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(AUTONOMOUS)

AUTOMATIC STREET LIGHT FAULT DETECTION SYSTEM USING LIGHT DEPENDENT RESISTOR

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ABSTRACT

"LightSense" aims to revolutionize urban lighting infrastructure by introducing an automated system for real-time street light fault detection, precise location tracking, and efficient maintenance. The current reliance on public reports or periodic surveys is time-consuming and inefficient. The project suggests a cost-effective solution utilizing Light Dependent Resistor (LDR) sensors integrated into a board connected to a Modular Network Module for detecting changes in light intensity or the absence of light. A unique identification number for each street light pole, is transmitted to a regional hub and then relayed to the nearest Electricity Board (EB) Office mainframe for precise location determination and technician dispatch. The system goes beyond fault detection, providing a versatile framework for future enhancements. The project's workplan includes milestones, and the college facilities available for prototype development are essential. Industry support is sought, and financial assistance is required. The expected outcomes include faster response times, reduced costs, and overall improved urban lighting infrastructure.

INTRODUCTION

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- Traditional methods of detecting and addressing faults in streetlights present significant challenges, often resulting in delays, inefficiencies, and increased costs.
- Public reports are often unreliable and difficult to prioritize among the vast number of reports received. On the other hand, periodic surveys conducted by technicians are time-consuming and inefficient, often taking days or even months to complete.
- Recognizing the need for optimization, this project proposes a novel solution leveraging wide-scale Internet of Things (IoT) technologies to revolutionize the detection and reporting of faults in street lighting infrastructure.

LITERATURE SURVEY PAPER-1

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Title	AUTHOR	YEAR	DESCRIPTION	ADVANTAGES	DISADVANTAGES
Smart Streetlights In Smart City: A Case Study Of Sheffield	Dizon, E., & Pranggono, B.,	2022	The study evaluates utilities of smart streetlight in the city of Sheffield, comparing it against traditional standards and found out some interesting correlations	The Study found that there is a correlation between crime rate and availability of streetlight, crucially it is inversely propositional to each other.	The study mainly focuses on benefits of high availability streetlights but not how to maintain such system.

LITERATURE SURVEY PAPER-2

Title	AUTHOR	YEAR	DESCRIPTION	ADVANTAGES	DISADVANTAGES
Smart Streetlight System Using Mobile Applications: Secured Fault Detection And Diagnosis With Optimal Powers	M. Kanthi., & Ravilla Dilli	2023	The work focuses on implementing power efficient streetlights by using LDRs to control the lamp based on the environment light deficiency.	The work has effectively saved approximately 53.45%, 44.76%, 39.39%, and 32.25% respectively for 10%, 20%, 30%, and 50% idle mode brightness.	The Work uses Radio and Bluetooth networking modules, which would only work on extremely short ranges. The work also do not have means to maintain multiple streetlights simultaneously limiting its scalability.

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LITERATURE SURVEY PAPER-3

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Title	AUTHOR	YEAR	DESCRIPTION	ADVANTAGES	DISADVANTAGES
Iot Based Automatic Damaged Street Light Fault Detection Management System	Ashok Kumar Nanduri, Siva Kumar Kotamraju, G L Sravanthi, Sadhu Ratna Babu	2020	The project uses LDRs, GPS, Twillio to maintain and identify faults in the streetlight automatically.	The project uses environment LDR to forgo the use of NTP to get context of day-night.	The project uses GPS for location tracking, which is an extra component that increases the complexity of the system. It also is tightly coupled with its network module which is GSM.

LITERATURE SURVEY PAPER-4

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Title	AUTHOR	YEAR	DESCRIPTION	ADVANTAGES	DISADVANTAGES
Street Light Controlling And Monitoring Of Fault Detection Using Lora	N. Sravani, Y. Latha, G. Nirmala	2021	The study presents a dual-model where one model utilizes IEEE 802.11 wireless technology within confined premises, while the other employs a wired setup for extended ranges, suitable for streetlamps.	The use of a short range and long-range networking modules significantly increases its adaptability.	The system is tightly coupled to those two standards, which limits scalability on areas with extreme conditions. The need of modular networking is evident here.

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LITERATURE SURVEY PAPER-5

Title	AUTHOR	YEAR	DESCRIPTION	ADVANTAGES	DISADVANTAGES
Simulators, Emulators, And Test-beds For Internet Of Things: A Comparison	N D Patel, B M Mehtre, Rajeev Wankar	2019	The paper compares various simulators, emulators, and testbeds for IoT, focusing on their scope, type, programming language, IoT layers, scale of operation, and security measures.	With the evaluations one can easily test out the initial implementation of a IoT system without having to physically assembling the system.	The study's emulator, simulator and testbed were remained largely unhelpful, however it set us on right path in finding our effective emulator: WokWi.

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EXISTING SYSTEM (DRAWBACKS)

- The current management of street lighting infrastructure relies on manual methods for fault detection and reporting.
- The reliance on manual processes for fault detection and reporting in street lighting infrastructure poses several challenges.
- Public reports are often sporadic and unreliable, while surveys are time-consuming and may not comprehensively cover all areas.
- These issues contribute to increased downtime, maintenance costs, and a diminished quality of urban lighting infrastructure.

PROPOSED SYSTEM (ADVANTAGES)

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- Recognizing the need for optimization, this project proposes a novel solution leveraging wide-scale Internet of Things (IoT) technologies to revolutionize the detection and reporting of faults in street lighting infrastructure.
- This system is loosely coupled from networking module and is designed so it can be changed with minimal code change.
- Allows for the dynamic control of streetlights and sends maintenance alerts for issues like burnt-out bulbs.
- The system goes beyond fault detection, providing a versatile framework for future enhancements.

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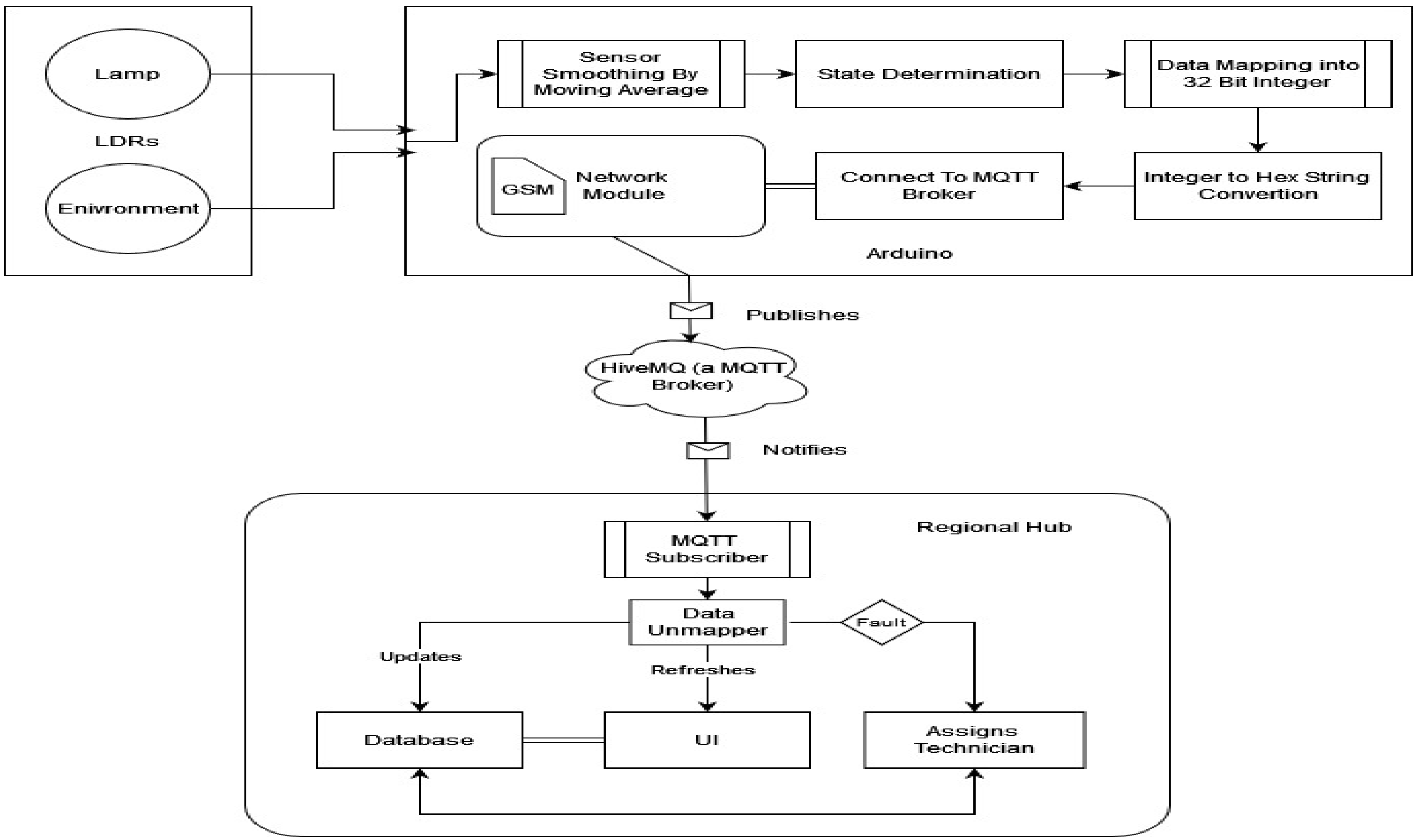
WORKFLOW DIAGRAM



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SYSTEM SPECIFICATION

HARDWARE SPECIFICATION

Board	:	Arduino UNO R3 / ESP32 Devkit
Sensor	:	Light Dependent Resistor
Networking Module	:	SIM800L GSM / Wi-Fi Module in ESP32
Computer	:	PC/Laptop with USB Port

SOFTWARE SPECIFICATION

Programming Languages	:	Python, Micropython, Arduino C++
GUI Framework	:	CustomTKinter
MQTT Broker	:	HiveMQ
DBMS	:	MySQL
Stimulation Tool	:	WokWi

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MODULES

The Modules included in a project are

1. Sensor Data Collection
2. Data Masking
3. Data Transmission
4. Data Storage
5. Data Monitoring and Visualization

MODULE 1

(SENSOR DATA COLLECTION)

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- There are two LDR Sensors, Lamp LDR which is placed such that it faces the bulb of the light pole, and the environment LDR which is exposed to the sky and placed such that it is isolated from the Lamp LDR..
- The environment LDR gives the context like night, dusk, dawn and day, and lamp LDR must be greater than environment during night and dusk.
- Since the LDR are connected in voltage divider circuit the resistance of the second resistor must be one magnitude higher than the LDR ohm range to get a readable voltage that makes sense during night and daytime .

MODULE 2
(Data Masking)

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- Data Masking is done to pack as much data as possible within a unit of storage, therefore this step is more akin to data packing or data compression, the masking part is the one that achieves it.
- The MCU would publish four pieces of data to the broker server: ID of the light pole, Lamp LDR value, Environment LDR value and finally the state of the lamp.
- The ADC in Arduino board would only resolve up to 10-bit (0-1023) so the values of both LDR is essentially capped at 0-1023 and finally the state/condition of the lamp would only have three states: working, sleeping and fault, which can be represented in 2 -bit number.

MODULE 3
(DATA TRANSMISSION)

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- SIM800L GSM module is responsible for establishing a cellular connection to transmit the collected data.
- The module is programmed to publish data at regular intervals, specifically every 10 seconds, ensuring a consistent flow of information.
- During each cycle of the main loop, the Arduino microcontroller performs a check to ensure that the GSM and the MQTT connection to the broker, are intact and functioning properly.

MODULE 4

(DATA STORAGE)

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- The project employs MySQL database for this purpose. This map's their unique identifiers to their respective locations. It also maintains a record of registered technicians and repair tasks facilitating efficient tracking.
- This also stores sensor data published by the streetlights. By which historical data analysis is done.
- The choice of MySQL was primarily driven by familiarity rather than efficiency. While MySQL is a robust and widely used database system

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MODULE 5 (DATA MONITORING AND VISUALIZATION)

- A comprehensive interface to monitor sensor data and visualize the status of streetlights in real-time, ensuring efficient management of urban lighting infrastructure.
- CustomTkinter, a Python GUI framework that wraps the standard Tkinter library is used. This module provides a user-friendly and visually appealing platform for data visualization and analysis.

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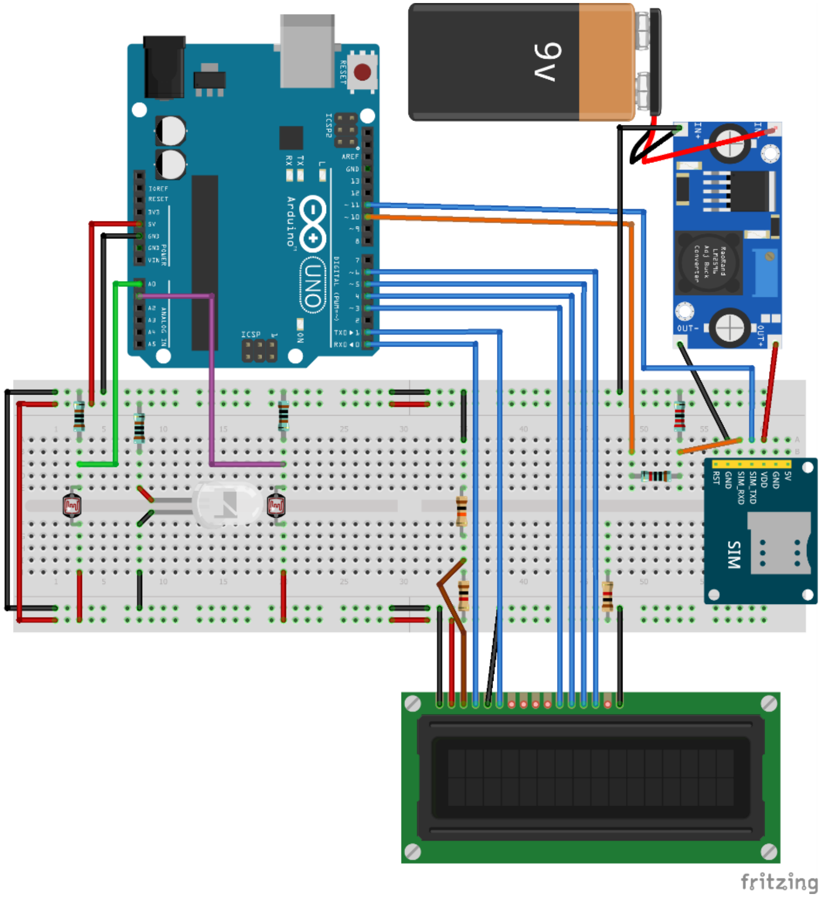
SYSTEM ASSEMBLY



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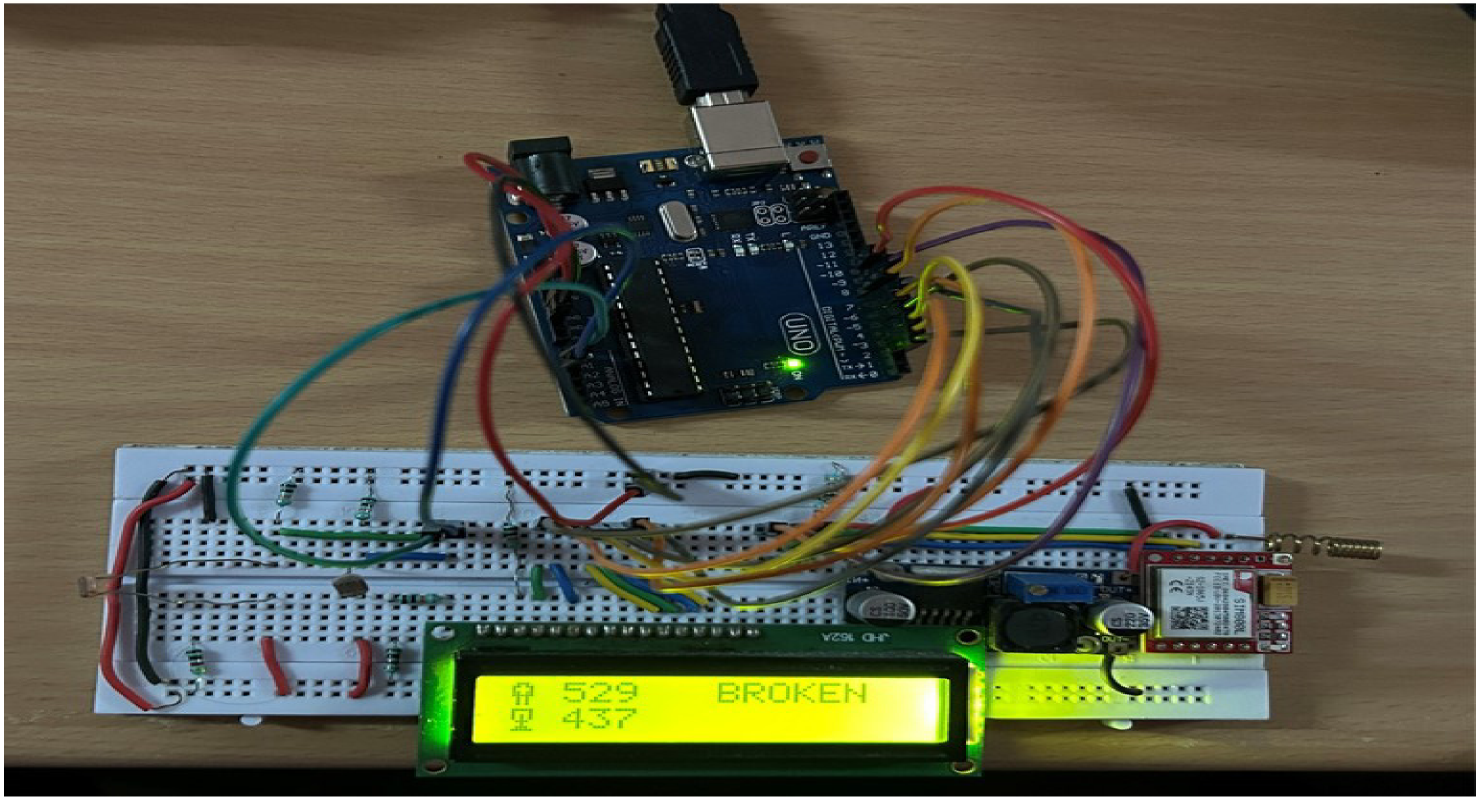
SCREENSHOTS

SCREENSHOT 1:



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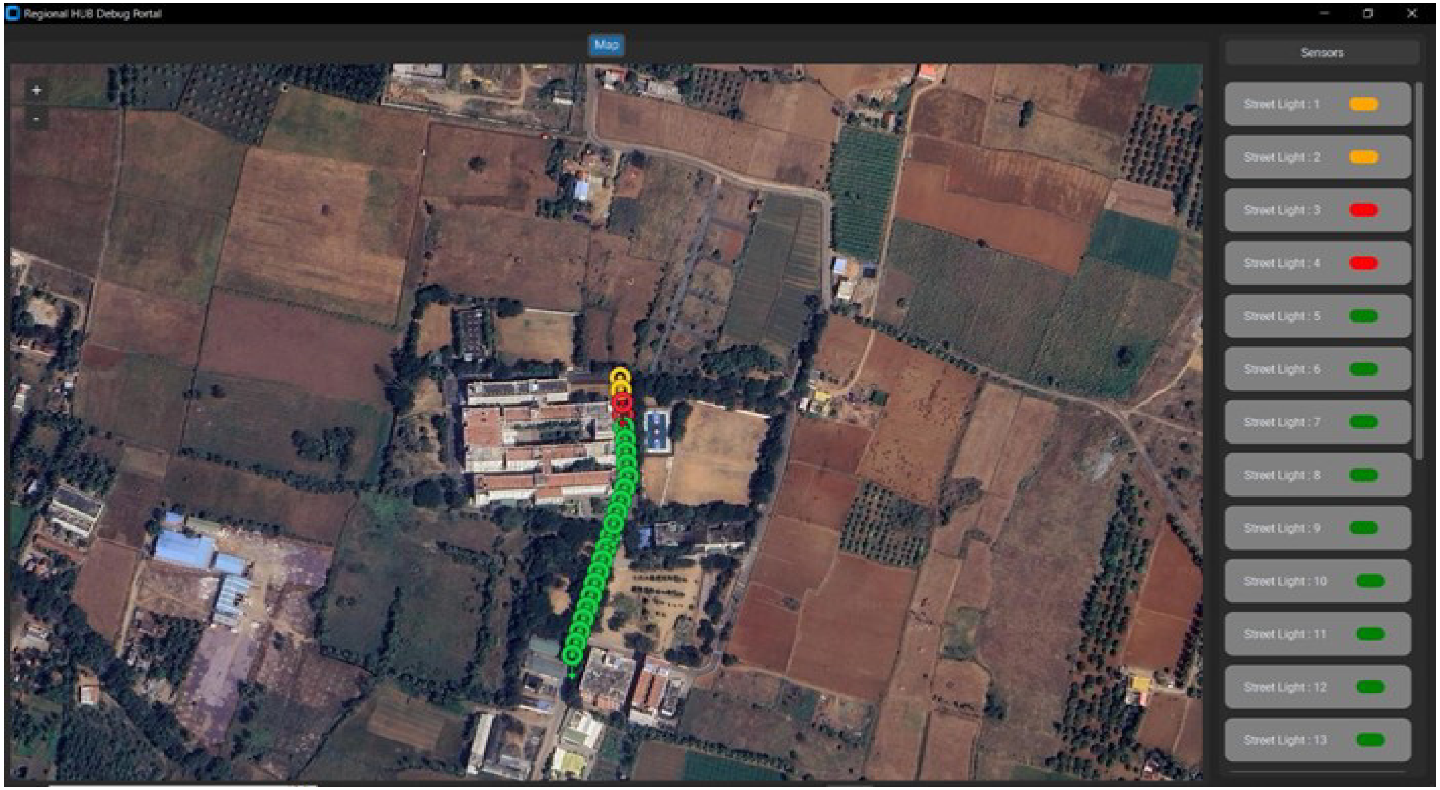
SCREENSHOT 2:



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RESULT AND DISCUSSION

- The proposed streetlight monitoring system addresses the challenges outlined in the problem statement by leveraging modern IoT technologies to enhance urban lighting infrastructure.
- By utilizing Light Dependent Resistor (LDR) sensors and modular network modules, this become a cost-effective and scalable approach to streetlight management.
- With its ability to improve response times, reduce costs, and enhance overall urban lighting infrastructure, the proposed solution offers a transformative approach to streetlight maintenance in both urban and rural areas.

CONCLUSION AND FUTURE ENHANCEMENT

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- This system not only optimizes the process of reporting faults but also lays the foundation for future enhancements and innovations.
- Incorporating machine learning algorithms can enable predictive maintenance capabilities, allowing the system to anticipate and address potential faults before they occur.
- Integrating advanced analytics and visualization tools into the GUI can empower users with deeper insights into streetlight performance and energy consumption trends.

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THANK YOU