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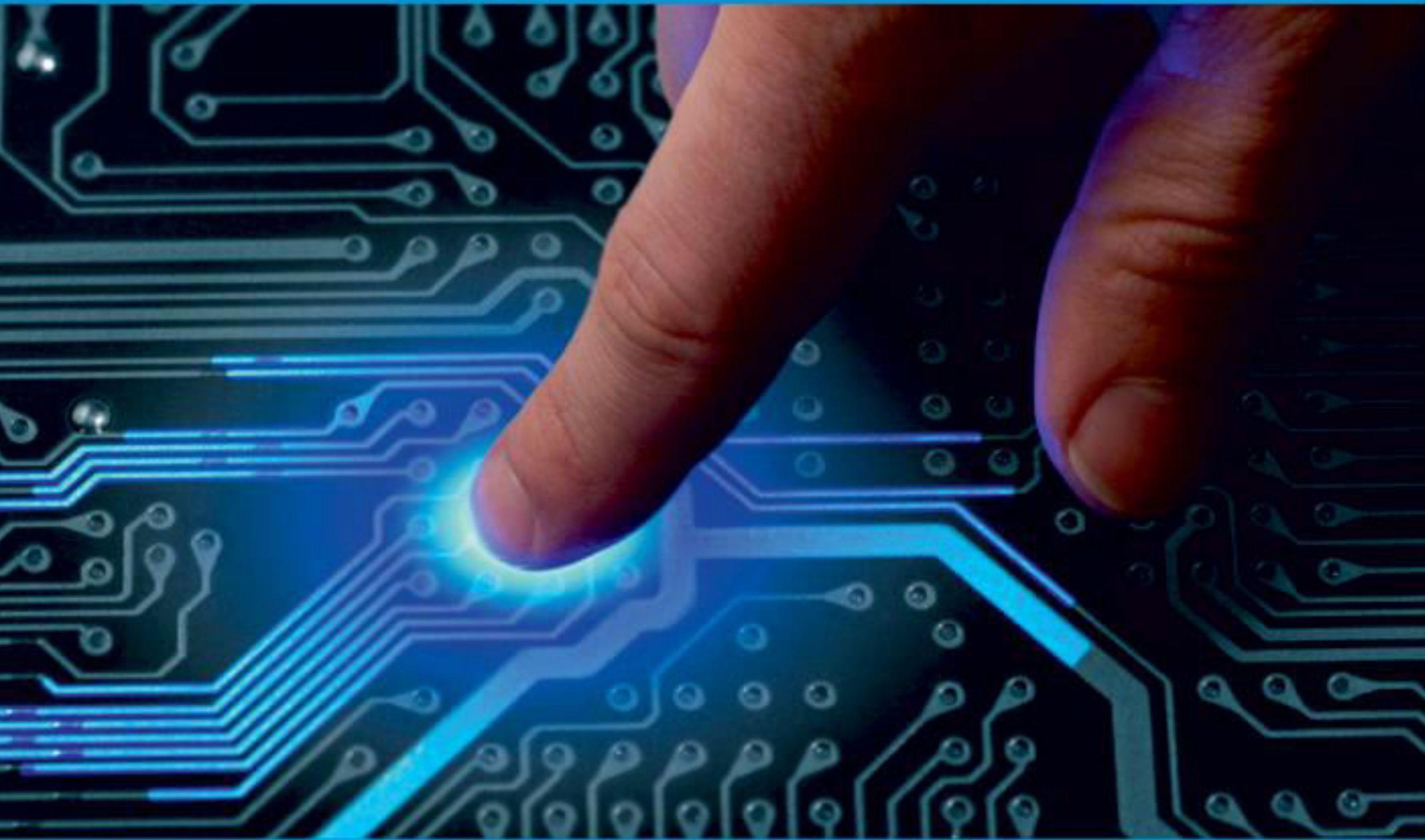

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Automatic Monitoring and Control of Street Light(IoT)

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ABSTRACT: The IoT (Internet of Things) is a blooming technology that mainly concentrates on the interconnection of devices or components to one another and the people. Finding the faulty street light automatically is become a vital milestone by using this technology. The primary goal of the project is to provide control and identification of the damaged street light automatically. The lighting system which targets the energy and automatic operation on economical affordable for the streets and immediate information response about the street light fault. In general, the damage of the street light is observed by getting the complaints from the colony (street) people. A Esp32 controller is used as a web server at the central base station to monitor the status of the streetlights.

KEYWORDS: IoT, Arduino , Street Light, Fault Detection.

I. INTRODUCTION

Traditional streetlight management relies on citizen complaints to identify faulty lights, a slow and inefficient method that results in extended darkness and safety concerns. This paper proposes a novel approach utilizing Internet of Things (IoT) technology to revolutionize street lighting. The proposed system equips each streetlight with sensors for automatic fault detection, promising significant improvements in response times, operational efficiency, cost savings, and public safety.

The main objective of this project is to develop an **IoT-based automated streetlight fault detection system**. This system aims to address the inefficiencies of the current complaint-driven approach by using sensors to automatically identify faulty lights, leading to faster repairs, improved efficiency, cost savings, and enhanced public safety.

II. PROPOSED SYSTEM

A. *Block Diagram*

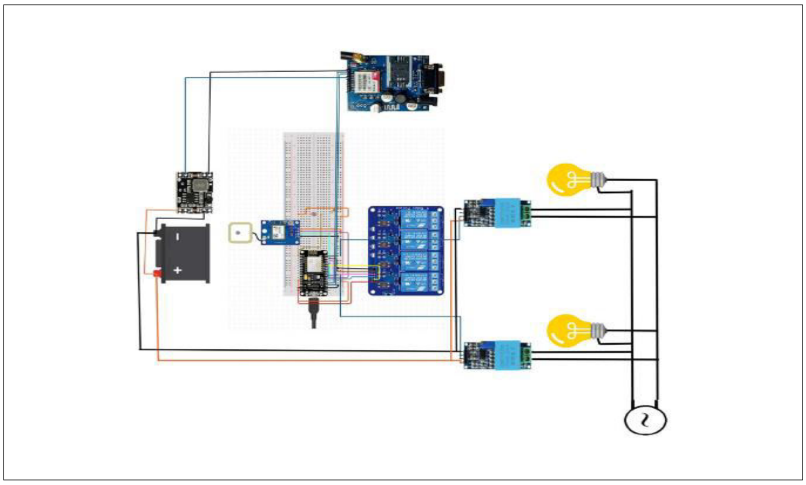

Fig 1: Block Diagram

B. *Modules*

1.Sensor Module.
- LDR(light dependency resistor)
- 0-25v DC voltage sensor
- ZMPT101B
- NEO-6 GPS

2.Communication Module.
- ESP32 DEVKIT V1
- SIM 900A

3.Central Management Interface.
- AWS IOT CORE

4. Power Management Module.
- DC-DC 12V Power Module

C. *Implementation*

This system utilizes flex sensors on a glove to detect finger positions, converting them into voltage variations via a potential divider. The analog signals are then processed by multiple ADS1115 ADC converters, interfaced with an Arduino Nano, and transmitted to a Raspberry Pi. The Pi stores the data, trains a machine learning model using libraries like pandas and sci-learn, and subsequently predicts finger positions. Commands are sent back to an Arduino Uno, which controls servo motors in a 3D printed robotic arm, allowing it to mimic the finger movements. Overall, the setup integrates sensor data acquisition, signal processing, machine learning, and actuation to enable real-time finger manipulation.

III. SYSTEM REQUIREMENTS

A. *Hardware Used:*
- ESP32 Microcontroller:
- communication interfaces (Wi-Fi, Bluetooth, etc.)
- Programming Language: Specify the programming language used to develop the ESP32 firmware (e.g., C++, Arduino IDE).
- Sensors:
- DC Voltage Sensor: Define the voltage range it can measure and its accuracy level.
- AC Voltage Sensor: Specify the voltage and frequency range it can handle, ensuring compatibility with the local power grid.
- Light Dependent Resistor (LDR) Sensor: It sensitivity to light intensity variations.
- Communication Module:
- Cellular connectivity (e.g., LTE) might be necessary in remote locations without reliable Wi-Fi coverage. Define the cellular network provider.

B. Software Used:
- ESP32 Firmware:
- Data Collection: Specify the frequency of sensor data readings
- Fault Detection Algorithm (Optional): Detail the specific checks implemented locally on the ESP32 to identify potential faults.
- Secure Data Transmission: Define the communication protocol used for transmitting data to AWS IoT Core (e.g., MQTT with TLS encryption).
- AWS IoT Core:
- Data Reception: Specify the format of the data received from streetlight units (e.g., JSON format with timestamps and sensor readings).
- Data Storage: Outline the data retention policy for real-time data stored in DynamoDB.
- Alerting System: Define the specific logic for triggering alerts based on pre-defined conditions.
- Monitoring Dashboard: Detail the functionalities of the dashboard, including (charts, maps) and (filtering data, exporting reports).
- Alert System:

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- Alert Conditions: Specify the exact thresholds or criteria that trigger different types of alerts (e.g., voltage exceeding 120% of nominal value for power outage alert).
- Notification Methods: Define the communication channels used for sending alerts (email addresses, phone numbers for SMS). Fault Detection Algorithm:

C. Database:

- DynamoDB: Specify the data model used for storing sensor data in DynamoDB, including data types for each sensor reading and timestamps.
- Amazon Athena (Optional): Outline the schema design for storing historical data in DynamoDB in a way that facilitates efficient querying and analysis using Athena.
- Monitoring Dashboard (AWS IoT Core):
- Real-Time Data Visualization: Define the specific data points displayed on the dashboard .
- Alert Configuration: Outline how authorized personnel can configure alert thresholds and notification preferences through the dashboard.
- User Access Management: Define the user roles and access levels for the monitoring dashboard (e.g., administrators with full access, viewers with limited access to specific data).

D. Algorithm Used:
Advanced Functionalities:
Adaptive Learning: The system can incorporate machine learning algorithms to learn historical usage patterns and dynamically adjust lighting profiles based on seasonal variations, recurring events, or special occasions.
Predictive Maintenance: By analysing sensor data over time, the system can identify potential equipment malfunctions and schedule preventive maintenance before failures occur.
Integration with External Systems: Consider integrating the system with traffic management systems for real-time traffic flow data. This allows for adjusting light intensity based on traffic volume, potentially improving traffic flow and safety.

IV. COMPONENTS DESCRIPTION

1) LDR:
   An LDR (Light Dependent Resistor) module is a sensor that detects changes in light intensity. This module is commonly used in street light management systems to measure ambient light levels, allowing for automatic adjustment of street light brightness.
2) 0-25V DC VOLTAGE SENSOR
   A 0-25V DC voltage sensor is a versatile device designed to accurately measure voltage levels within the range of 0 to 25 volts in a direct current (DC) electrical system.
3) ZMPT 101B
   The ZMPT101B voltage sensor is a specialized module tailored for accurately measuring AC voltage levels in electrical systems. Operating within a specified voltage range, it generates an analog output signal proportional to the AC voltage being measured.
4) NEO-6M GPS
   The NEO-6M GPS sensor module is a compact and versatile device designed for accurate positioning and navigation applications.
5) ESP32 DEVKIT V1
   The ESP32 Dev Kit V1 is a versatile development board based on the ESP32 microcontroller chip, which integrates Wi-Fi and Bluetooth connectivity along with a wide range of peripheral features.
6) SIM900A GSM
   The SIM900A GSM module is a compact and versatile communication device designed for facilitating GSM (Global System for Mobile Communications) connectivity in embedded systems and IoT (Internet of Things) applications.
7) AWS IOT CORE
   AWS IoT Core is a cloud-based platform provided by Amazon Web Services for securely connecting IoT devices to the cloud and enabling communication between them. It facilitates device registration, authentication, and management, ensuring secure and reliable interactions between devices and the cloud infrastructure.. The platform includes built-in security features such as encryption, authentication, and access control to protect IoT data and devices from unauthorized access and cyber threats.
8) DC-DC 12V POWER MODULE
   The DC-DC 12V power module is a compact and efficient voltage converter designed to step down or boost DC voltage levels as needed. It typically takes input from a DC power source, such as a battery or a solar panel, and converts it to a stable 12-volt output.

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V. Simulation Results

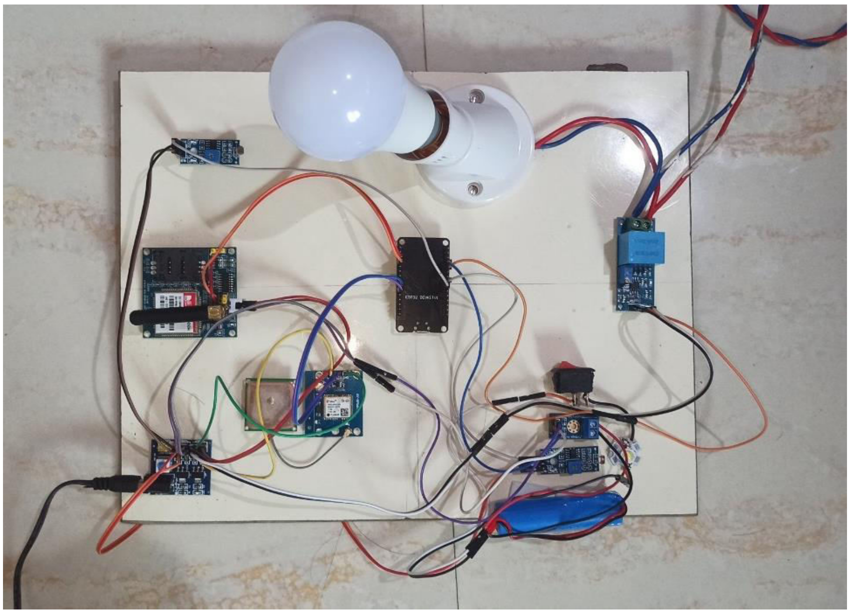

Fig 2: Smart Monitoring and Controlling Street Light

VI. Conclusion and Future Work

Automatic street light monitoring offers a promising future for cities, reducing energy consumption and enhancing safety through dynamic lighting adjustments. However, successful implementation hinges on pilot projects, public engagement to address privacy and light pollution concerns, potential integration with existing urban management systems, and exploration of advanced features like predictive maintenance, adaptive learning, and real-time power flow integration. By embracing these future considerations, cities can unlock the full potential of smart street lighting for a sustainable and data-driven urban future.

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