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CENTRALIZED MONITORING SYSTEM FOR STREET LIGHT FAULT DETECTION AND LOCATION TRACKING

Prathiba R[*1], Chinmayi C[*2], Mohammed Mustafa A[*3], Punith Gowda A[*4], Suhas SM[*5]

[*1]Assistant Professor, Department Of Information Science And Engineering, S J C Institute Of Technology Chickaballapur, India.

[*2,3,4,5]Under Graduate Student, Department Of Information Science And Engineering, S J C Institute Of Technology Chickaballapur, India.

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ABSTRACT

A major concern facing street lighting is the malfunction of lights which not only poses a danger to public safety but also leads to unnecessary energy wastage. The current approach to identifying and locating faulty lights relies on manual inspections which are not only inefficient but also time-consuming. This paper presents a novel solution in the form of a centralized monitoring system capable of real-time fault detection and location tracking for street lights. The system employs sensor nodes attached to individual lights equipped with light detectors and potentially voltage/current sensors. These nodes communicate wirelessly with a central server transmitting valuable data on light status environmental conditions and potential electrical irregularities. By leveraging advanced algorithms the server can efficiently detect faults and accurately pinpoint their location using GPS integration or unique identifiers. Subsequently maintenance crews receive automated alerts leading to quicker response times and effective management of street lighting infrastructure. This innovative approach offers numerous advantages including improved public safety reduced energy consumption and streamlined maintenance efforts.

Keywords: Real-time, Sensor nodes, Automated Alerts, Central Server, Light Detection.

I. INTRODUCTION

The Internet of Things (IoT) is playing a crucial and indispensable role in the daily lives of individuals. It has brought about significant changes in traditional systems and household components enhancing the overall quality of life. However one of the major hurdles faced by the current electricity system is connectivity as it relies heavily on manual handling by multiple contractors. This not only makes it tedious but also leads to maintenance problems. Moreover the timer used in the manual system requires a continuous power supply of 12 hours which can be disrupted and cause inconvenience. IoT is renowned for its widespread use of micro devices capable of processing and storing data with emphasis on performance confidentiality consistency and security. These pervasive devices are interconnected through IoT providing secure and efficient services for all applications at any time and place. The integration of IoT with IT and OT has revolutionized the way unstructured data generated by machines is analyzed to make improvements. This holistic approach aptly termed as IoT encompasses all the components required to create a seamless ecosystem. For instance streetlights which are considered a vital asset for any city play a crucial role in enhancing road safety and security in both residential and commercial areas. The applications of IoT are diverse and cater to multiple aspects of our daily lives. From smart roads and parking to intelligent lighting and home automation the possibilities are endless. However the existing manual system of street lighting has its fair share of challenges including connectivity issues maintenance problems and timing discrepancies. In conclusion the Internet of Things has become an integral part of our lives bringing convenience efficiency and security. With its ability to seamlessly integrate technology and operational processes IoT has paved the way for a better and more connected future. Its vast array of applications including those in street lighting have not only simplified our lives but also made them safer and more sustainable.

II. METHODOLOGY

At first sensors such as a voltage sensor current sensor and Light Dependent Resistor (LDR) are responsible for transmitting information to an Arduino microcontroller. The Arduino then carefully analyzes the data from the

sensors to potentially uncover any defects in the electrical supply or the light fixture itself. The LDR is specifically designed to determine whether the surrounding environment's light is in an ON or OFF state. If it is found to be in the ON state no further action is taken. However if the weather conditions result in the lights being turned OFF the street lights will automatically illuminate. In the event of a malfunctioning street light a red LED indicator attached to each street light will turn ON. This red color is used to signify the damage. Each street light has its own LDR and red LED with the LDR being responsible for detecting the status of the light and automatically activating the red LED in case of a faulty lamp. Additionally a message containing a description of the issue and the authorized person's mobile number is included. Once a fault is detected this message is transmitted to the designated individual. GPS technology will also be utilized to accurately pinpoint the location of the damaged lamp. While there are various forms of data that can be used our project utilizes Bluetooth data that includes longitude and latitude coordinates of the faulty light. Once repairs have been made the red LED will automatically turn OFF.

III. PROBLEM STATEMENTS AND DEFINITIONS

1. Manual Street Light Management:

- Problem: Traditional street light systems rely on manual operation, leading to inefficiencies in turning lights on/off and delayed identification of faults.
- Definition: The project addresses the challenge of manual street light management by introducing an automated system for controlling lights and detecting faults.

2. Delayed Fault Detection:

- Problem: Faults in street lights often go unnoticed until residents file complaints, causing delays in repairs and negatively impacting public safety.
- Definition: The project aims to provide real-time fault detection, reducing response time and enhancing the overall reliability of street lighting.

3. Energy Inefficiency:

- Problem: Conventional street light systems lack adaptive control, resulting in unnecessary energy consumption during daylight or favorable weather conditions.
- Definition: The project focuses on energy-efficient street lighting by incorporating weather-responsive controls and automatic ON/OFF based on ambient light levels.

4. Lack of Systematic Monitoring:

- Problem: Existing systems lack a centralized monitoring mechanism, making it challenging to assess the overall health of the street light network.
- Definition: The project establishes a cloud-based storage system for systematic monitoring, allowing authorities to access real-time data and make informed decisions.

5. Reliance on Manual Complaints:

- Problem: Identifying faulty street lights traditionally relies on complaints from residents, leading to a reactive rather than a proactive approach to maintenance.
- Definition: The project employs sensors for automatic fault detection, eliminating the need for manual complaints and ensuring a more proactive maintenance strategy.

6. Inefficient Communication of Faults:

- Problem: Communication channels for reporting and addressing street light faults may be inefficient, causing delays in alerting responsible authorities.
- Definition: The project integrates a Blynk-based alert system, enabling immediate communication of faults, along with precise location information, to authorized personnel.

7. Lack of Location Precision:

- Problem: Locating faulty street lights accurately can be challenging using traditional methods, leading to delays in repairs.

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- Definition: The project incorporates GPS technology to pinpoint the exact location of faulty lights, streamlining the repair process and improving overall maintenance efficiency.

8. High Operational Costs:

- Problem: Traditional street lighting systems may result in higher operational costs due to energy wastage, delayed maintenance, and inefficient resource utilization.
- Definition: The project aims to reduce operational costs by implementing cost-effective IoT technologies, energy-efficient controls, and a centralized monitoring system.

IV. MODELING AND ANALYSIS

The system incorporates various sensors to monitor the condition of the street light shown in the below figure1.

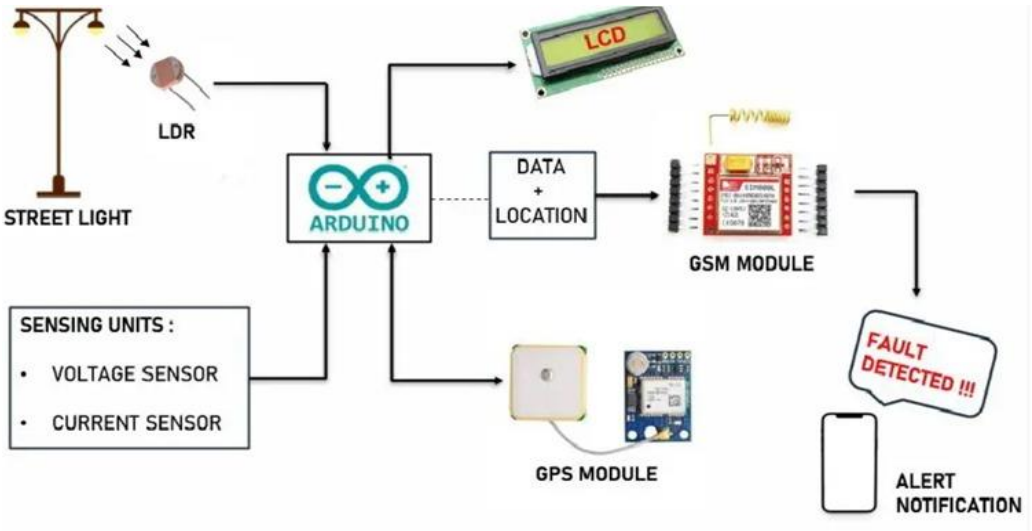

Figure 1: Block Diagram

V. RESULTS AND DISCUSSION

Initially we created a preliminary model to assess the organization process of the entire system and can be utilized in future investigations and advancements. Upon completing the entire project we designed a proposed framework as depicted in figure 2. Once the system was developed it underwent rigorous testing for several months to ensure its full functionality in real-world situations. Our approach resulted in increased accuracy in detecting faults as well as the automatic switching on and off of lights leading to significant energy savings. In cases where the first street light malfunctioned the red LED would illuminate indicating the issue. However if the street light was functioning properly no further action was required. For our experimentations we substituted basic LEDs in place of actual lights.

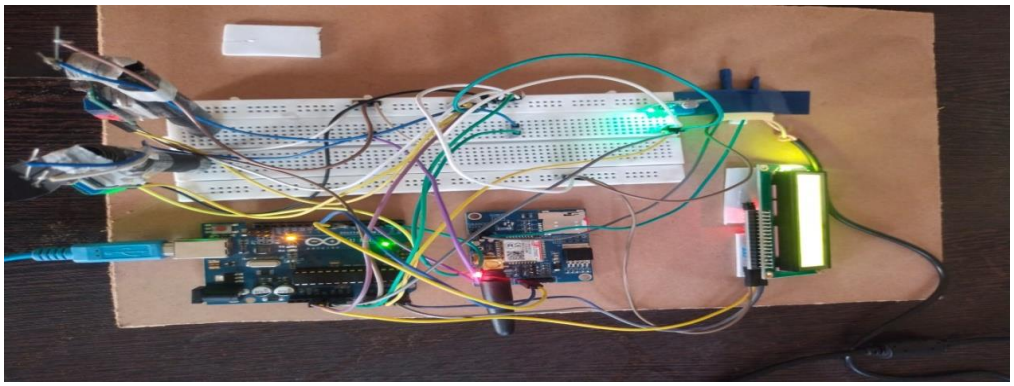

Figure 2: Overall view of the research work

Figure 3 describes the message sent from authorized person from the GPS/GSM Module. Damage is the message which we have written as the indication and the URL is fetched using GPS.

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Figure 3: Output Message

Figure 4 shows the location of the damaged light. The indicator indicates the exact location.

Figure 4: Damaged Street Light finding Location

VI. CONCLUSION

Nowadays natural resources such as water power and air are extremely valuable assets. This project aims to safeguard one such resource - energy. The wastage of electricity is a major contributor to energy loss. Through the use of IoT technology the operation of street lights can be automated based on weather conditions. By monitoring the working status of street lights any issues can be identified and addressed promptly. The inclusion of Light Dependent Resistors (LDR) ensures that the lights are switched on and off automatically according to changes in the environment. In the event of a malfunction or failure of a street light during night time the LDR sensor will detect it and send a notification to the authorized person including the exact location via GPS. This reduces the need for human intervention and minimizes delays in resolving the issue. This automated system can be applied to all street lamps in rural areas providing efficient pre-identification of damaged lights based on the expiry of the lamps.

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