JoFRISE 2 (4) (2024)
Journal of Frontier Research in Science and Engineering
https://journal.riau-edutech.com/index.php/jofrise
Publisher :
Andester Riau Edutech
Pusat Inovasi Pendidikan dan Teknologi
ISSN : 3032-0348

Automatic Ventilation Design Using DHT-11 Sensor and Microcontroller Based LDR Sensor

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Submiited: 28/10/2024
Revised: 20/11/2024
Accepted: 20/11/2024
Published: 31/12/2024
Vol. 2
No. 4

Abstract- Automatic ventilation using temperature sensors and light sensors very useful for users by applying it in life daily. Therefore, in this research, it was designed according to needs users can control the temperature and light intensity so that the air is warm Entering the user's room feels comfortable. This research uses Arduino Uno as the brain, DHT-11 sensor to measure room temperature, and an LDR sensor to measure light intensity. Data from both sensors is processed by Arduino to get the room temperature and light intensity values for move the Servo to open the ventilation cover and it will be displayed on LCD. Based on the overall performance of the tool, it can work well.

Keywords: *Arduino uno, temperature sensor, light sensor, Servo*

1 Introduction

Air is a very important need for living creatures, especially humans, to maintain their lives. However, various kinds of human activities, both intentional and unintentional, can cause air pollution. Air pollution worsens air quality which affects human, animal and plant health (Airunnisa & Herzanita, 2023). Air can be grouped into outdoor and indoor air. Indoor air quality greatly affects human health because 90% of human life is indoors (Ministry of Health, 2019). One of the factors that influences indoor air quality is outdoor air quality (Ministry of Health, 2020). Having a ventilation system in the room will facilitate air exchange from outside to inside the room so that there is air change (Ramadhan et al., 2021). When there is air pollution from outside the room, dirty air can enter the room through ventilation, so a ventilation control system is very necessary to regulate the incoming and outgoing air so as to minimize the entry of dirty air from outside into the room (Ramadhani et al., 2023).

Poor air quality can contribute to a variety of health problems, such as allergies, asthma and other respiratory illnesses. Poor air quality can have serious impacts on human health. Long-term exposure to air pollution, such as vehicle fumes, industry, and burning fossil fuels, can trigger various respiratory diseases such as asthma, bronchitis, and chronic obstructive pulmonary disease (Umah & Gusmira, 2024). Poor air quality can reduce life expectancy and reduce people's quality of life, in this context, automatic ventilation systems emerge as an innovative solution, designed to efficiently regulate air flow, maintain a comfortable temperature, and remove pollutants that can harm the health of residents.

Advances in sensor and control technology, automatic ventilation systems are now able to monitor various environmental parameters in real-time, such as temperature, humidity and light intensity. This allows the system to dynamically adapt to fresh air requirements, creating a healthier and more comfortable environment. Apart from that, this system also contributes to energy efficiency (Abdullah & Sujiwa, 2024).

How to Cite :

Fitri, Yoli Wilanda, & Irawan, Dedi. (2024). Automatic Ventilation Design Using DHT-11 Sensor and Microcontroller Based LDR Sensor. *Journal of Frontier Research in Science and Engineering(JoFRISE)*, **2(4), 49-55**

By optimizing energy use and adjusting air flow according to actual needs, automatic ventilation systems not only help reduce operational costs, but also minimize environmental impacts (Gayuh & Dewi, 2021).

Increasingly stringent regulations and standards in various countries are also driving the adoption of effective ventilation systems. Many governments have set requirements requiring the use of proper ventilation systems in new buildings, to ensure the health and safety of occupants. Thus, automatic ventilation systems are not only a smart choice, but also a necessity in modern building design (Rahman & Suryani, 2020).

Automatic ventilation systems have wide applications in various sectors, from residential to commercial and industrial. Each sector has specific needs that can be met by this system, making it a flexible and adaptive solution (Aribowo et al., 2022). In all these aspects, the development of automatic ventilation systems focuses not only on comfort, but also on health and efficiency, making them an important component in creating a better environment for everyone (Ivan et al., 2019).

2 Research Methodology

2.1 Tools and Materials

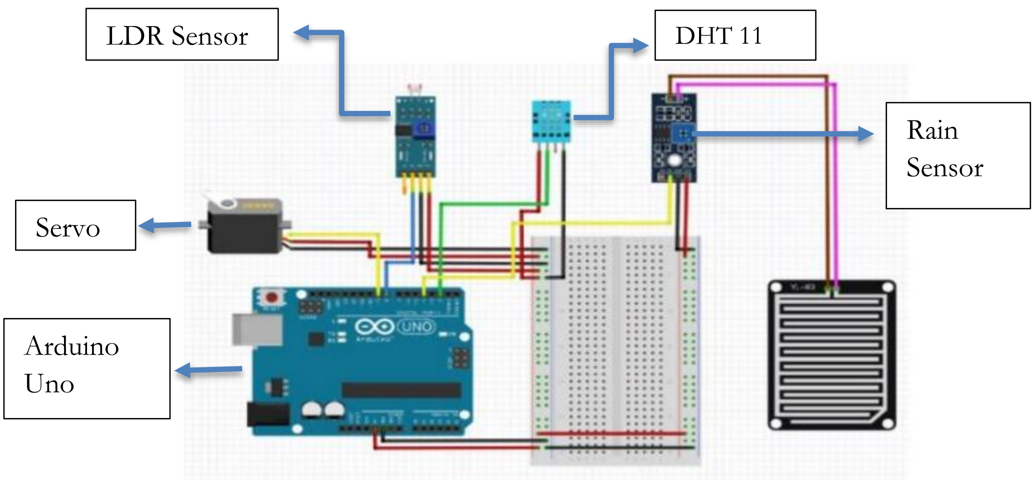
The tools and materials used are Laptop, Arduino Uno R3, DHT 11, LDR Sensor, Servo, Step Down, 12 V Adapter, Jumper, Solder, Soldering Tin, Arduino Ide Application.

2.2 Steps for Designing an Automatic Ventilation System

This section will discuss scheduling activities and designing microcontroller-based automatic ventilation devices. This research was conducted at the University of Riau over a period of one semester, starting from August to December 2024.

The steps for designing an automatic ventilation system are creating a concept for designing an automatic ventilation device based on Arduino Uno using a DHT-11 temperature sensor and LDR light sensor, searching for and studying material related to the design of the device being made so that it makes research easier, preparing the tools and materials that will be used. used in research, designing the hardware used in research, testing each piece of hardware that will be used, whether it works well or not, making a control system program, testing the control system program that will be made, if it fails, it will be evaluated if If it works well then continue the next stage, testing the control system that is working well and starting to collect data (Firmansyah et al., 2020; Kanata et al., n.d, 2022)

2.3 Hardware Design

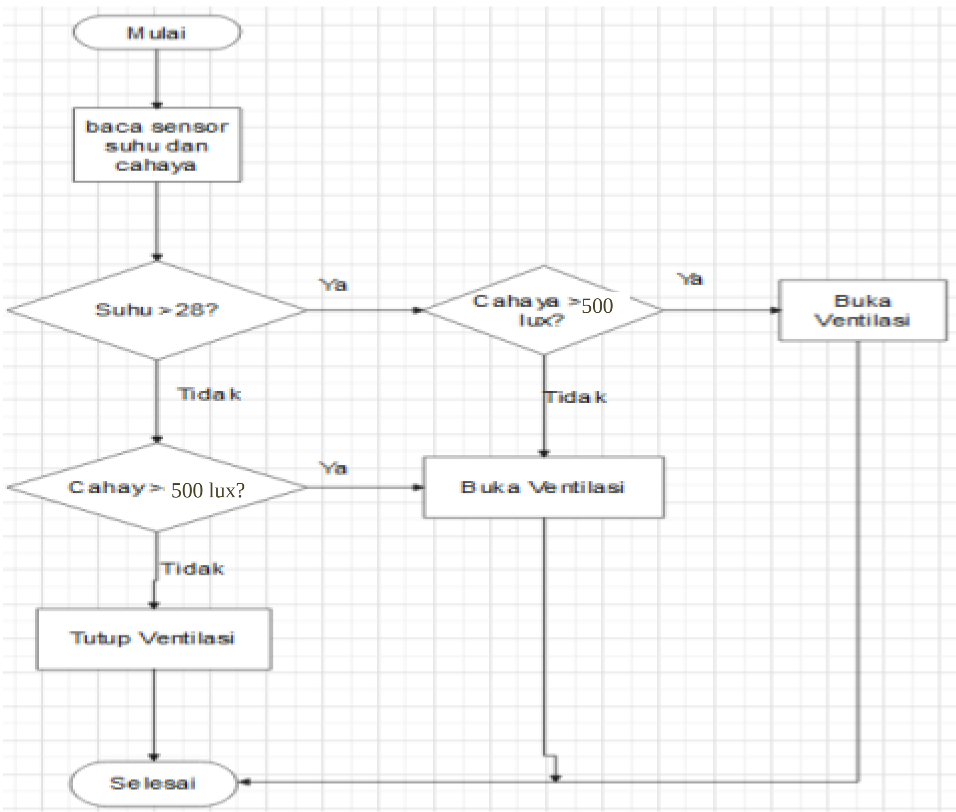


Picture 1.Hardware Design

Hardware design includes designing the temperature sensor circuit (DHT-11) and light sensor (LDR), and the Arduino UNO minimum system circuit. The DHT-11 sensor and LDR sensor detect temperature and light. The DHT11 sensor works by utilizing a temperature sensor element (NTC thermistor) to measure temperature and a capacitor element to measure humidity. After reading the temperature and humidity, the sensor will convert this data into a digital signal which is then sent to the microcontroller via one data pin (Rahman & Suryani, 2020; Yusika et al., 2020). The data received by the microcontroller consists of two parts: one for temperature and one for humidity, which must be processed to obtain a readable value (Ethan, 2023).

The LDR sensor is an electronic component that is sensitive to light. This sensor functions to detect the intensity of light in the environment and convert it into an electrical signal (Mulyanto, 2020; Utama et al., 2018). When the temperature is hot and the light is bright, the sensor will send information to the microcontroller as a condition parameter for automatic ventilation. With the specified parameters, the ventilation can work automatically to open and close according to the desired temperature and light conditions in the surrounding environment.

The program that will be used by the microcontroller is not written directly but is written first in a flowchart. When preparing programs for microcontrollers, attention must be paid to the logic used so that the program can run well (Rumalutur & Mappa, 2019; Dwi et al., 2021). Errors in writing the logic of a program will cause errors in the program output. Before writing a program, the problem to be solved must be determined to help track the correct logic of a program (Aulia et al., 2021; Syas & Rakhmadi, 2019). The following is the flowchart of the automatic ventilation opening and closing system below:



Picture 2. Flowchart program

The program will be active using analog input. If the DHT-11 sensor temperature is less than 28 ℃ and the LDR sensor detects light less than 500 lux, then the motor will move to close the ventilation and the ventilation will stop by itself. If the DHT-11 sensor temperature value is more than 28℃, if the temperature is hot and the LDR sensor has a light intensity of more than 500 lux, the motor will move to open the ventilation.

2.4 Tool test results

The prototype design is a tool design specifically for working in the room, the tools that work in the room are the development board (Arduino), temperature sensor, light sensor, the tool is shown in Figure 3.

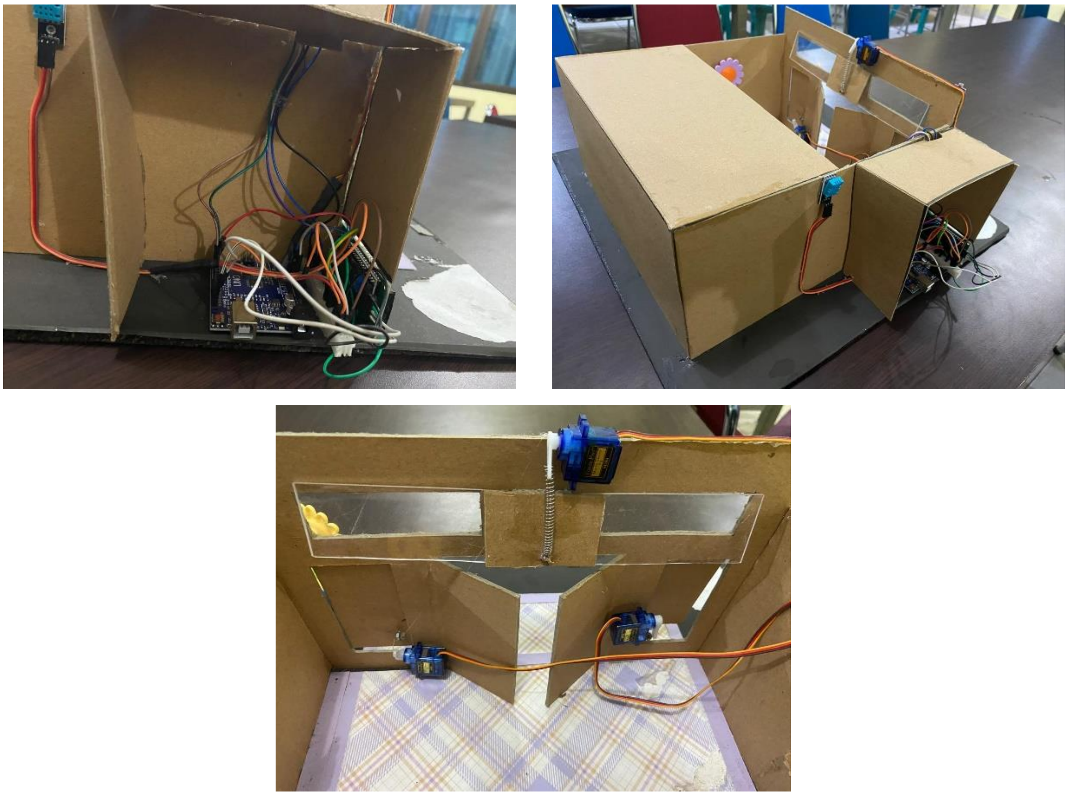


Figure 3. Ventilation Design

In Figure 3 above is a display of the automatic ventilation design that has been designed. To carry out experiments on designing an automatic ventilation system based on temperature and brightness based on a microcontroller, the ventilation will open and close automatically based on temperature and can detect the brightness of the room.

3 Results and Discussion

Testing the sensor results on the automatic ventilation system is carried out by comparing the sensor results on the device display, for temperature and humidity indicators using DHT-11 it will be compared with thermometer and LDR sensor compared to Lux Meter. The following data results were obtained

Table. 1 System Test Results

No	Time (WIB)	Sensor Reading Results		Results of readings from ventilation		Condition Measuring Instruments
		DHT- 11	LDR	*Thermometer*	Lux Meter	

1	Morning (09.00)	28,7˚C	>500 (Bright)	28,5˚C	786	Opened
2	Noon (12.00)	29˚C	>500 (Bright)	30˚C	861	Opened
3	Night (20.00)	23,5˚C	<500 (Dark)	24˚C	425	Closed

Table 1 is a table of the results of overall system testing carried out in the morning, afternoon and evening, starting at 09.00, 12.00 and 20.00 with 3 data samples taken. Each data sampling uses intervals or time differences between morning, afternoon and evening. The first measurement data in the morning can be seen in the table above, namely 28.7℃ and the thermometer temperature is 28.5℃ and measuring light >500 lux while the lux meter light is 786 with the ventilation open. The data for the two measurements during the day can be seen in the table above, namely 29℃ and the thermometer temperature is 30℃ and measuring light >500 lux while the lux meter light is 861 with the ventilation open. And the data for the three measurements during the day can be seen in the table above, namely 24 ℃ and the thermometer temperature is 23.5℃ and measuring light <500 lux while the lux meter light is 425 with closed ventilation conditions.

In the measurement results in table 1, it is found that the ventilation conditions are open in the morning and afternoon and closed at night, the ventilation is open because the temperature is quite hot in the morning and afternoon, which on average exceeds the ideal room temperature, namely 28˚C and light intensity > 500 in bright conditions.

4 Conclusion

From the results of testing automatic ventilation devices, several conclusions can be drawn as follows:

1. In testing the temperature sensor, the room temperature value was 24℃ to 30℃, while for the light sensor the value obtained is 400 lux to 800 lux.
2. In this test it can be seen that the highest temperature was in the daytime test because the data collection was carried out from 12.00 WIB, while the lowest temperature value was in the test at night because the data collection was carried out at 20.00 WIB and in the test the room light intensity value was highest at testing during the day because data collection was carried out from 12.00 WIB, while the lowest room light intensity values were obtained at night.
3. Overall testing can be concluded that two closed ventilation conditions were obtained at night at 20.00 WIB, because the room temperature value was below 24 ℃, while the room light intensity value is below 500 lux. And open ventilation conditions are obtained in the morning and afternoon at 09.00 and 12.00 WIB, because the temperature value is above 24℃ and the room light intensity value is above 500 lux.

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