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Automatic Light Design Using Light Sensors

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ABSTRACT

The increasing tendency of people to spend time outside their homes, engage in late-night outdoor activities, and neglect household maintenance contributes to the rising risk of community crimes. Unlit or poorly maintained houses often become easy targets for criminal activity, highlighting the need for reliable automatic home security systems. The research problem addressed in this study is how to design an Automatic Light Design Using Light Sensors system that can improve household safety and energy efficiency. The objective of this study is to develop and test an Arduino Uno-based automatic lighting system controlled by a Light Dependent Resistor (LDR) sensor and timer. The research employs a descriptive method, utilizing systematic and reliable data to describe and test system performance. The system integrates an LDR sensor connected to a relay, allowing the lights to turn off automatically when ambient light exceeds a threshold of 200 at the beginning of the day and to turn on during low-light conditions. Additionally, a timer function enables manual adjustments to improve efficiency during irregular conditions such as seasonal rain or system disruptions. The results demonstrate that the Arduino-based automatic lighting system responds effectively to changing light conditions, offering a practical solution to reduce unnecessary energy consumption and enhance security. The study implies that smart home technologies can play a significant role in crime prevention and sustainable energy management, while also providing a foundation for further innovation in home automation systems.

Keywords: Light Dependent Resistor (LDR), Automatic Light Resistor, Light Sensor

INTRODUCTION

When technology is used to create something new, it significantly impacts human life by facilitating various activities (Agarwal & Anand, 2023). Technology encourages people to continuously develop new and advanced technologies and improve existing ones (Adiansyah, Agusdinata, & Putra, 2025). In an increasingly modern and developing technological landscape, humans strive to integrate technology into everyday life to simplify work (Ratna, Huld, & Yousif, 2015). The integration of technology into daily life has led to significant changes in human behavior and lifestyle (Silalahi, 2021). Studies have shown that technology adoption can enhance productivity and efficiency in various sectors (Subarkah, 2022).

By using a light sensor, which can convert light intensity into electrical signals and is controlled using Arduino Uno, automatic switching can be achieved (Chekired et al., 2022; Nieh & Chen, 2023; Waluyo et al., 2022). In dark conditions, the Arduino will be instructed to turn the lights on or off

(Fischer & Fischer, 2024). Arduino Uno is a small computer consisting of easy-to-operate hardware and software chips and an open-source electronic framework with its own programming language, namely C++. Light sensors, such as Light Dependent Resistors (LDRs), are commonly used in these systems due to their simplicity and cost-effectiveness (Guntara, 2025). The Arduino Uno processes the signals from the light sensor and controls the switching mechanism accordingly (Delviandri & Irawan, 2023). This integration allows for energy-efficient lighting solutions in various applications, including home automation and educational tools (Nurroniah et al., 2023). The use of Arduino-based systems for light control has been demonstrated in several studies, showcasing their effectiveness and versatility (Nasirrudin & Sembodo, 2022).

Currently, the existence of automatic light design using light sensors requires further development because many problems can only be solved by manipulating light sensors (Guntara, 2025). In this article, the author develops automatic light design using light sensors through the Time Delay Relay (TDR) system (Delviandri & Irawan, 2023). The TDR system allows for adjustable time delays to automatically turn the lights on or off based on the light intensity detected by the sensor (Nurroniah et al., 2023). The use of this system can increase energy efficiency and user comfort by reducing manual intervention in lighting settings (Nasirrudin & Sembodo, 2022). Furthermore, the application of TDR in automatic lighting systems can extend the lifespan of devices by optimizing their operational cycles (Mitra, 2019).

Previous research by Kilari and Rao (2020) developed an automatic light intensity control system using *Arduino UNO* and LDR, showing that such systems can effectively reduce energy consumption by adjusting light based on environmental conditions. However, their work was limited to intensity adjustment and did not address timing control or broader automation for varied daily conditions. Similarly, a study by Yadav et al. (2019) on automatic street lighting using LDR and *Arduino* demonstrated improved efficiency in streetlight operations, but the system lacked flexibility in handling irregular scenarios such as seasonal variations or temporary disruptions. Both studies focus heavily on energy savings, yet neither fully integrates time delay relay (TDR) mechanisms to improve resilience and operational reliability.

The objective is not only to ensure responsive and efficient light control but also to enhance system stability under varying environmental conditions. The benefit of this research lies in providing a practical framework for developing household and community-based lighting systems that balance security, efficiency, and sustainability.

METHOD

This study employed a descriptive qualitative approach supported by experimental design. Data collection was carried out through two main techniques: (1) a literature review, which involved analyzing relevant journals, conference papers, books, and online sources related to automatic light systems, light sensors, Arduino Uno, and Time Delay Relay (TDR) applications; and (2) practical observation and system testing, where the researchers designed and implemented an automatic light circuit using an LDR sensor connected to an Arduino Uno and a relay module. The data sources consisted of secondary data from online publications and primary data obtained from experimental trials of the prototype system. The tools and materials included Arduino Uno, an LDR sensor, a Time Delay Relay (TDR), resistors, a power supply, and light bulbs. The data analysis technique used was descriptive analysis, focusing on system performance evaluation. Specifically, the prototype was tested under varying light intensity conditions to measure the sensor's sensitivity, relay response, and timing accuracy. The results were then interpreted to assess the system's effectiveness in controlling automatic lighting, energy efficiency, and adaptability to environmental conditions.

RESULTS AND DISCUSSION

Analysis of journals and other relevant sources, the use of light sensors (such as Light-Dropping Resistors or LDRs) in automated lighting systems can help save energy and automate lighting systems **.** Building automation systems and smart home projects widely use this technology, according to research from Google Scholar.

The analysis shows that adjusting the light intensity threshold is very important to prevent system activation errors, for implementation, most sources suggest using basic components such as LDR sensors, transistors, relays, or microcontrollers for more complex systems. Based on the data collected, here are the main points of the analysis results:

Energy Efficiency : Automatic lights based on light sensors can reduce electricity consumption by only turning on when needed.

System Responsiveness : Ambient light changes the system instantly.

Low Implementation Cost : The components used are cheap and can be easily obtained.

Scalability : Applicable for small to large scales, such as homes.

Discussion

The Assembly Making stage begins with the creation of a circuit design or electronic schematic for the required hardware. Once the design is complete, the assembly is carried out in reality by following the established schematic, which helps save time during the assembly process, prevents potential risks of electrical short circuits, and reduces errors in pin installation that can cause short circuits. By using a Light Dependent Resistor (LDR) light sensor and an Arduino Uno module, you can create an automatic lamp that manages a relay that acts as an automatic switch to turn the lamp on or off based on the light intensity detected by the sensor.

Arduino operates the relay as an automatic switch that receives commands based on sensor values below a specified value, indicating a bright condition. As a result, the relay is instructed to turn off the light or prevent it from turning on. Conversely, when the LDR sensor detects a value above a specified value, Arduino directs the relay to signal the light to turn on. The automatic light circuit configuration is illustrated as below.

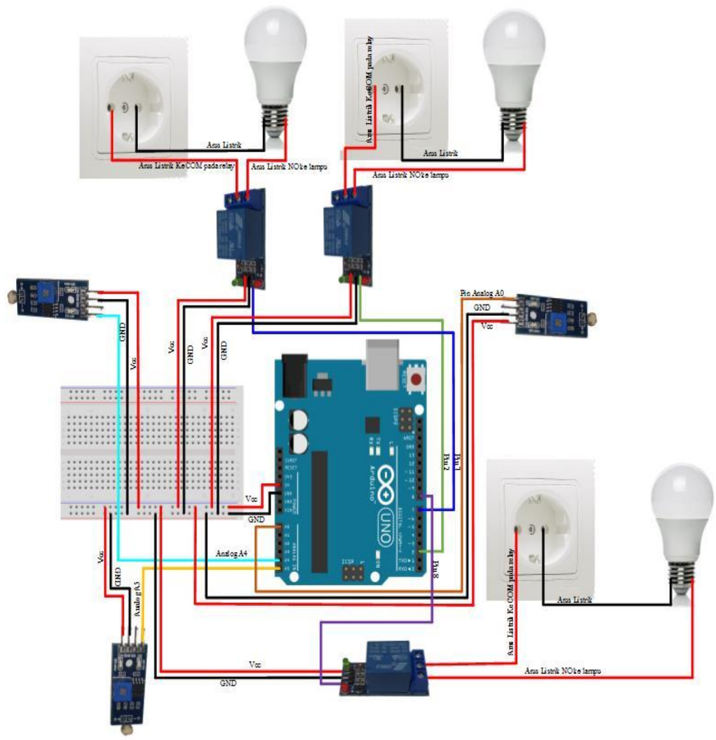

Figure 1. automatic light circuit configuration
Source: Harmen Isra, Diki Arisandi, Zul Indra

Some details in the image above are as follows:
Arduino to Circuit Board
Vccke board +
Gnd to board -
LDR 1 to Circuit Board
Vcc to board +
Gnd to board –
Analog goes to Arduino pin A5
LDR 2 is connected to the Circuit Board
Vcc to board +
Gnd to board –
Analog goes to Arduino pin A4

LDR 3 to Circuit Board
Vcc to board +
Gnd to board –
Analog goes to Arduino pin A0
Relay to Circuit Board
Vcc to Board +
In relay 1 to Pin 8 arduino
In relay 2 to Pin 7 arduino
In relay 3 to Pin 2 arduino
Gnd to Board –

The socket is connected to the relay
The current cable is connected to the COM pin of the relay, and
The current cable is connected to the NO pin of the relay.
This data collection is an activity that includes designing automatic lights using light sensors. This data only contains how to turn the LDR sensor light on and off.

To improve the accuracy of detecting lighting demands, the system allows for the inclusion of advanced features such as timers and integration with additional sensors, such as motion sensors, in addition to the standard settings. The system can be upgraded to include Internet of Things (IoT)-based control, allowing users to monitor and manage the lights remotely through a specific platform or application.

As shown by Rizki et al. (2022), this technology has been successfully used in a variety of settings, including homes and businesses such as police stations. This system is beneficial not only because it automates lighting but also because it uses less energy and requires less manual intervention.

According to the implementation system, the lights can turn on automatically when the light intensity is below the threshold (for example, at night) and turn off when the light intensity exceeds the threshold (for example, during the day). This is in accordance with the results of Rizki et al. (2022) who successfully implemented a similar system at the Pematangsiantar police station.

This system is suitable for public areas such as offices, parks, hallways, and parking areas, as well as for household scale. In addition, this system can be expanded by adding motion sensors (PIR), WiFi modules for remote control based on the Internet of Things (IoT), or automatic time settings using a real-time clock (RTC).

Consequently, the use of LDR sensors together with Arduino Uno microcontrollers and relays as actuators offers a versatile, economical and effective alternative for the implementation of automated lighting systems.

CONCLUSION

The automatic lighting system based on a light sensor effectively detects changes in ambient light intensity to turn lights on or off, using an LDR sensor, relay module, and Arduino Uno microcontroller to enhance energy efficiency and user convenience. This cost-effective and responsive system is easily integrated into various scales, from smart homes to larger buildings. Future research could focus on integrating Internet of Things (IoT)-based controls and motion sensors to further improve the system's efficiency and adaptability.

REFERENCES

Adiansyah, J. S., Agusdinata, D. B., & Putra, A. P. (2025). Environmental impacts of solar PV energy systems for small-island communities in Indonesia: A life cycle assessment approach. *Energy for Sustainable Development, 85,* 101651. https://doi.org/10.1016/j.esd.2025.101651

Agarwal, R., & Anand, K. (2023). How to power Indonesia's solar PV growth opportunities. *McKinsey & Company.* https://www.mckinsey.com/id/our-insights/how-to-power-indonesias-solar-pv-growth-opportunities

Chekired, F., Taabli, O., Khellili, Z. M., Tilmatine, A., de Almeida, A. T., & Canale, L. (2022). Near-Zero-Energy Building Management Based on Arduino Microcontroller—On-Site Lighting Management Application. *Energies*, *15*(23), 9064. https://doi.org/10.3390/en15239064

Delviandri, R., & Irawan, D. (2023). Development of light On/Off controller simple using LDR sensor-based relay and Arduino Uno on physics learning electromagnetic material. *Journal of Science, Learning Process and Instructional Research,* *1*(1), 1–7. https://journal.riau-edutech.com/index.php/joslepi/article/view/3

Fischer, M. S., & Fischer, M. C. (2024). Cost-effective, open-source light shutters with Arduino control. *HardwareX*, *19*, e00548. https://doi.org/10.1016/j.ohx.2024.e00548

Guntara, D. (2025). Effectiveness of various light sensors for indoor use. *Simple Journal of Science and Technology,* *1*(1), 1–7. https://simple.ascee.org/index.php/simple/article/view/106

Mitra, S. (2019). Smart light for home with automatic direction and intensity adjustment using Arduino. *ResearchGate.* https://www.researchgate.net/publication/334319697_Smart_Light_for_Home_with_Automatic_Direction_and_Intensity_Adjustment_using_Arduino

Nasirrudin, H., & Sembodo, B. P. (2022). Control system automatic for light and air conditioner at living room using Arduino Uno controller. *Journal of Applied Electrical & Science Technology,* *4*(1), 15–20. https://doi.org/10.5281/zenodo.8160171

Nieh, H.-M., & Chen, H.-Y. (2023). An Arduino-Based Experimental Setup for Teaching Light Color Mixing, Light Intensity Detection, and Ambient Temperature Sensing. *The Physics Teacher*, *61*(2), 133–137.

https://doi.org/10.1119/5.0066060
Nurroniah, Z., Anggraeni, N. P., Asy'ari, I. H., Putri, D. S. A., Sani, S. A., Harijanto, A., & Subiki. (2023). Design of an Arduino UNO-based automatic light control system as a basic physics teaching aid on Ohm's law. *Jurnal Ilmiah Wahana Pendidikan, 9*(13), 663–673. https://doi.org/10.5281/zenodo.8160171

Ratna, D., Huld, T., & Yousif, Y. (2015). Performance analysis of solar panels in tropical regions: A case study in Surakarta, Indonesia. *Proceedings of the 3rd International Conference of Health, Science and Technology (ICOHETECH).* https://www.researchgate.net/publication/366829255_Performance_Analysis_of_Solar_Panels_in_Tropical_Region_A_Study_Case_in_Surakarta_Indonesia

Rizki, D. B., Sumarno, S., Lubis, M. R., Andani, S. R., & Sari, I. P. (2022). Design and construction of automatic lights using Arduino-based light sensors at Pematangsiantar Police. *Scientific Journal of Science and Technology, 6*(1), 1–11. https://doi.org/10.47080/saintek.v6i1.1837

Silalahi, D. F. (2021). Indonesia's vast solar energy potential. *Sustainability, 14*(17), 5424. https://doi.org/10.3390/su14175424

Subarkah, R. (2022). The development of photovoltaic application in Indonesia. *Proceedings of the 8th International Conference on Energy and Environment.* https://www.scitepress.org/Papers/2019/99061/99061.pdf

Waluyo, Hadiatna, F., Widura, A., & Setiana, P. (2022). Development and testing of a light dimming control using arduino uno. *IOP Conference Series: Materials Science and Engineering*, *1212*(1), 012043. https://doi.org/10.1088/1757-899X/1212/1/012043