
AUTOMATIC CLOTHESLINE USING RAIN SENSOR AND LDR SENSOR BASED ON ARDUINO UNO

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Abstract

The high rainfall has caused people to feel anxious about their clotheslines. Most choose to dry clothes on terraces or under transparent roofs, which slows drying and can cause bad smells. To address this, the author designed an automatic clothesline puller using an Arduino Uno microcontroller equipped with a rain sensor and a Light Dependent Resistor (LDR) sensor. The device detects weather conditions through these sensors. There are four operational conditions: when the sensor detects bright light (sensor read > 778) and no rain, the clothesline is pulled outside. If bright light and rain are detected, the clothesline is pulled inside, and a heater is turned on. If dark light (sensor read < 50) and no rain are detected, the clothesline is pulled inside. If dark light and rain are detected, the clothesline remains inside. The tool only pulls clothes outside if it is sunny and not raining. In all other conditions, the clothes are pulled inside. This automatic clothesline puller aims to reduce worries about drying clothes during the rainy season. The test results confirm its effectiveness in various weather conditions, providing a practical solution for the community.

Keywords: Arduino UNO, Light Depending Resistor (LDR), Microcontroller, Rain sensor

INTRODUCTION

High rainfall often becomes an obstacle for people, especially in household activities such as drying clothes. The uncertainty of the weather makes many people feel anxious when drying clothes in open spaces. A common solution that is often used is drying under the roof or on the terrace of the house. However, this approach slows down the drying process due to minimal exposure to direct sunlight and air circulation, which can ultimately cause clothes to smell bad (Aditya, 2020).

Technological advances, especially in the field of microcontrollers and sensors, open up new opportunities to create innovative solutions in various aspects of daily life. The Arduino Uno microcontroller, for example, has been widely used in automatic control systems because of its ability to integrate various sensors and provide real-time responses (Fatmawati & Gunawan, 2020). Apart from that, rain sensors have also been widely used to detect weather conditions accurately and provide automatic solutions for various household devices (Dewi, 2021). In this context, the development of automatic drying equipment based on microcontroller technology becomes relevant to overcome the problems faced by society related to unpredictable weather.

This research utilizes rain sensors and Light Dependent Resistor (LDR) sensors to detect weather conditions accurately. This system is designed to pull the clothesline out when it's sunny and put it back inside when it's raining or dark. With the integration between the LDR and rain sensors, the system is able to adapt to various operational conditions (Chen *et al.*, 2019). In this application, the Arduino Uno microcontroller acts as a control center that allows the device to operate efficiently and automatically (Kurnia *et al.*, 2020).

The implementation of this technology aims to reduce people's concerns about drying clothes, especially during the rainy season. In addition, this research shows that simple microcontroller-based technology can provide practical solutions that directly impact daily life (Nasution & Putra, 2021). This tool focuses on a simple local control system, without requiring network connectivity or IoT-based technology, so it is more cost-effective and easy to apply by the general public (Santoso, 2019).

This research not only offers practical solutions, but also contributes to the development of automated household devices that emphasize efficiency and ease of use. With test results showing its effectiveness in various weather conditions, it is hoped that this tool can become an appropriate alternative technology that can be widely applied (Wang *et al.*, 2020; Widodo, 2020).

LITERATURE REVIEW

1. Arduino UNO R3



Figure 1. Arduino UNO R3

According to Roni (2022) Arduino is an open-source platform used to build electronic projects. This platform consists of a microcontroller board (such as Arduino Uno, Arduino Nano, etc.) and a software development environment (IDE) that is used to write and upload code to the microcontroller board. Arduino has become popular because it is easy to use, flexible, and accessible to both beginners and professionals in electronics and programming.

Arduino has functions, namely the first as input and output processing arduino is used to read inputs from the environment through sensors (such as temperature sensors, proximity sensors, etc.) and control outputs, such as turning on LEDs, running motors, or displaying data on LCD screens. And the second as automation and control arduino can be used to automate tasks, for example in robotic projects, home automation systems, temperature monitoring systems, light control, and so on.

2. Light Sensor or LDR (Light Dependent Resistor)

According to Deny Siswanto and Slamet Winardi (2015) LDR or Light Dependent Resistor is one type of resistor whose resistance value is influenced by the light received by it. The magnitude of the resistance value on the LDR depends on the size of the light received by the LDR itself. LDR is a type of resistance that is very sensitive to light. The nature of this LDR resistance is that its resistance value will change when exposed to light or light. To be able to know the sensitivity of the Light Dependent Resistor sensor, it is necessary to do some testing, namely by putting the LDR sensor in a bright place and a dark place. In the process of experimenting with light sensors can use

the help of light from a lamp or light sourced from the sun. The LDR (Light Dependent Resistor) Sensor symbol is described as a resistor symbol in general. The physical form and symbol of the LDR sensor can be seen in Figure 2.

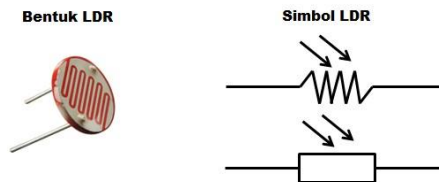


Figure 2. Physical form and symbol of LDR sensor

The construction of an LDR (Light Dependent Resistor) sensor is made of cadmium sulfide (CdS) or cadmium selenide (CdSe). This substance is placed on a glass or ceramic substrate and then sealed in plastic or glass. When light shines on the photoresistive material, it liberates electrons. These electrons then turn into current, and the resistance decreases. The more light shines on the LDR sensor, causing the resistance to decrease. LDR (Light Dependent Resistor) sensors just like resistors in general do not have polarity or positive poles and negative poles. Can be seen as shown in Figure 2.3.

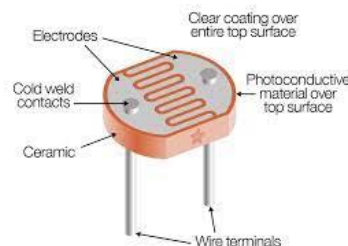


Figure 3. LDR sensor construction

The voltage divider circuit is a basic circuit using only two resistors or can also use one resistor and one LDR (Light Dependent Resistor) sensor installed in series with a voltage source ($V +$) and ground. The output voltage (V_{output}) is the voltage resulting from the division between the LDR sensor and the resistor or vice versa. The LDR sensor has a test circuit image as below.

The characteristics of the LDR (Light Dependent Resistor) sensor itself are that it has resistance during dark conditions or bright conditions between hundreds of ohms (Ω) to several Mega Ohm ($M\Omega$) depending on the type of LDR sensor (Light Dependent Resistor). The characteristics of the LDR (Light Dependent Resistor) sensor can be seen in the picture below.

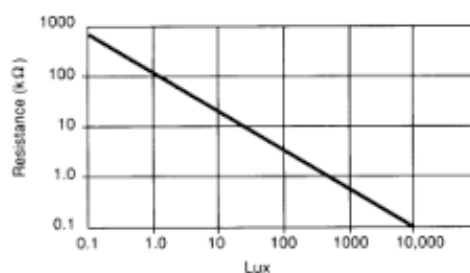


Figure 4. LDR sensor characteristics

LDR is a form of component that has a change in resistance that depends on light. Therefore, it is necessary to convert the ADC value on the LDR to process the resulting data (Supatmi, 2010). To calculate the ADC conversion on the LDR, the first thing that must be known is the resistance of the LDR. Here is the calculation formula to find the ADC of the LDR sensor.

Formula	: $V_{LDR} = \frac{R_{LDR}}{R_{LDR} + R_1} \times V_{REF}$
	: $DHK = \frac{V_{LDR}}{SS}$
Description	:
V_{LDR}	: Output voltage generated from LDR sensor
R_{LDR}	: Resistance of the LDR sensor
R_1	: Resistance
V_{REF}	: Reference voltage or input voltage source in the circuit
DHK	: Degree of output count
SS	: Step size

3. Rain Sensor



Figure 5. Rain Sensor

Rain sensor is a type of sensor that functions to detect whether it is raining or not, which can be used in all kinds of applications in everyday life. The working principle of this sensor module is that when rain falls and hits the sensor panel, an electrolyzation process will occur by rainwater. And because rainwater is included in the class of electrolyte liquids where the liquid will conduct electric current.

In this rain sensor there is a comparator ic where the output of this sensor can be in the form of logic high and low (on or off). And in this sensor module there is an output in the form of voltage as well. So that it can be connected to a special Arduino pin, namely the Analog Digital Converter. In short, this sensor can be used to monitor the condition of whether there is rain in the outside environment where the output of this sensor can be an analog signal or a digital signal.

RESEARCH METHOD

Designing this tool so that it becomes a unified system that can run well involves several steps.

1. Literature Study

The first is to conduct a literature study of various previous studies that can be a guide and reference in designing this tool. In the literature study, the author found several shortcomings and advantages of each in previous studies. The information was collected and analysed further. Not only research journals, the author also conducted research into various current news and articles related to problems that can be solved by the designed tool. One example is that currently the

weather can be predicted and updated in real-time, but it is not uncommon for rain to occur suddenly even though the predicted weather is sunny. The thing that some people are worried about is if they are drying their clothes and they are working or often in conditions outside the home. The result will slow down the drying process of the clothes and the clothes will also give off a bad odour.

2. Problem Identification

Step Two is the identification of problems that might be solved with this tool. It can be seen in the previous explanation that nowadays people are often outside the home either for work or holiday. Generally, big cities have a majority of the population as circular workers. According to (Haryono, 2007), a circular worker is a worker who travels regularly between their place of residence and place of work in different districts or cities. Reporting from a survey conducted by (Ayuningtyas, 2024) in big cities, one of them is the city of Jakarta, which has the most circular workers with high school graduates and above, namely 87.2%. Then, followed by circular workers in North Sumatra with 63.1%. The third position is filled by workers in South Sumatra with 62.5%. From this data, it can be concluded that there are still many people who do not have time to dry their clothes or only dry them on the terrace, which causes the clothes to not dry properly.

3. Tool Design

From the results of the problem identification above, a tool is needed that can detect rain and weather brightness levels. After considering several aspects of conditions, such as the level of durability and accuracy, the author chose to use a rain sensor and a light sensor (LDR) as input data for weather conditions in this tool. Both sensors have good resistance to weather or temperature differences. According to the LDR sensor datasheet issued (Components, 1997), LDR has an operating temperature between -60°C to $+75^{\circ}\text{C}$. As for the rain sensor, it has resistance to water so it is suitable for use during the rainy season. The component used as a data processor from the sensor is Arduino UNO. Arduino UNO is considered to have good reliability and accuracy in running a system. Arduino UNO can also be programmed in such a way that the system can run according to its purpose. Because the design of this tool is only in the form of a prototype, the component used to move the clothesline is a servo motor that can rotate as much as a certain angle clockwise or counterclockwise. Variations in the angle and direction of rotation can be used to move the clothesline inwards or outwards at a certain distance.

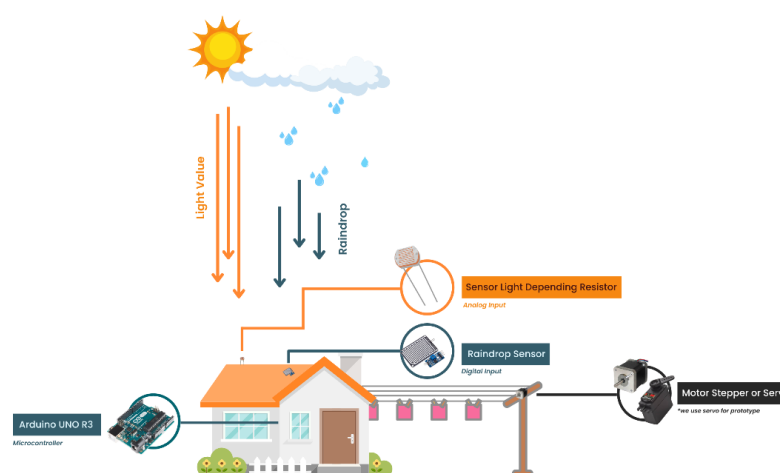


Figure 6. Diagram of tool design

4. Sensor Testing

Before entering the tool design stage. An important step that must be done is to test the sensor. The purpose of this test is to find out the sensor response if given several conditions. As in LDR sensors given conditions in dark and bright light. The value produced by the sensor from these two conditions will be analysed so that it makes it easier to make conditioning in the program listing later. During testing, one of the LDR pins is connected to the Arduino analogue pin. This is because the LDR sensor must be able to detect several kinds of conditions such as bright or dark weather or cloudy weather. Therefore, so that some of the conditioning can be carried out, the use of analogue values is needed. To find out the analogue value obtained from some of these conditions, the author conducted tests when the sensor was placed in bright light and dark light conditions.

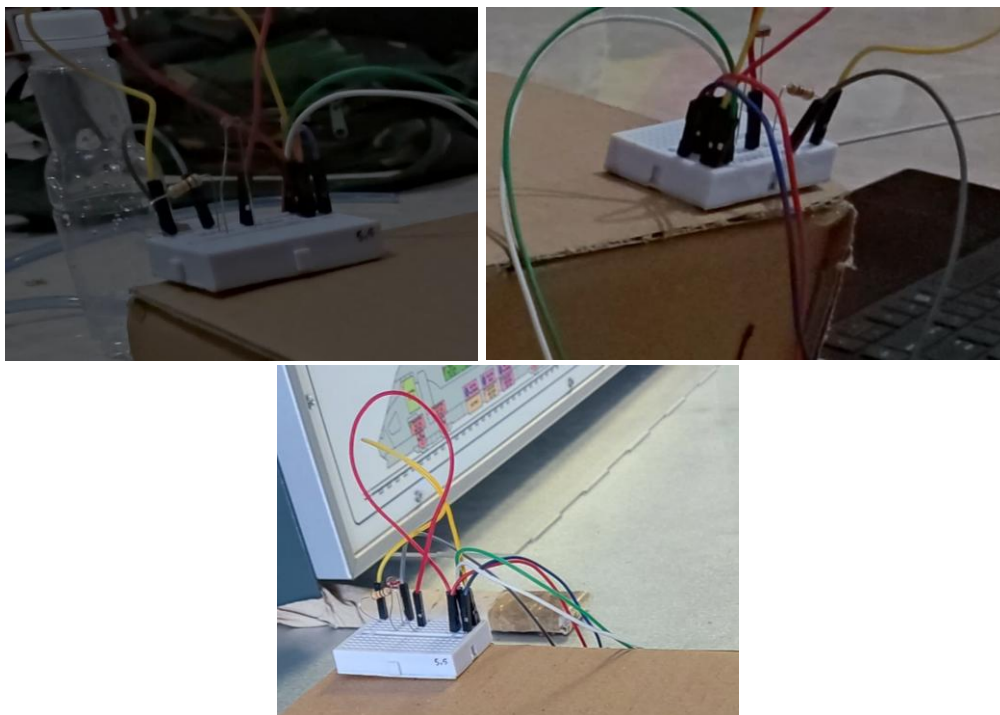


Figure 7-9. LDR in various lighting conditions. Dark light (upper left), less light (upper right), bright light (bottom)

When the sensor is placed in a place with minimal lighting conditions, the light value displayed on the Arduino IDE serial monitor is between 29 - 45. While in bright light, the light value displayed on the serial monitor is between 778 - 929. Between the two intervals of the displayed value, there is quite a gap between dark conditions and bright conditions, namely between 46 - 777. Therefore, the author adds one more conditioning, namely dim light. If bright light represents sunny weather, then dark light represents that it is night, then dim light represents cloudy weather. As proof, we did one more test to get cloudy weather data. The light value produced by the sensor when placed in a dim place is in the interval 46-777. From the three LDR conditioning, the output displayed on the serial monitor is as follows.

Output	Serial Monitor	Output	Serial Monitor	Output	Serial Monitor
	Message (Enter to send)		Message (Enter to send)		Message (Enter to send)
LDR Value: 778		LDR Value: 268		LDR Value: 29	
LDR Value: 864		LDR Value: 269		LDR Value: 30	
LDR Value: 904		LDR Value: 267		LDR Value: 31	
LDR Value: 922		LDR Value: 269		LDR Value: 40	
LDR Value: 929		LDR Value: 268		LDR Value: 45	
LDR Value: 902		LDR Value: 269		LDR Value: 42	
LDR Value: 932		LDR Value: 267		LDR Value: 42	
LDR Value: 929		LDR Value: 266		LDR Value: 42	
LDR Value: 929		LDR Value: 266		LDR Value: 42	

Figure 10-12. Serial monitor display in various light conditions

Next is testing the raindrop sensor. This test is done to find out how accurate this sensor is in detecting raindrops. During testing, the pin out used on the raindrop sensor is the digital output pin. The reason is that in use this sensor is only used to detect the presence of water or not (HIGH or LOW) and not to detect the level of humidity in the surrounding air. From the tests carried out, this sensor is considered capable of detecting raindrops even though it is drizzling. After having some data, a flowchart can be made as a reference in making the next program code.

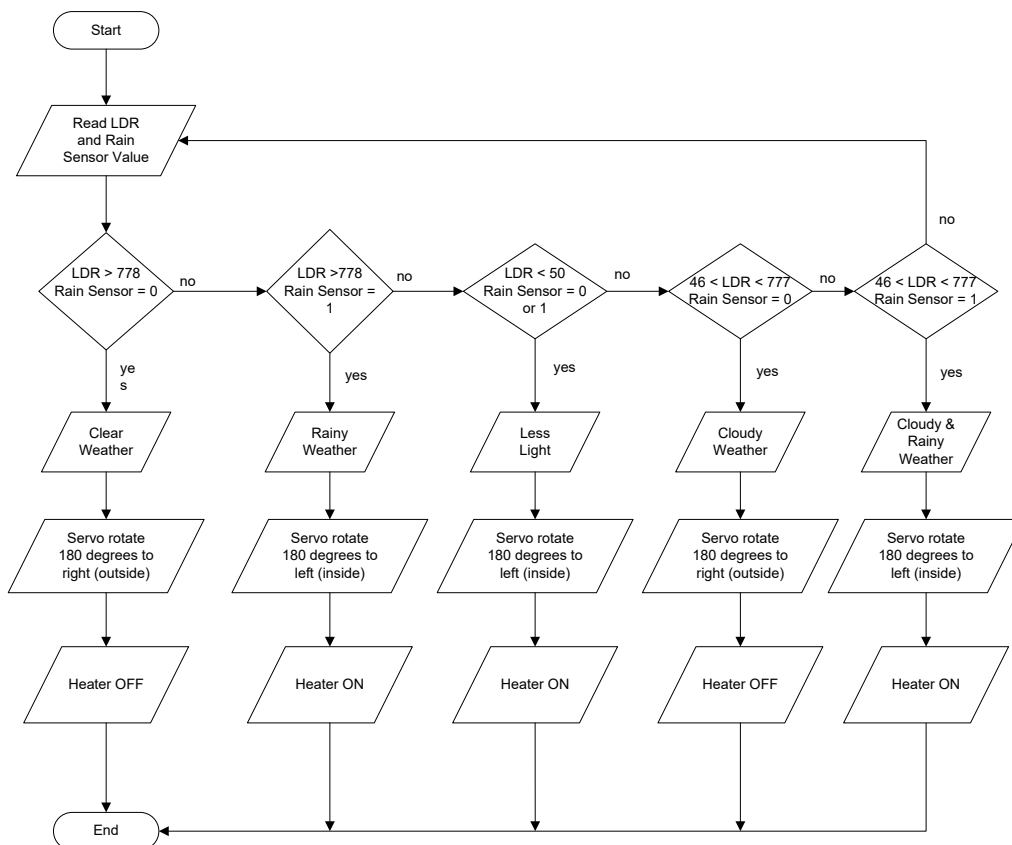


Figure 13. Flowchart of the entire system

The flowchart above shows that there are 5 conditions. Among the 5 conditions, 3 conditions result in the clothesline being put in and 2 conditions result in the clothesline being taken out from inside. The conditioning for the incoming clothesline is if the LDR sensor value is above 778 but the raindrop sensor detects rain, then if the LDR sensor value is below 50 whether it is raining or not,

the clothesline still goes inside. And the third condition is if the LDR sensor value is between 46 and 777 and it is raining. The author also adds that if the clothesline enters, it will activate the heater in the house so that the clothes will also be able to dry even in the house. Apart from these three conditions, the clothesline will come out and the heater in the room will turn off.

RESULTS AND DISCUSSION

After doing some previous tool design. In order for the tool to be used properly and have the right level of accuracy, a series of stages must be carried out as follows.

1. Wiring

At this point, a circuit is made that functions as a link between components into one system so that the circuit can be programmed for the next step. The components and equipment used in making this tool are Arduino UNO microcontroller, Light Dependent Resistor sensor, Servo Motor, jumper cable, LED lamp, resistor, and raindrop sensor. The following is a circuit scheme of the automatic clothesline prototype that the author made.

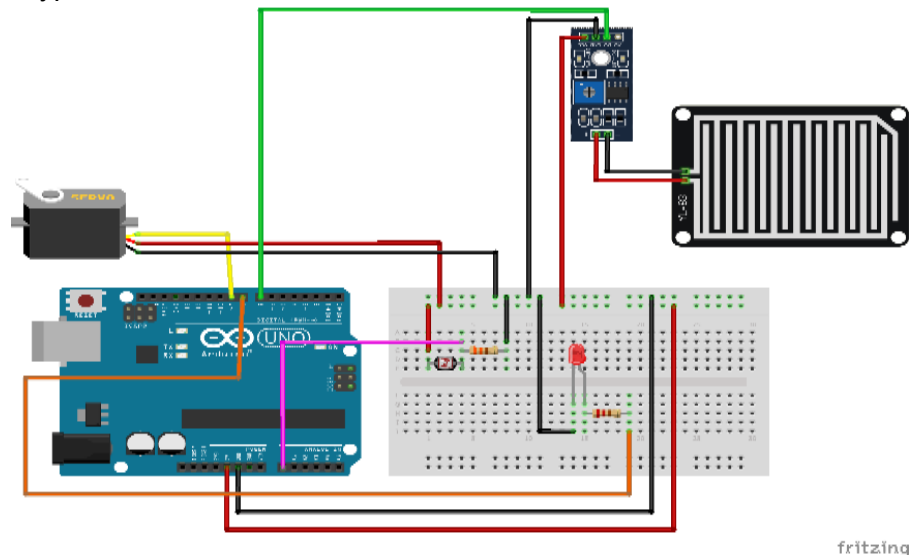


Figure 14. System wiring

Explanation of the function of each component is as follows:

- Arduino UNO as a microcontroller which is the brain that controls all components so that they can work properly.
- LDR sensor as an input to measure the light intensity level around the sensor.
- Servo motor as an output that will move the clothesline.
- LED sebagai output yang digunakan sebagai indikasi bahwa heater telah menyala atau belum.
- Raindrop sensor as input to detect raindrops.

2. Tool Design

This automatic clothesline is designed with ergonomics and efficiency in mind. The clothesline is designed in such a way that it is more or less the same as in real life. At both ends of the rope, a servo motor is installed to drive the clothesline back and forth. The house is made open from the side to make it easier for the clothesline to get inside. Sensors are installed on the roof of the house so that it can detect light properly. Then the raindrop sensor is also installed on the roof of the house

so that it can detect raindrops optimally. The overall appearance of the automatic clothesline prototype is as follows.

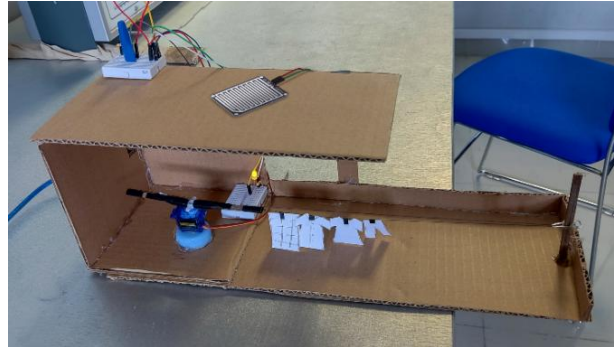


Figure 15. Overall view of the tool

If you look closely, you will see that there are 2 pieces of wood attached to each servo propeller. This is so that the servo can pull the clothesline a longer or further distance. However, a motor or stepper motor can be used for this purpose. The house is designed to be open so that you can see if all the clothes are under the roof. The propeller on the servo also causes the house to be open from the outside, because if it is closed, the wall will block the servo propeller from turning. Inside the house there is an LED that lights up when clothes have entered the house, indicating that the heating should be turned on. Here is what the house looks like when the clothes are inside.



Figure 16-17. Heater ON-OFF indicator LED

As explained earlier, the position of the sensor is on the roof of the house. This is so that the sensor can best detect light and droplets. However, what needs to be known when applying the sensor to the actual house is that such sensor placement has the disadvantage that it can be exposed to rainwater (for LDR sensors) or excessive heat, which can reduce the sensor's performance. Therefore, it would be nice if the LDR sensor had a waterproof but translucent protection, such as glass or clear plastic.

3. Tool Test

Functional testing of tools can ensure that the implemented system can meet the operational requirements that have been designed and planned. The purpose of these tests, for both hardware and software, is to ensure that the product works as expected. The results of these tests are usually documented in technical or functional specifications. This tool experiment involves testing the response of the sensor and also the actuator to a number of pre-defined conditions. These conditions

include the level of light intensity, the sensitivity of the rain sensor in detecting water, and also the accuracy of the servo rotation following several previous conditions.

Experiment Results

a) Light Dependent Resistor (LDR) Sensor Testing Results

The LDR sensor is a sensor that can convert the amount of light into the amount of resistance. The main material used in this sensor is cadmium sulphide, which is a semiconductor material. With this material, the energy from the falling light causes more charge to be released or the electric current to increase. This means that the resistance of the material has decreased. The more light shines on the LDR sensor, the more the resistance value decreases (Supatmi, 2010). Changes in resistance to changes in the level of light given are not always the same for each sensor, some have significant changes and some have slight changes (Dr Eng. Siti Sendari *et al.*, 2021). Therefore, to find out the level of change in the value of the sensor owned, it is necessary to conduct an experiment. The results of the experiment are shown in the following table.

Testing to-	Light Condition	Readout on Serial Monitor (1-5 lines)	Highest value	Lowest value	Average of readings
1.	Dark	29, 30, 31, 40, 45	45	29	35
2.	Dark	38, 32, 31, 30, 29	38	29	32
3.	Less	268, 269, 267, 269, 268	269	267	268,2
4.	Less	257, 259, 259, 258, 260	260	257	258,6
5.	Bright	778, 864, 904, 922, 929	929	778	879,4
6.	Bright	897, 895, 893, 895, 897	897	893	895,4

The light sensor experiment data table shows the analogue value readings from the LDR in dark, dim and bright conditions, with each condition taken from five lines of readings displayed on the serial monitor. In the dark condition, the readings ranged from 29 to 45 with an average of around 35, indicating a very low and consistent value. In the dim condition, the readings ranged from 257 to 269 with an average of around 268.2, showing a higher and more consistent value compared to the dark condition. Meanwhile, in the bright conditions, the readings ranged from 778 to 929 with an average of around 879.4, reflecting very high values and greater variation. It should be noted that the calculation of this value is based on the voltage value produced, rather than the resistance value produced by the sensor. The voltage value increases when the light is brighter because the resistance value of the sensor decreases. The relationship between the sensor value and the lighting conditions is shown in the graph below.

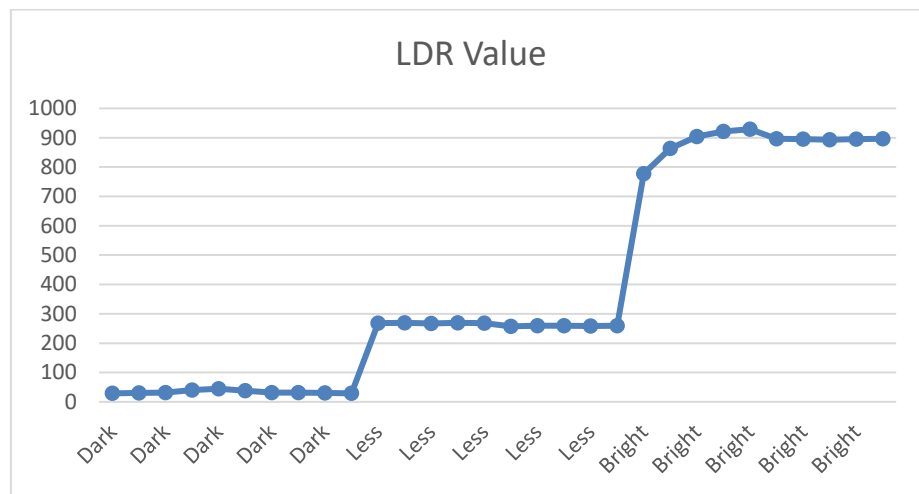


Figure 18. Relationship between light conditions and sensor values

b) Raindrop Sensor Test Results

The rain sensor in this tool is only used to detect whether it is raining or not by using the digital output on the sensor. The surface of this sensor has a conductive path, so when rainwater hits it, an electrolysis process takes place (Fauzan, 2021). Therefore, some of the conditions used for this test are only wet or dry on the sensor surface. The results of the rain sensor test are given in the following table.

Testing to-	Surface Condition	Readout on Serial Monitor
1.	Dry	LOW
2.	Dry	LOW
3.	Wet	HIGH
4.	Wet	HIGH

From the test data obtained, the accuracy of the rain sensor reading in detecting rain has a percentage of 100% or all is correct. The downside of using this sensor is that the sensor will continuously give a HIGH output until the sensor surface is completely dry. This means that the sensor will continue to detect rain even after the rain has stopped. However, this will not last long as the impermeable surface of the sensor will dry out quickly.

c) Testing Servo Motor and LED Response

The use of servomotors as the output in this tool is because servomotors can rotate both clockwise and anti-clockwise. However, as this is only a prototype tool, the use of a suitable tool for the output is a drive motor when it has been implemented in everyday life. The purpose of this test is to find out whether the servomotor can operate in accordance with the previous conditioning. For example, if the LDR gives an output value above 778, but the rain sensor detects water droplets, the servomotor must turn to the left to allow the clothes to enter. And a few other conditions that have different commands. In addition to observing the servo response, this test was also carried out to observe the LED response as an on/off indicator for the heating in the house. The heating is only

switched on when clothes are in the house. The results of testing the response of the servos and LEDs to the inputs given by the LDR sensors and rain sensors are shown in the following table.

Table 3. Test results of servo motor and LED responses

Testing to-	LDR Sensor Readout	Raindrop Sensor Redout	Servo Rotation Direction	LED condition	Error (%)
1.	30	HIGH	Left (Inside)	light up	0%
2.	45	LOW	Left (Inside)	light up	0%
3.	268	LOW	Right (Outside)	lights out	0%
4.	266	HIGH	Left (Inside)	light up	0%
5.	267	HIGH	Left (Inside)	light up	0%
6.	778	LOW	Right (Outside)	lights out	0%
7.	820	HIGH	Left (Inside)	light up	0%

Discussion

From the results of several experiments that have been carried out, overall the results obtained from several tests are as desired. In testing the LDR sensor, it can be seen that the value produced by the sensor experiences a significant difference in value against some of the given conditioning. This is what is used to create if-else logic in the program listing. The average reading on the LDR sensor also shows a stable value in 2 trials, only in the last trial which shows a fairly high increase in value against the previous trial.

In the raindrop sensor test results, the sensor detected the presence of water quite well and there were no reading errors at all. The only drawback faced when using this sensor is that it will continue to send HIGH input continuously until the sensor surface is completely dry. However, this is not too much of a problem because the sensor surface can dry out in a fairly short time.

From the data table of the test results of the servo and LED response to the input from the LDR sensor and rain sensor, it can be seen that all the experiments carried out have a 0% error rate. However, there is one thing that needs to be evaluated, and that is the servo rotation speed, which cannot be adjusted, so no tests or analysis can be carried out. In fact, if the servo rotation is fast enough, the movement of the clothesline on this prototype tool will be incompatible with that on tools that have been implemented in everyday life. Some of these shortcomings can be used as reference material for the future development of this tool.

CONCLUSION

The project 'Automatic Clothesline Using Rain Sensor and LDR Sensor Based on Arduino Uno' successfully developed an automatic clothes dryer system that utilises a rain sensor and a Light Dependent Resistor (LDR) sensor to detect weather conditions, so that it can pull the clothesline automatically when rain is detected. The system is designed to address the challenges of drying clothes in areas with high rainfall, where weather uncertainty often makes the drying process difficult. The test results show that the rain sensor functions properly without any reading errors, despite the shortcoming in the non-adjustable rotational speed of the servo, yet *all* experiments show an error rate of 0%, signalling the reliability of the system. Thus, this device not only provides a practical

solution to the problem of drying clothes, but also has the potential for further development, such as servo speed adjustment and integration with other technologies. Recommendations for future research include improving the responsiveness of the system to sudden changes in weather and developing a mobile application for notifications to users, so as to increase the convenience and efficiency of using this device in daily life.

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REFERENCES

- Aditya, R. (2020). Implementasi Sensor Hujan untuk Kendali Otomatis pada Sistem Rumah Pintar. *Jurnal Teknologi dan Rekayasa*, 12(3), 123-130.
- Ayuningtyas, A. D. (2024). *Hanya 2 dari 100 Penduduk Indonesia yang Bekerja Merantau*. GoodStats. <https://goodstats.id/article/hanya-2-dari-100-penduduk-yang-merantau-di-indonesia-lepjl>
- Chen, Z., et al. (2019). Development of Automated Clothes Drying Systems. *International Journal of Smart Technology*, 15(4), 210-220.
- Components, R. (1997). Light dependent Resistors Datasheet. *RS Component*, 12(651).
- Dewi, I. R. (2021). Rancang Bangun Sistem Deteksi Cuaca Berbasis Sensor Hujan. *Jurnal Sains dan Teknologi*, 5(2), 89-97.
- Dr. Eng. Siti Sendari, S. T. M. T., I Made Wirawan, S. T. M. T., & Nasrulloh, M. (2021). *SENSOR TRANSDUSER*. Ahlimedia Book. <https://books.google.co.id/books?id=2SFREAAQBAJ>
- Fauzan, A. (2021). Simulasi Proteus Atap Stadion Automatic Berbasis Arduino Dengan Menggunakan Sensor Hujan Dan Sensor Ldr. *Jurnal JEETech*, 2(2), 84–90. <https://doi.org/10.48056/jeetech.v2i2.173>
- Fatmawati, T., & Gunawan, S. (2020). Sistem Kontrol Otomatis dengan Arduino Uno. *Jurnal Teknologi Informasi*, 8(3), 231-238.
- Haryono, T. J. S. (2007). Jaringan sosial migran sirkuler: Analisis tentang bentuk dan fungsi. *Jurnal Masyarakat, Kebudayaan Dan Politik Jurusan Antropologi FISIP Universitas Airlangga Surabaya*.
- Kurnia, D., et al. (2020). Rancang Bangun Sistem Jemuran Otomatis. *Jurnal Teknik Elektro*, 6(1), 45-55.
- Nasution, R., & Putra, A. (2021). Penggunaan Arduino pada Aplikasi Kehidupan Sehari-Hari. *Jurnal Elektronika dan Robotika*, 7(4), 178-189.

- Santoso, D. (2019). Rancang Bangun Sistem Monitoring Cuaca Otomatis. *Jurnal Informatika Indonesia*, 11(2), 89-98.
- Supatmi, S. (2010). Pengaruh Sensor Ldr Terhadap Pengontrolan Lampu. *Majalah Ilmiah UNIKOM*, 8(2), 175–180. http://jurnal.unikom.ac.id/_s/data/jurnal/v08-n02/volume-82-artikel-5.pdf/pdf/volume-82-artikel-5.pdf
- Wang, T., *et al.* (2020). Design and Implementation of Rain-Sensing Devices. *International Journal of Automation Systems*, 13(5), 567-579.
- Widodo, T. (2020). Analisis Efektivitas Penggunaan Sensor Hujan. *Jurnal Teknologi dan Sistem Kontrol*, 7(3), 111-122.