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Implementation of Energy-Saving Lamp With Automatic System Using LDR SENSOR (Light Dependent Resistor) Combination at Village Guard Posts and Mosques in Probolinggo

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ABSTRACT

This study presents the design of an energy-saving lamp with an automatic system using LDR (Light Dependent Resistor) sensors. The LDR sensor acts as a light regulator based on its resistance value, influenced by the received light intensity. The sensor activates when there is a slight increase in the received light. This sensor is used in combination with lamps to enable automatic operation, relying on sunlight as an essential aspect. The sensor-controlled lamps remain off during the day and turn on automatically at night due to reduced sunlight. The installation of these sensor-based lamps is implemented in guard posts within residential areas and mushollah to significantly contribute to efficient illumination in the surrounding areas. The benefits of these sensor-based lamps alleviate the need for manual activation by the guards as the lamps function automatically with the integrated sensor system.

Keywords: Automatic System, Energy-saving Lamp, LDR Sensor, Sunlight-based Illumination.

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INTRODUCTION

Electricity demand is crucial in daily life (Swamardika et al., 2018; Wie & Agung, 2018), as it is used for various activities, including lighting during the night. However, the use of electricity continues to increase annually, leading to bad habits such as forgetting to turn off lights during the day, resulting in wasteful energy consumption with negative impacts on the environment and finances. To address this issue, awareness and tangible actions from the community are needed to use electricity more wisely, optimizing the use of electronic devices and turning off lights when not in use. Moreover, campaigns and education on energy conservation need to be intensified to foster a sustainable mindset in electricity consumption (Dahroni et al., 2019). In the long run, investments in renewable energy sources are also crucial to reduce reliance on fossil fuels and mitigate the negative impacts of climate change. Collaboration among governments, institutions, and communities is necessary to foster sustainable behavioral changes. With collective awareness and actions, we can preserve electricity availability for the future and create a more sustainable environment.

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The advancement of technology has helped humans efficiently control electricity usage. The latest innovation in the form of LDR (Light Dependent Resistor) sensors utilizes automation to smartly turn on and off lights based on surrounding light conditions. LDR is an electrical device that responds to light and is known as a photosensor, photoconductor, or photoresistor (Rombekila et al., 2022; Tsauqi et al., 2016). This resistor type has variable resistance depending on the amount of light it receives from the surroundings (Setyaji & Handoko, 2019). In darkness, LDR functions as a sensor, activating and turning on the light. However, during the day, the light is turned off as the sensor is not triggered by sufficient light (Desmira, 2022). Thus, LDR becomes an efficient solution in lighting control, saving energy, and providing comfort in various applications (Al Ghifari et al., 2022; Telleng et al., 2020). Simply put, LDR is a light-sensitive resistor, and its resistance changes with the received light intensity (Manik et al., 2020). Testing LDR involves placing it in both dark and bright environments to assess its sensitivity to light. With this capability, LDR is widely used in various applications, such as in lamp automation systems or light intensity measurements in different devices. Using LDR as a light sensor enables the light to turn on when it is dark and automatically turn off when sufficient light is available. This helps reduce energy wastage as the light is only active when needed. Such a system can significantly contribute to effective and sustainable electricity conservation efforts. With the implementation of such technologies, we can move towards a more energy-efficient and environmentally friendly lifestyle.

After conducting a survey in Kelurahan Pakistaji, Kota Probolinggo, it was observed that there are still many places, especially posko and musholla, where outdoor lights remain on during the daytime. This phenomenon leads to unnecessary electricity wastage, which should be avoided. This situation has motivated us to innovate and design an automatic sensor light to address this issue. In our effort to reduce electricity wastage and create a beneficial innovation for the community, we are striving to design an efficient and energy-saving automatic sensor light. By utilizing advanced sensor technology, this lamp will automatically turn on during low light conditions, such as at night, and turn off when there is sufficient light, such as during the day. Consequently, the lamp will only be active when needed, significantly reducing energy wastage.

The first step in designing the automatic sensor light is to investigate and analyze the lighting needs in Village Guard Posts and Mosques. Subsequently, we conduct experiments and trials to identify components that suit the requirements and the environment of these places. Various components such as LDR, resistor, capacitor, and diode are being considered to create an optimal sensor light system. We hope that the design of this automatic sensor light can provide an efficient and sustainable solution to the electricity wastage issue in the observed locations. By integrating smart sensor technology, we aim to make a positive contribution to the community and the surrounding environment. We aspire that our innovation can inspire others to participate in creating a more environmentally friendly and energy-efficient environment.

METHODS

In the design of automatic sensor lamps, an important component known as IC (Integrated Circuit) is used. The IC plays a crucial role in controlling and managing the performance of the combined sensors in the automatic lamp (Regivan & Almasri, 2019). Its function is to control the electronic circuitry once the entire device system is complete. Additionally, other components in this device include a capacitor, which serves as a temporary energy storage (Stiawan & Taufiq, 2020), a diode as an energy rectifier (Apriani & Barlian, 2018), a resistor as an electrical resistance (Rohana & Zulfikar, 2018), and an LDR sensor that automates the sensor lamp (Al Hafiz, 2020). The LDR sensor detects ambient light and automatically controls the lamp, turning it off when it receives light and turning it back on when there is no light.

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The use of IC and other components in this automatic sensor lamp is crucial to create an efficient and automated system. The IC acts as the brain of the system, coordinating the work of sensors and other components. Additionally, the capacitor serves as a temporary energy storage to ensure smooth system performance. The diode regulates the current, ensuring smooth energy flow within the system. The resistor functions as a resistance to control the flow of electrical energy. Meanwhile, the LDR sensor adds intelligence to the sensor lamp, allowing it to adapt to the surrounding environmental conditions. With this combination of technology, the automatic sensor lamp can work efficiently and automatically, saving energy, and providing comfort and convenience to users. All these electronic components work harmoniously to create a latest innovation for the community.

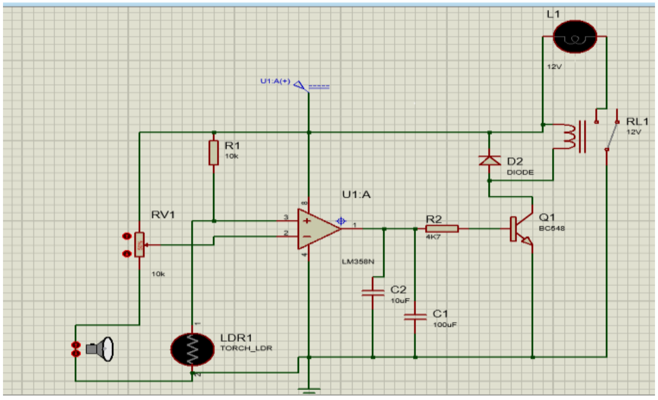

Figure 1. The simulation design in creating an LDR sensor lamp
Source: Data processed by the author

RESULTS AND DISCUSSION

In designing an automatic sensor lamp, meticulousness and a high level of concentration are required to pay attention to its details. Despite involving a combination of components commonly used in conventional lamps, this automatic sensor lamp has its own uniqueness in the design process. Focusing on the design details is the key to creating an efficient and automated system, thereby saving energy and providing greater benefits to users. Therefore, the design of this automatic sensor lamp is carried out in several stages, including:

In the design of the automatic sensor lamp, the first step is to connect the cable with the resistor component, which serves as a resistance to the flow of electricity to reduce the risk of damage to the lamp sensor components. The process of connecting the resistor components is done using solder, which securely and stably binds the resistor component with other components.

The connection of the cable with the resistor component is a crucial initial step in designing the automatic sensor lamp. The resistor plays a role as an electrical resistance, and the use of solder is an effective method to connect the components precisely. By following these steps, the design of the automatic sensor lamp can proceed smoothly, ensuring that the system functions as expected and creating reliable and high-quality results.

Figure 2. Integration of CSR components
Source: Data processed by the author

The next step in designing an automatic sensor lamp is to integrate the SCR (Silicon Controlled Rectifier) component, which is a type of diode with the ability to control and rectify electric currents. The SCR component is connected to other components using solder to firmly bond them together. This bonding process involves the use of tin, which, when melted with solder, acts as an effective adhesive.

The integration of the SCR component with solder is a crucial step in designing the automatic sensor lamp. The SCR serves as a controller that enables precise regulation of electric currents, and with a strong bond, it ensures the stability and reliability of the sensor lamp system. The use of tin as an adhesive helps efficiently and securely connect the components. By proceeding with this step, the design of the automatic sensor lamp can achieve optimal results in controlling and regulating the flow of electricity to meet the user's needs.

Figure 3. Combine the capacitor component
Source: Data processed by the author

After integrating the SCR components, the next step in designing an automatic sensor lamp is to combine the capacitor component. The capacitor component serves as a temporary energy storage for electrical charges and also functions as a safeguard against power failures in the design or electrical circuit with coils.

The combination of the capacitor component is an important step in creating an efficient and reliable automatic sensor lamp. The capacitor acts as an electrical energy storage, which helps maintain the smooth operation of the system temporarily during electrical fluctuations. Additionally, the capacitor serves as a safeguard to protect the circuit from potential electrical disturbances. By involving the capacitor in the design, the automatic sensor lamp can have improved performance and work more stably. The process of combining these components requires precision and skill in integrating them to produce an effective system for controlling and regulating the flow of electricity for automatic sensor purposes.

Figure 4. Diode component installation
Source: Data processed by the author

The next step is to install the diode component, which is a two-pole active component that generally acts as a semiconductor. Diodes have an important function as a rectifier of electrical energy, flowing electrical energy in one direction, and inhibiting current from the opposite direction. The process of installing diode components is done in the same way as other components, using solder as an adhesive glue that bonds the component with tin material.

The installation of diode components is an important step in designing automatic sensor lights. Diodes act as electric current regulators, ensuring that energy flows precisely according to the needs of the system. By using solder as an adhesive, the diode components can be firmly and stably attached, thus contributing to the reliable and efficient performance of the automatic sensor light. In this design, care needs to be taken to avoid errors in installation, resulting in a well-functioning and reliable system. The process of installing these components is an essential part of designing an optimally functioning automatic sensor light, ensuring the flow of electricity is controlled appropriately and providing maximum benefit to the user.

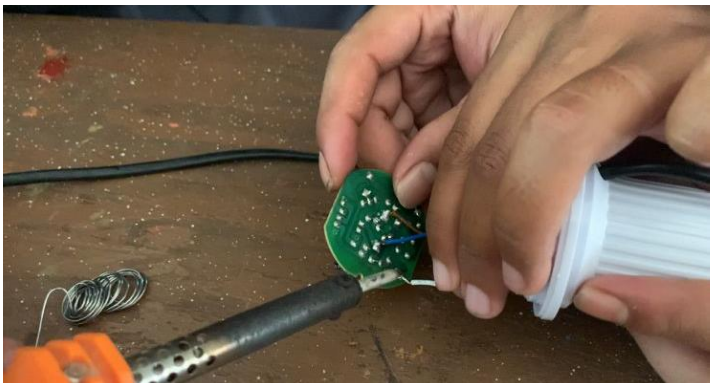

Figure 5. Installation on the lamp socket
Source: Data processed by the author

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After the process of installing various components such as resistors, SCR (Silicon Controlled Rectifier), capacitors, and diodes to design the sensor lamp, the next step is to install it in the lamp socket to test the success of the sensor lamp design.

The installation process of these components is a crucial stage in creating an efficient and well-functioning sensor lamp. By combining various electronic components, it is expected that the sensor lamp can operate automatically and effectively save energy. After all components are installed correctly and well connected, the next step is to install it in the lamp socket to be used. The installation in the lamp socket is a crucial stage in determining the success of the automatic sensor lamp design. Testing is conducted to ensure that the sensor lamp can function properly, turning on and off automatically according to the surrounding conditions. By following these steps, it is expected that the design of the automatic sensor lamp can achieve optimal results and provide significant benefits in saving electricity and increasing efficiency in its use.

Figure 6. Automatic light experiment process
Source: Data processed by the author

Based on observations of the sensor lamp that has been installed and functions properly, it is concluded that the design of the sensor lamp has been successful. Before confirming this success, a specific test was conducted to examine the performance of the Light Dependent Resistor (LDR), which is one of the crucial components in this sensor lamp. The LDR is set in such a way that it will light up when placed in a dark condition and turn off when exposed to bright light.

Figure 7. Completed automatic light design
Source: Data processed by the author

After a series of successful trials, the automatic sensor lights are ready to be used and installed in Village Guard Posts and Mosques. The presence of these sensor lights provides significant benefits to the surrounding community by creating environmentally friendly and energy-efficient innovations. Installing the sensor lights in areas that require high-efficiency lighting can help reduce energy wastage and create a more sustainable environment.

With the successful design of the automatic sensor lights, it is hoped to serve as a positive example and inspiration for the development of other technologies. The knowledge and information related to these automatic sensor lights will help raise public awareness about the importance of using environmentally friendly innovations to preserve the surrounding environment. Through the implementation of these sensor lights, a smarter, more efficient, and environmentally conscious lifestyle can be fostered within the community. This is done to support the Green Innovation strategy in an effort to save electrical energy. The green innovation strategy is a solution to the increasing pressure caused by the environment, (Sezen and Çankaya, 2013). According to Chen, Lai, and Wen (2006) green innovation is a product-related innovation tool, including innovations in technology that can create energy savings, pollution prevention, waste recycling, environmentally friendly product design or corporate environmental management.

CONCLUSION

One way to save electrical energy is through the design of automatic sensor lights, which can help reduce excessive energy consumption. This innovation showcases creativity that benefits the community. Testing the design of automatic sensor lights using the LDR system demonstrates good performance in reading light sensors and automatically turning the lights on and off. With the use of this LDR system, the automatic sensor lights are suitable for installation in posts or small mosques around residential areas with minimal lighting. This innovation is expected to inspire the community to foster high creativity and encourage the creation of sustainable innovations.

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