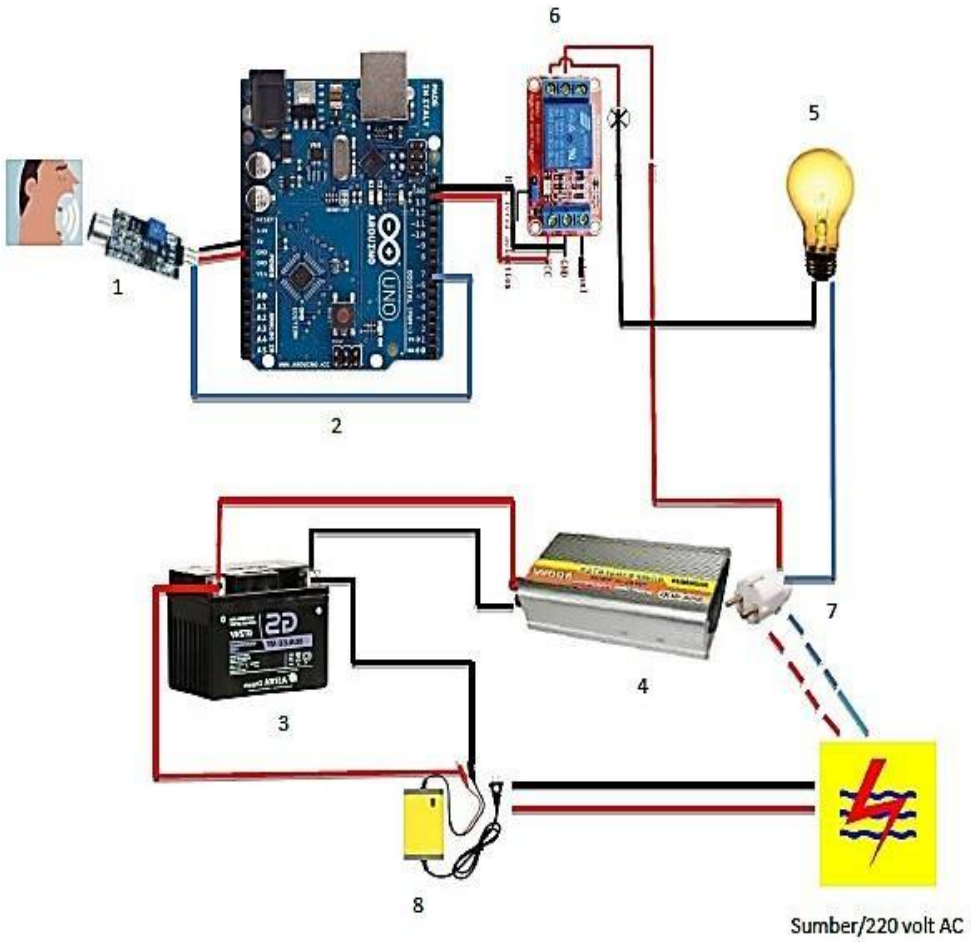


Figure.7 Manual for designing simple mechanisms and control systems
Source : Author (2024)

It's as if someone is throwing a burden or asking for a green light. The microphone will collect sound and convert it into an electrical signal. The sound sensor module then evaluates the signal and sends the output to the microcontroller, which includes ground, VCC, and others. After the process is complete, the microcontroller will send 5 volt input (+), ground (-), and a signal to the relay module with one channel, asking it to turn on the light. The relay module has three terminals connected to VCC (+) and NO (normally open), and the output is connected to PLN 220 volts, and on. as a result, the NO terminal at the output will be connected or closed, which is the more common mode. The voltage will go to the load or lamp, and the wiring phase will go directly to the lamp, which will then turn on immediately.

RESULT AND DISCUSSION

Thorough system testing using three 5 watt Screwdrivers showed that the system functions according to the software instructions entered into the Arduino UNO R3 using the FC-04 sound sensor as input. The purpose of this test is to change the lights that the author will use when a power outage occurs. This will be done by using a sound sensor as a detector. Whenever authors want, they can choose to turn the lights on or off with this tool. After testing and validating various devices to ensure that they can carry out the assembly process on, the tools used include: (Figure 8)

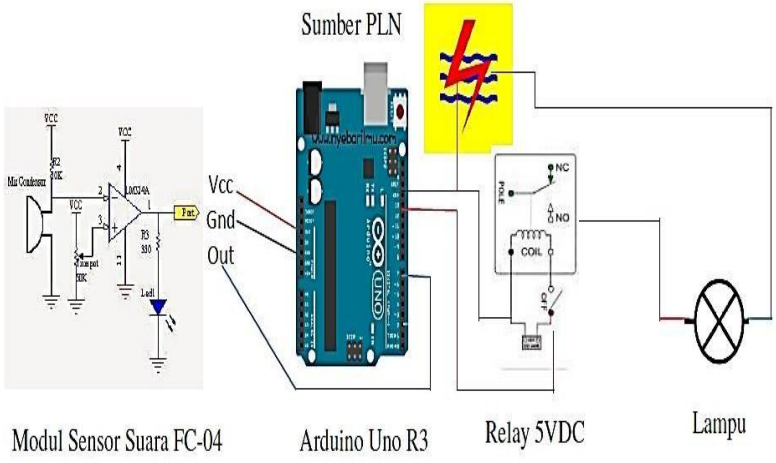


Figure 8. Overall design scheme using PLN as the source
Source : Author (2024)

a. Install the papa module with three fittings;
b. connect the red (+) and black (-) cables to the connectors of each fitting;
c. Install a three-terminal socket on the side of the module board;
d. Install TDOS;
e. connection of all three fittings in parallel to TDOS;
f. Install TDOS;
g. Connect the source cable to the standard relay pin;
h. connect the black NYA (-) cable from the lamp fitting to the NO terminal (normally open); And
i. Connect pin 4 of Arduino uno r3 to the sound sensor output;
j. Connect the jumper from the VCC relay input to pin 13 I/O Arduino uno r3;
k. Connect the jumper from the relay input to the ground pin;
l. Connect pin 4 of Arduino uno r3 to the sound sensor output;
m. Connect the 5 volt pin of Arduino uno r3 to the VCC pin of the sound sensor; And
n. Connect the sound sensor ground pin to the sound sensor ground pin.
o. To get program instructions, connect the Arduino USB port to the laptop.

p. To get program instructions, connect the Arduino USB port to the laptop. Then, connect the Arduino Uno R3 to a 9 volt power supply/battery (Figure 9).

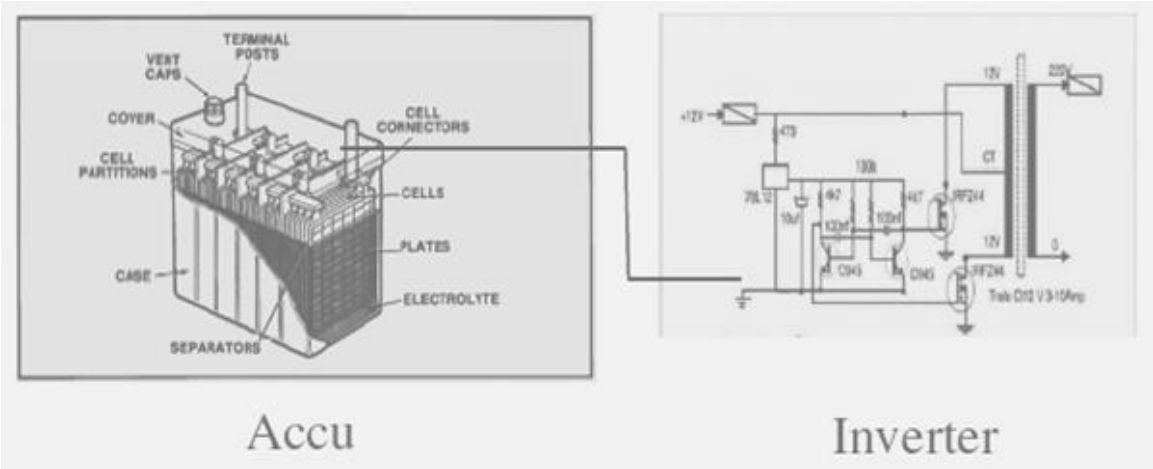


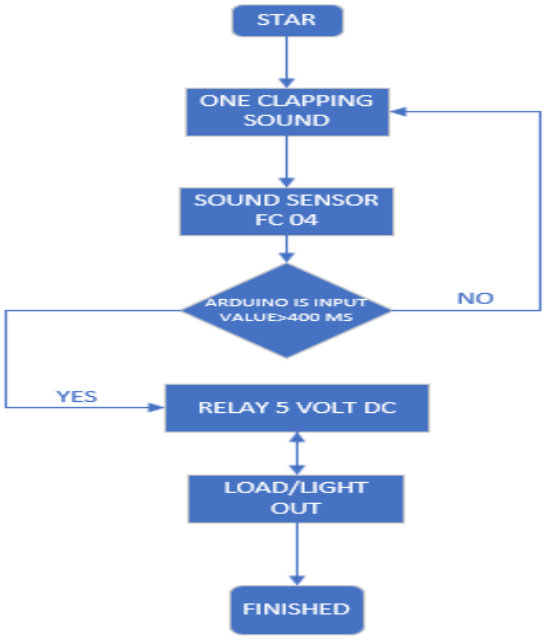
Figure 9. System design for alternative energy sources
Source : Author (2024)

The microphone's working mechanism lies in measuring how strong or weak the sound waves or waves are that hit the sensor membrane. These sound waves move small coils consisting of sensor membranes up and down. The LM393 chip then converts its output into output signals of 1 and 0. The sensitivity of the microphone can be changed with the available trimpot, which is connected to this output module and the sound sensor. The Atmega 328 chip will process the input after the program is uploaded which contains 500 millisecond bottle instructions with a validation value of >400 milliseconds to turn on or turn off the lights and output pin 13 as an output voltage with a value of >400 milliseconds or 5 volts. Next, the Arduino ground pin (-) is connected to the pin. input relay ground The working principle of this relay states that when C1 (ground) and C2 (VCC) are known, there is a coil that acts as a driver when C1 (ground) and C2 (VCC) have not been passed by voltage. If voltage is supplied to both C1 (ground) and C2 (VCC), then the COM and NC (Normally Close) terminals will be connected, but the NO (Normally Open) terminal will be disconnected.

Table.2 Experimental control system with a maximum range of 3 meters

No	Initial state of the lamp	Votes/applause given	Sound sensor input signal time (ms)	Sound sensor voltage	Final state of the lamp	
					Goes out	Light up
1	Goes out	One round of applause	>400 ms	0,5 VDC		✓
2	Goes out	One round of applause	<400 ms	0,5 VDC	✓	
3	Light up	One round of applause	>400 ms	0	✓	
4	Light up	One round of applause	<400 ms	0		✓

Source : Author (2024)



Picture. 10 Control system flow diagram over 400 ms with lights turned off at the start (Source : Author, 2024)

Control system flow diagram showing that if the sound sensor receives an output of more than 400 ms and someone claps once, the light will turn on (Figure 10). The light is turned on to the starting position.

CONCLUSION

The research results can be used to make the following conclusions. When the FC-04 sound sensor detects a clap with a value of 1, the system will run. The program uploaded to the Arduino will collect this value to use it as a 5 volt output to turn the light on or off for 400 milliseconds. (iii) The FC-04 sound sensor can only produce digital signals with values between 1 and 0; and this depends on a number of variables, including the temperature at the location. This development research still has many shortcomings and needs. to upgrade, for example. Voice instructions can be statements heard along with a voice recording to adjust the lights. The specifications of the FC-04 sound sensor regarding the intensity of hand clapping in decibels are unknown. In addition, the output voltage from the Arduino can be stabilized to serve three 5 Volt DC relays at once to power three light loads)

ACKNOWLEDGMENT

We are grateful to the ahli and innovators in the fields of knowledge and technology for their contributions beyond their usual role in improving human life. In this day and age, technological advancements have led to the development of various home management systems, such as listrik control based on suara. These innovations, such as suara sensor technology like FC-04, enable us to control lamps only using suara perintah without needing to jerk, making life more comfortable and efficient.

With a sensor that is connected to a microcontroller and programmed using Arduino, we can easily set up or operate a bulb. Even if there are drawbacks, such as sensor sensitivity and environmental sensitivity, this technology shows how far we have come in using technology for daily needs. We extend our gratitude to all the organisations that consistently support innovation in order to create a better way of life.

REFERENCES

Articles from the Journals

Agnesia, A., Kustidarsyah, F., Setiawan, I. M. A., & Muharani, L. (2024). Implementasi Sistem Irigasi Smart Garden IoT pada Perkebunan Stroberi. *Jurnal Inovasi Teknologi Terapan*, *2(1)*, 88-98.

Akbar, R. S., Kholid, F., Kasiyanto, K., Widiatmoko, D., & Achmad, A. (2024). Design of Fuel Monitoring Application for Reservoir Tanks in Army Fuel Supply Point on Military Logistics Corps Based on Internet of Things. *International Journal of Engineering and Computer Science Applications (IJECSA)*, *3(1)*, 19-32.

Arianti, N. N., Bintang, R. M., & Mulyasari, G. (2022). Persepsi dan Adaptasi Petani Perikanan Air Tawar terhadap Perubahan Iklim di Kecamatan Padang Jaya Kabupaten Bengkulu Utara. *Jurnal Kebijakan Perikanan Indonesia, 14(2)*, 73-85.

Emidiana, E., Nurdiana, N., Al Amin, M. S., Azis, A., Febrianti, I. K., & Perawati, P. (2023). Sosialisasi Penggunaan Panel Surya Bagi Petani Sawah Tadah Hujan. *Jurnal Pengabdian kepada Masyarakat Nusantara*, *4*(2), 629-633.

Fahlevi, M. R., & Gunawan, H. (2020). Perancangan Sistem Pendeteksi Banjir Berbasis Internet Of Things. *IT Journal*, *8*(1).

Mamahit, C. (2024). Rumah Pintar dengan Lampu Kontrol Suara Menggunakan Arduino Uno R3. *Electrician: Jurnal Rekayasa dan Teknologi Elektro*, *18*(2), 144-152.

Naga, J. B., Widiatmoko, D., & Kasiyanto, K. (2023). Translation Motion-Based Backpack for Indonesian Army Soldiers as a Source of Energy for Military Communication Devices. *Jurnal Bumigora Information Technology* (BITe), 5(2), 187-194.

Pratiwi, R. M. C., & Fatchiya, A. (2021). Sikap Petani Atas Peralihan Fungsi Lahan Pertanian Ke Non Pertanian Di Kelurahan Pasir Putih, Sawangan, Depok. *Jurnal Sains Komunikasi Dan Pengembangan Masyarakat [JSKPM]*, *5*(3), 462-472.

Prayogi, S., Widiatmoko, D., Syafaat, M., Pradigdo, D., Alfarizi, R. M., & Sridaryono, A. (2024). Design of the pistol P1 weapon storage system shelf using fingerprint electronic system in the TNI-AD units. *TEKNOSAINS: Jurnal Sains, Teknologi dan Informatika, 11(2)*, 238-244.

Puspito, A. S., Jeki, S., & Aguk, S. (2020). Pada Rancang Bangun Sistem Kontrol Robot Intai Menggunakan Metode Artificial Neural Network. *Jurnal Elkasista*, 1, 21-26.

Saputra, A., Ansori, M., & Widiatmoko, D. (2020). rancang bangun alat pendeteksi suhu tubuh otomatis dengan image processing menggunakan metode backpropagation. *Jurnal Elkasista*, 1(1), 1-6.

Sugiarta, A., Kasiyanto, K., Widiatmoko, D., Syafaat, M., Achmad, A., & Asif, I. (2023). Technology Biomechanic-Based Design of Knee Protector Generator for Portable Electricity Generation to Support Military Operations in the Field. *Jurnal Bumigora Information Technology (BITe)*, *5*(2), 159-170.

Suprayadi, M., Suryadi, K., & Widiatmoko, D. (2020). smart charging with stepper pada sepatu pdl tni sebagai suply alat komunikasi saat patroli di daerah perbatasan. *Jurnal Elkasista, 1(1)*, 1-6.

Syahid, M., Salam, N., Piarah, W., Djafar, Z., Tarakka, R., & Alqadri, G. (2022). Pemanfaatan pompa air tenaga surya untuk sistem irigasi pertanian. *JURNAL TEPAT: Teknologi Terapan untuk Pengabdian Masyarakat*, 5(1), 102-108.

Tamboenan, F. D., Syafaat, M., Setiawan, A., Widiatmoko, D., & Al-farizi, R. M. (2024). Implementation of the SN04 Roko metal sensor on a 5.56 mm caliber portable magazine feeder. *TEKNOSAINS: Jurnal Sains, Teknologi dan Informatika, 11(2)*, 306-311.

Widiatmoko, D., Setiawibawa, R., Al-farizi, R. M., Syafaat, M., & Prawira, E. (2023). Implementasi Sensor LDR Pada Prototipe Sistem Tracking Dual Axis Untuk Deteksi Arah Sinar Matahari Pada Sel Surya. *ASPIRASI: Publikasi Hasil Pengabdian dan Kegiatan Masyarakat*, *1*(5), 132-140.

Widiatmoko, D., Apriharta, A., Kasiyanto, K., Irmanto, D., & Prasetyo, M. W. (2024). Power Efficiency using Bank Capacitor Regulator on Field Service Shoes with Fast Charge Method. *MATRIK: Jurnal Manajemen, Teknik Informatika dan Rekayasa Komputer*, *23*(2), 273-284.

Worden, J., & Zuercher-Martinson, M. (2009). How inverters work. *Solar Pro*, (2.3).

Proceeding

Uriawan, W., Zulfikar, W. B., Sofa, R. M., & Ramdhani, M. A. (2018, November). Internet of things for automatic garage doors using ESP8266 module. In *IOP Conference Series: Materials Science and Engineering* (Vol. 434, No. 1, p. 012057). IOP Publishing.

Published Book

Setiawibawa, R., Widiatmoko, D., Kasiyanto, K., Setiawan, H., & Sridaryono, A (2023). *Elektronika Dasar*. Purbalingga : Penerbit Cv.Eureka Media Aksara.