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Automatic Street Light Control using LDR

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ABSTRACT - The main aim of this project is to automatically control street lights based on the surrounding light conditions. In this system, a Light Dependent Resistor (LDR) is used to sense the amount of light present in the environment. During daytime, when there is enough sunlight, the resistance of the LDR becomes low, and the circuit keeps the street light in OFF condition. When it becomes dark, the resistance of the LDR increases, which makes the circuit turn ON the street light.

This project uses a transistor and relay circuit to switch the lights ON and OFF without any manual operation. By using this automatic method, electricity can be saved because the lights will only work during night time or when needed. This also reduces the need for human involvement and maintenance. The system is simple, low-cost and can be used for roads, parks, and residential areas.

Overall, this project helps in saving power, improving safety during night time, and reducing wastage of electricity by controlling street lights automatically using an LDR.

2. INTRODUCTION

Street lighting plays an important role in providing safety and visibility during night time, especially in the public areas like road, parks, and residential areas. In many places, street lights are still operated manually or stay switched ON for long hours even when they are not required. This leads to unnecessary power consumption and wastage of electricity. With the increasing demand for energy and the need to reduce electricity bills, automatic control of street lights has become an important solution. The main idea of this project is to use a Light Dependent Resistor (LDR) to sense the ambient light level and automatically control the street lights depending on the environmental conditions. During daytime, when enough sunlight is available, the LDR keeps the lights in OFF condition. When it becomes dark, the resistance of the LDR increases, which activates a switching circuit to turn the lights ON.The proposed model uses simple electronic components such as a transistor and a relay to perform switching operations. The design is low-cost, easy to implement, and can be used in rural as well as urban areas. By using automatic street light control, electricity can be saved and overall energy efficiency can be improved. This project also promotes the use of smart and eco-friendly technologies in everyday applications.

3. METHODOLOGY

The methodology of this project involves the theoretical study and practical implementation of an automatic street lighting system using a Light Dependent Resistor (LDR) and a microcontroller. The main objective of this work is to automatically control the street light depending on the ambient light conditions with minimum human intervention. The system detects changes in external light intensity and operates the light accordingly to reduce energy consumption.

- **Requirement Analysis**

The requirement analysis for the automatic street light system includes both hardware and software aspects. The system must be capable of sensing ambient light levels in real-time and take appropriate switching decisions. The street lights should automatically turn ON in low light conditions or during night time,

and turn OFF in the presence of sufficient daylight. To achieve this, components such as an LDR, a microcontroller (Arduino/NodeMCU/any suitable controller), transistors, resistors, relay, and a power supply are used. From the software perspective, a simple embedded program is required to read the LDR sensor values and generate control signals based on

predefined threshold levels. The system is expected to operate automatically without requiring manual switching.

- **System Architecture**

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The system uses an LDR sensor to sense ambient light. Under daylight conditions, the LDR's resistance remains low, allowing current to flow smoothly, which keeps the street light OFF. When the surroundings become dark, the resistance of the LDR increases significantly, which is detected by the microcontroller as a drop in light intensity.

The microcontroller processes this input and triggers the relay driver circuit, turning ON the street light. The driver circuit typically uses a transistor to control the switching mechanism. A diode is used to protect the relay coil from back EMF. The whole system is powered using a DC adapter or battery.

- **Working Principle**

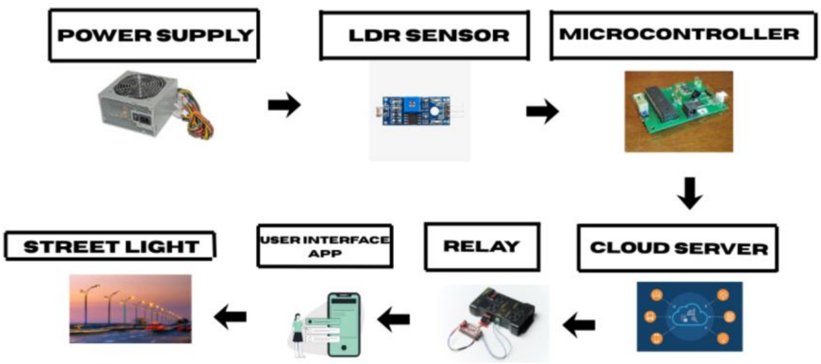
During daytime, the LDR sensor detects high illumination and sends a corresponding signal to the microcontroller. The controller identifies this state and ensures the relay remains OFF, thus keeping the light turned OFF. At night, the absence of light causes an increase in LDR resistance. This change is recognized by the microcontroller, which then activates the relay to power the street light. Once daylight is detected again, the controller automatically turns OFF the light.

The embedded program uses simple conditional statements to compare the sensor readings with a threshold value and generate output accordingly.

Advantages This method minimizes manual effort, reduces unnecessary power consumption, and increases system reliability. Automatic operation ensures safety, convenience, and improved energy efficiency.

4. MODELLING AND ANALYSIS

The system is modelled to detect ambient light using an LDR and generate a control signal for switching the street light through a relay. The microcontroller processes the sensor input and performs automatic ON/OFF operation based on predefined thresholds. This model ensures efficient energy usage and quick response to changing light conditions.



5. RESULTS AND DISCUSSION

The developed system successfully automates the street lighting based on the varying light intensity detected by the LDR. When the surrounding area becomes dark, the LDR resistance increases, resulting in a higher output voltage, which triggers the light to turn ON automatically. Conversely, during bright conditions, the LDR resistance decreases, producing a lower output voltage and switching the light OFF.

In indoor or ambient lighting conditions, the resistance is moderately high, and the output voltage is also moderate, however, the light still remains OFF since illumination is adequate. During dark or nighttime conditions, the resistance reaches a high value which generates a high output voltage, thereby turning the light ON. Additionally, when a focused light source such as a torch is directed at the LDR during night, its resistance suddenly decreases and the light turns OFF again, demonstrating the system's quick responsiveness to changing light intensity.

As light intensity increases, the LDR resistance shows a noticeable decline, indicating its inverse relationship with light. The output voltage similarly decreases with increasing illumination, resulting in automatic light control. The smooth downward trend in both parameters reflects consistent sensitivity of the sensor, making it suitable for real-time street lighting applications

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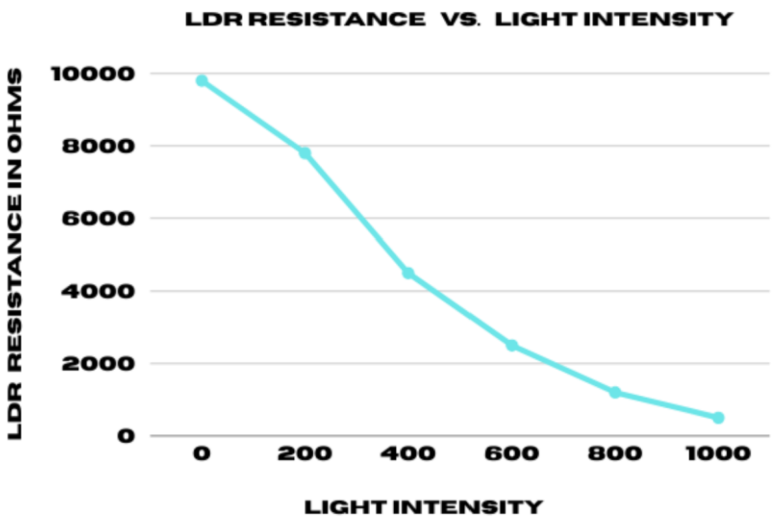
Overall, the results confirm that the designed system is capable of dynamically controlling street lights without human intervention. The system responds efficiently to environmental changes, minimizing unnecessary power consumption. This makes the proposed model both energy-efficient and cost-effective, providing a reliable solution for smart street lighting applications.

Performance of Automatic Street Light System

Test Condition	**LDR Resistance**	**Output Voltage**	**Light Status**
Bright Sunlight	Low	Low	OFF
Indoor Ambient Light	Medium	Moderate	OFF
Torchlight on LDR at Night	Low	Low	OFF
Dark / Night	High	High	ON

Experimental Readings of LDR-Based Automatic Light Control

Light Intensity (Lux)	**LDR Resistance (Ω)**	**Output Voltage (V)**	**Light Status**
0 (Dark)	9800	4.8	ON
200	7800	3.6	ON
400	4500	2.9	ON
600	2500	1.6	OFF
800	1200	0.9	OFF
1000 (Bright)	500	0.2	OFF



6. CONCLUSION

The automatic street light system using an LDR successfully turns the lights ON in low-light conditions and OFF when adequate light is present, reducing manual effort and saving energy. The results confirm that the LDR's resistance decreases with increasing light intensity, enabling accurate switching through the microcontroller. Overall, the system is simple, reliable, cost-effective, and suitable for smart lighting applications. In the future, this system can be enhanced by using motion sensors to turn ON lights only when vehicles or pedestrians are detected. IoT-based monitoring can also be added for remote control and fault detection. Solar energy integration can further improve sustainability and reduce electricity cost.

7. REFERENCES

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