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CENTRALIZED STREET LIGHT MONITORING SYSTEM USING IOT

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ABSTRACT

The importance of solar LED street lighting systems in reducing the significant energy consumption of conventional street lights is described in this abstract. It emphasizes how solar panels and IoT technology may be combined for effective energy management and conversion. The primary goals of the system are intelligent light control with motion sensors, problem detection through GSM technology, and real-time monitoring of solar panel and battery performance. Energy efficiency and the use of renewable energy sources are provided by this system, which uses solar radiation during the day to power LED lights at night. It also highlights the project's role in facilitating effective IoT integration and data transfer, which makes real-time energy management and monitoring possible.

Keywords: *Street Light, Real-world Problem, IoT*

I. INTRODUCTION

The primary objective of this project is to create a practical and affordable model of a street lighting system that makes use of sensors to improve energy efficiency and decrease the amount of manual intervention required. For this project, three different areas on the IIUC campus will be investigated to determine the best streetlight dimming schedules. The cost of electricity consumption can be significantly reduced by establishing a system that performs at full power during non-dimming hours and decreases power consumption by 10% during those hours. As a result, a comparison involving this model and the campus's current street lighting system will be supplied to show the cost savings made conceivable by them.

Essentially, the initiative aims to improve university campus street lighting efficiency in order to contribute to the larger goal of lowering carbon emissions and conserving energy, therefore fostering a more sustainable and greener future.

Many of the new technologies made possible by the Internet of Things could transform today's cities into "smart cities." The smart street lighting system's (SSLS) electricity consumption can be reduced by about with the help of this innovative technology. Because of this, university administrations take action to reduce electricity waste and increase campus sustainability. However, people's hectic lives and additional responsibilities these days mean that manually turning on and off-street lights is not done on time. Sometimes the street light is left off even after the light has become too intense, while other times the lights are turned on early while there is still a lot of sunshine falling short of a specific benchmark. Electricity is wasted when street lights are not always switched off at the appropriate hour in the morning. The goal of the IoT-based street light management and monitoring system project is to address the issue of late-night power consumption and street lighting. LED street lighting systems are replacing today's street lights since they use less energy. The ease with which the intensity of LED lighting can be adjusted is another benefit. Therefore, it is easy to design street light control based on movement detection. Focus must be placed on balancing supply and demand, which means that attention must be paid to lowering electrical power waste in the streetlight area. It has been demonstrated that installing street illumination reduces pedestrian collisions by almost half. An automated system called "Street Light Monitoring and Control" uses controlled, scheduled street light switching to increase an organization's accuracy and efficiency. But in the future, a lot of developing nations will build a lot of lamps and Control is an automated system that uses timed, controlled switching of street lights to boost an enterprise's efficiency and accuracy. However, in the future, many developing countries will construct a large number of streetlights and require a substantial amount of electricity to operate. Therefore, even with the usage of LED lights, curbing the amount of electricity used for street lighting is necessary to reduce greenhouse gas emissions and further green our environment. Thus, simply implementing smart street lighting is insufficient; we also need to implement this smart system as a green project for our campus. In order to run entirely on renewable energy, our system is managed by an Arduino Nano that is further connected to a WiFi module. Our method uses direct current (DC) electricity to lower the lights while simultaneously conserving energy. Our device generates green energy for the environment since it uses solar power to charge its batteries. Creating a system that is intelligent, economical, and energy-efficient is the primary concern.

II. PROBLEM STATEMENT

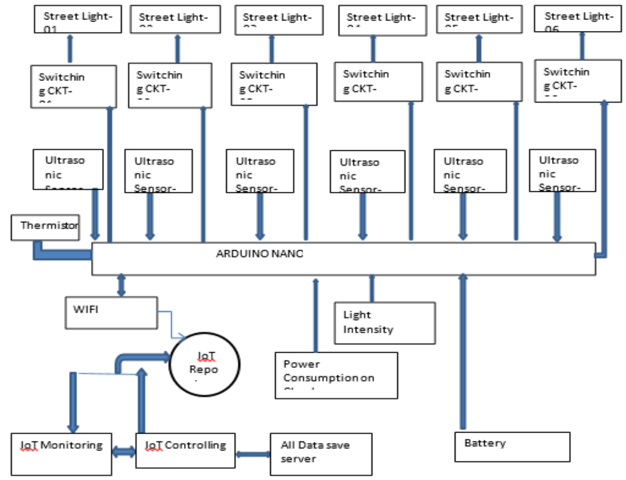
In contemporary urban environments, efficient and sustainable street lighting management is a critical concern. The proposed Centralized Street Light Monitoring System, leveraging the capabilities of the Internet of Things (IoT), offers an innovative solution to address these challenges. This system is designed to enhance the administration and efficiency of street lighting infrastructure, promising a multitude of advantages, including energy conservation, reduced maintenance expenses, and an improved quality of urban lighting

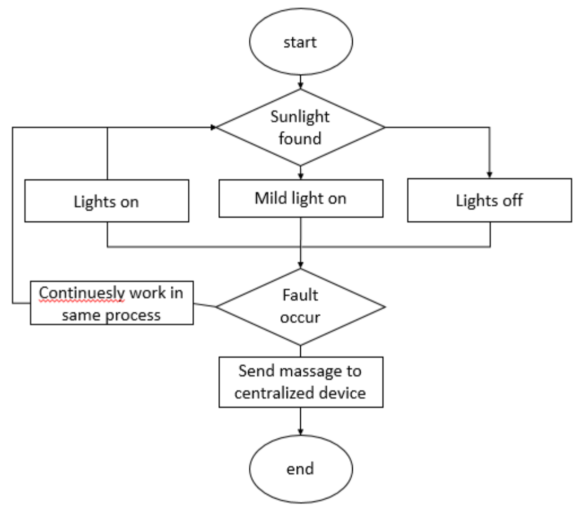
In summary, the Centralized Street Light Monitoring System using IoT is a forward-looking solution that combines cutting-edge technology with sustainability, cost-efficiency, and enhanced urban living. It empowers administrators to efficiently manage street lighting and provides a valuable tool for data-driven decision-making and future city planning, ensuring well-lit, cost-effective, and environmentally responsible urban environments.

III. METHODOLOGY

The system is primed for initialization. It comprises three essential components:

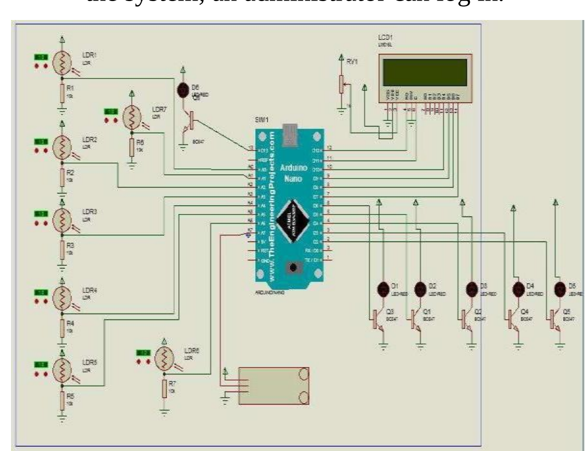
BLOCK DIAGRAM





Flow diagram

1. **Sensor Initialization:** The system begins by initializing the various sensors, ensuring they are ready to capture data.
2. **Daylight Detection:** The system continually monitors the presence of natural light if sunlight is detected via the light dependent Resistor (LDR), the entire system remains switched off during daylight hours.
3. **Admin Login:** To gain access and administer the system, an administrator can log in.



In the event of a "yes" response from the sensors, data from the sensors are collected. Any potential errors in the system's operation are swiftly reported to the server for prompt resolution.

Conversely, if the sensors detect no natural light, the system activates with full brightness. In the absence of any movement or obstacles within the vicinity, the system defaults to a dimming mode after 10 seconds of inactivity. However, should any vehicles or obstacles be detected by the Ultrasonic Sensors, the system responds by increasing the brightness of the streetlights to ensure safety and visibility. In the absence of such obstructions, the lights remain in a dimmed state, contributing to energy efficiency and cost savings.

Circuit diagram of the street light system- In our street light system, the circuit configuration is designed to optimize power usage and ensure seamless functionality. Here are a few components and connections which are used here.

- **Power Supply:** A 12V battery is employed to power the system. However, since all the components operate at 5V, a regulator IC is used to convert the voltage from 12V to 5V
- **Arduino Nano:** The central control unit of the system, an Arduino Nano, is used to interconnect and manage all the system's devices. It plays a pivotal role in orchestrating the system's operation.

Component Connections:

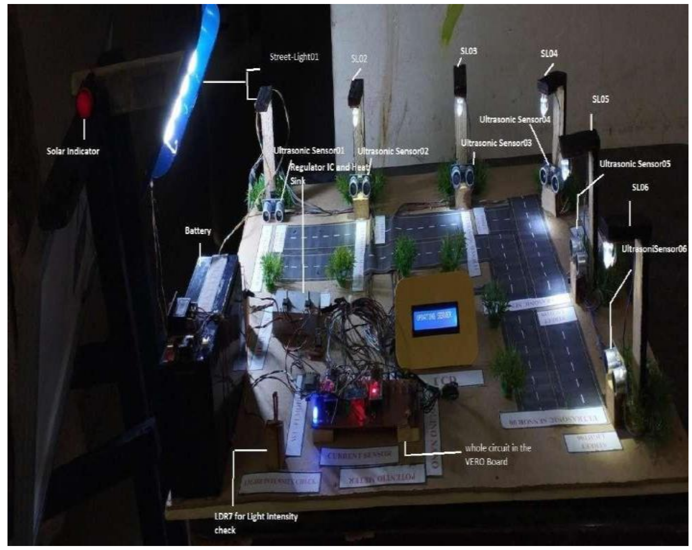
- **LEDs:** The LEDs, responsible for street lighting, are connected to the digital pins of the Arduino Nano, including D1, D2, D3, D4, D5, D6, and D13. These pins enable dynamic control of the illumination.
- **LCD Display:** To provide real-time information and status updates, an LCD display is integrated into the system. It is connected to digital pins 12, 11, 10, 9, 8, and 7, allowing for clear data visualization.
- **Light Dependent Resistors (LDRs):** The system employs Light Dependent Resistors to detect ambient light conditions. These sensors are connected to the analog pins of the Arduino Nano, denoted as A0, A1, A2, A3, A4, A5, A6, and A7, facilitating precise light-level monitoring.

This comprehensive circuit configuration forms the backbone of our street light system, ensuring efficient power management and intelligent control of illumination, ultimately contributing to energy conservation and sustainability.

Project Outcomes-In this section, we will discuss the overall achievements and results of our project. Upon the successful initialization of our system, it operates seamlessly, guided by automated server control. Our project demonstrates proficiency in both system control and monitoring, as well as accurate detection capabilities.

Project Overview-To gauge light intensity, our system employs Light Dependent Resistors (LDRs). When a mobile torch is activated directly above the LDR, the entire street light system remains switched off. This feature ensures that during daylight hours, the street lights are automatically turned off, aligning with the primary objective of our smart street light system. This automated control serves to mitigate significant electricity losses and enhance energy efficiency.

Furthermore, the project includes an obstacle detection mechanism using ultrasonic sensors, which triggers an increase in LED brightness beneath the sensors when obstacles are detected. This feature ensures that the environment remains well-illuminated in the presence of vehicles or obstructions, contributing to safety and visibility.



Benefits

- **Cutting-Edge Technology:** This system leverages the latest technological advancements, ensuring innovation in the field.
- **User-Friendly Operation:** The system is designed for effortless operation, making it accessible to a wide range of users, regardless of technical expertise.
- **Energy Conservation:** One of the primary benefits is its ability to curtail electricity wastage, contributing to significant energy savings and environmental preservation.
- **Real-Time Fault Detection:** The system offers real-time monitoring, enabling the prompt identification of malfunctioning street lights, and allowing for quick repairs.
- **Minimal Manpower Requirement:** The system demands very little human intervention for maintenance, reducing operational costs and ensuring seamless functionality.

Limitations:

- **Internet Dependency:** The system relies on internet connectivity, and slow internet speeds or server downtimes may impact its effectiveness.
- **Geographical Constraints:** The system's control area may have limitations based on its current configuration.

Future Enhancements:

- **Advanced Communication Technologies:** Future improvements may include the integration of advanced communication technologies such as GSM and GPRS for more extensive coverage and reliability.

- **Li-Fi Integration:** The system can be further developed to incorporate Li-Fi technology, which has potential applications in controlling automated vehicles within the city. Li-Fi networks are known for their enhanced security, making them a robust choice for city-wide automation.
- **Artificial Intelligence Integration:** In the future, the system can be enhanced by integrating artificial intelligence, allowing for more intelligent, adaptive, and self-optimizing control of street lighting, improving efficiency and reducing energy consumption.

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