Industrial Internship Report on

”Automatic Street Light System”

Prepared by

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Executive Summary
This report provides details of the Industrial Internship provided by upskill Campus and The IoT Academy in collaboration with Industrial Partner UniConverge Technologies Pvt Ltd (UCT). This internship was focused on a project/problem statement provided by UCT. We had to finish the project including the report in 6 weeks' time. My project is (AUTOMATIC STREET LIGHT SYSTEM) This internship gave me a very good opportunity to get exposure to Industrial problems and design/implement solution for that. It was an overall great experience to have this internship.

AUTOMATIC STREET LIGHT SYSTEM

An automatic street light system employs an Arduino, LDR, and relay module. The LDR senses ambient light levels, and the Arduino processes this data. When the light level drops below a certain threshold at sunset, the Arduino triggers the relay to turn on the street lights. Conversely, at sunrise, when the light level rises above the threshold, the lights are turned off. This energy-efficient system reduces electricity usage by only illuminating when needed, making it ideal for outdoor lighting applications like streets and pathways.

Components Needed:

- Arduino board (such as Arduino Uno)
- LDR (Light Dependent Resistor)
- Resistor (for voltage divider circuit with LDR)
- Relay module (to control the street lights)
- LED street lights (or any other suitable light source)
- Connecting wires and power supply

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1 Preface

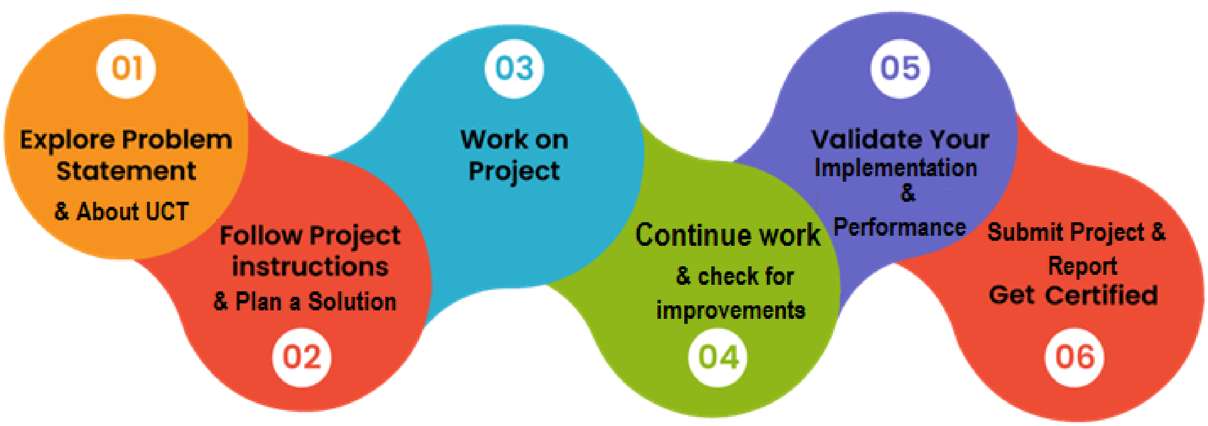
Summary of the whole 6 weeks' work.

About need of relevant Internship in career development.

Brief about Your project/problem statement.

Opportunity given by USC/UCT.

How Program was planned



Your Learnings and overall experience.

Thank to all (with names), who have helped you directly or indirectly.

Your message to your juniors and peers.

2 Introduction

2.1 About UniConverge Technologies Pvt Ltd

A company established in 2013 and working in Digital Transformation domain and providing Industrial solutions with prime focus on sustainability and RoI.

For developing its products and solutions it is leveraging various **Cutting Edge Technologies e.g. Internet of Things (IoT), Cyber Security, Cloud computing (AWS, Azure), Machine Learning, Communication Technologies (4G/5G/LoRaWAN), Java Full Stack, Python, Front end** etc.

i. UCT IoT Platform ( )

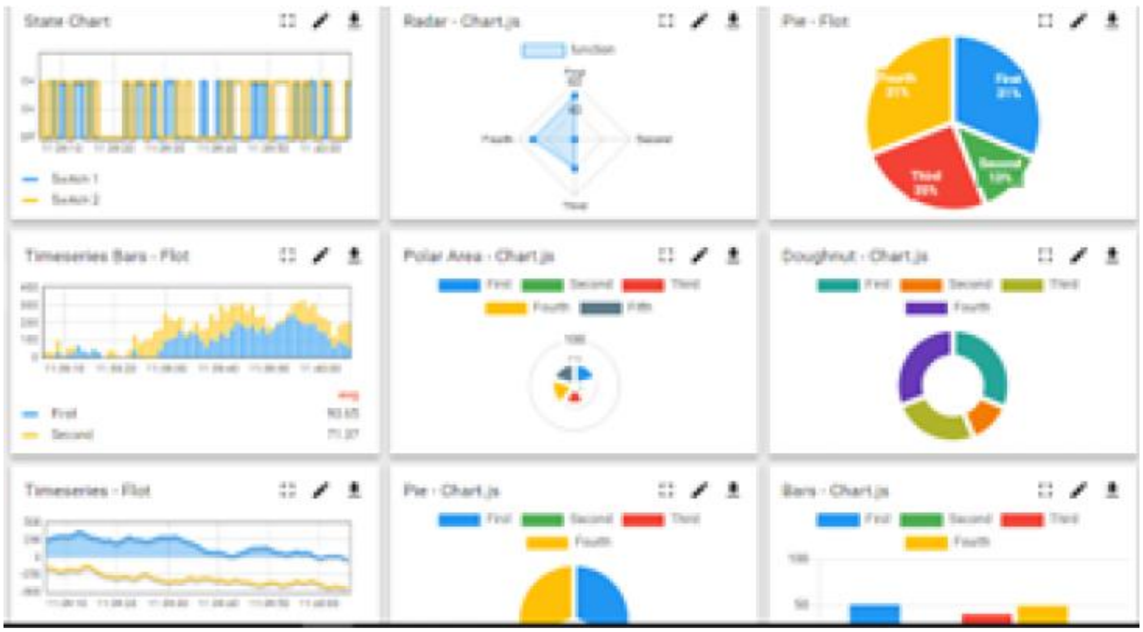
UCT Insight is an IOT platform designed for quick deployment of IOT applications on the same time providing valuable “insight” for your process/business. It has been built in Java for backend and ReactJS for Front end. It has support for MySQL and various NoSql Databases.

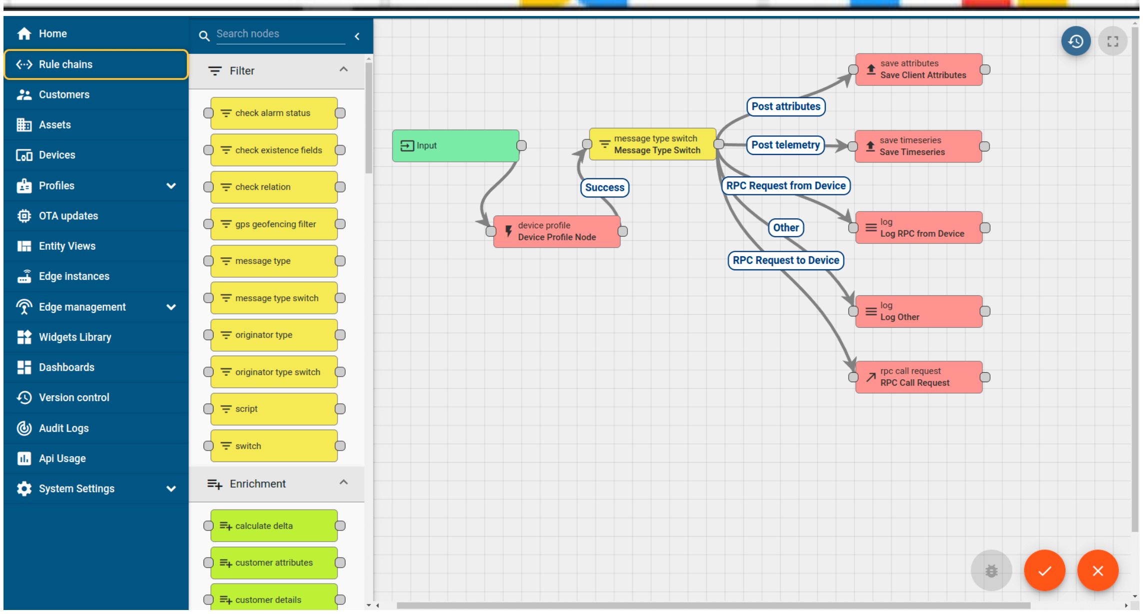
- It enables device connectivity via industry standard IoT protocols - MQTT, CoAP, HTTP, Modbus TCP, OPC UA

- It supports both cloud and on-premises deployments.

It has features to

- Build Your own dashboard
- Analytics and Reporting
- Alert and Notification
- Integration with third party application(Power BI, SAP, ERP)
- Rule Engine


State Chart
Radar - Chart.js
Pie - Flot
Timeseries Bars - Flot
Polar Area - Chart.js
Doughnut - Chart.js
Timeseries - Flot
Pie - Chart.js
Bars - Chart.js


Home
Rule chains
Customers
Assets
Devices
Profiles
OTA updates
Entity Views
Edge instances
Edge management
Widgets Library
Dashboards
Version control
Audit Logs
Api Usage
System Settings
Search nodes
Filter
check alarm status
check existence fields
check relation
gps geofencing filter
message type
message type switch
originator type
originator type switch
script
switch
Enrichment
calculate delta
customer attributes
customer details
Input
message type switch
Message Type Switch
device profile
Device Profile Node
Success
Post attributes
Post telemetry
RPC Request from Device
Other
RPC Request to Device
save attributes
Save Client Attributes
save timeseries
Save Timeseries
log
Log RPC from Device
log
Log Other
rpc call request
RPC Call Request

ii. Smart Factory Platform (FACTORY WATCH)

Factory watch is a platform for smart factory needs.

It provides Users/ Factory

- with a scalable solution for their Production and asset monitoring
- OEE and predictive maintenance solution scaling up to digital twin for your assets.
- to unleased the true potential of the data that their machines are generating and helps to identify the KPIs and also improve them.
- A modular architecture that allows users to choose the service that they what to start and then can scale to more complex solutions as per their demands.

Its unique SaaS model helps users to save time, cost and money.

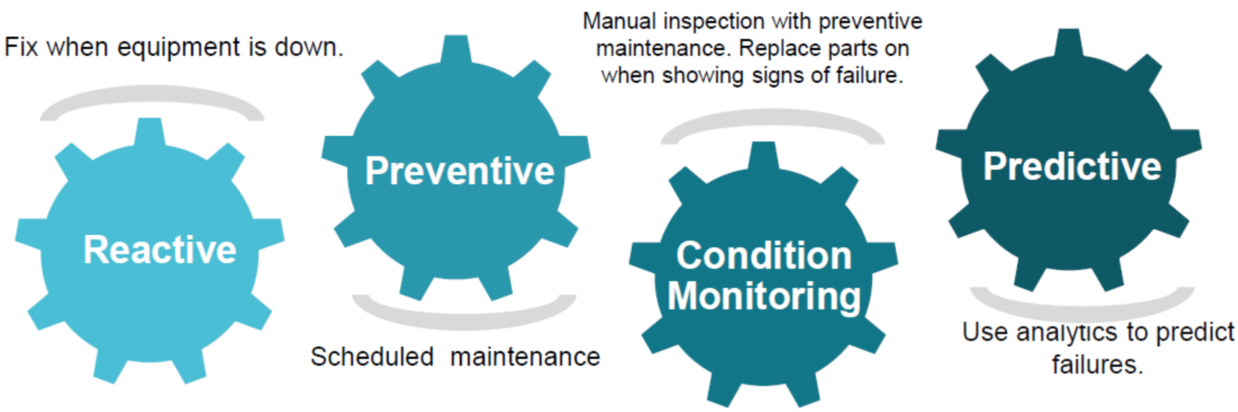
Machine	Operator	Work Order ID	Job ID	Job Performance	Job Progress		Output		Rejection	Time (mins)				Job Status	End Customer
					Start Time	End Time	Planned	Actual		Setup	Pred	Downtime	Idle		
CNC_S7_81	Operator 1	WO0405200001	4168	58%	10:30 AM		55	41	0	80	215	0	45	In Progress	i
CNC_S7_81	Operator 1	WO0405200001	4168	58%	10:30 AM		55	41	0	80	215	0	45	In Progress	i

iii. LoRaWAN based Solution

UCT is one of the early adopters of LoRAWAN teschnology and providing solution in Agritech, Smart cities, Industrial Monitoring, Smart Street Light, Smart Water/ Gas/ Electricity metering solutions etc.

iv. Predictive Maintenance

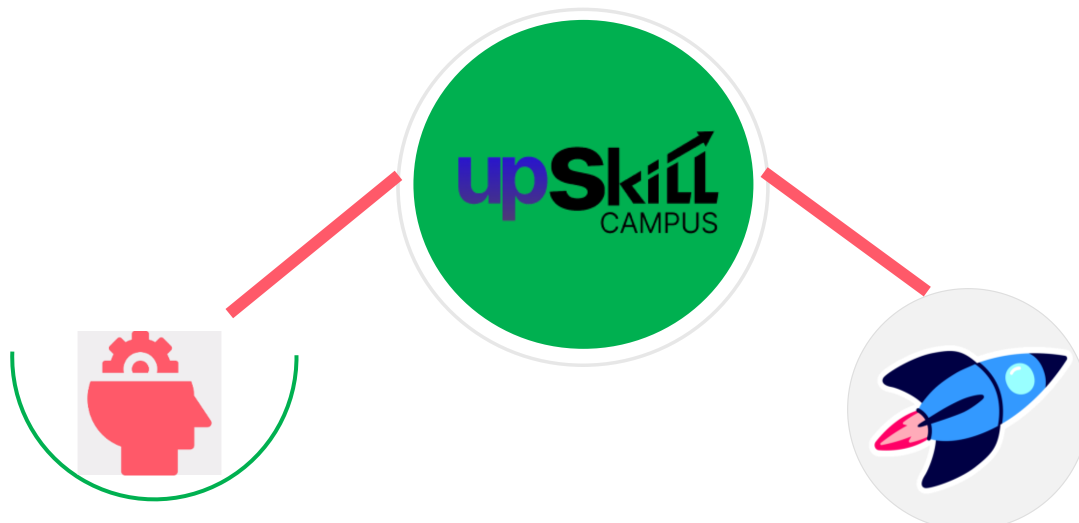
UCT is providing Industrial Machine health monitoring and Predictive maintenance solution leveraging Embedded system, Industrial IoT and Machine Learning Technologies by finding Remaining useful life time of various Machines used in production process.



2.2 About upskill Campus (USC)

upskill Campus along with The IoT Academy and in association with Uniconverge technologies has facilitated the smooth execution of the complete internship process.

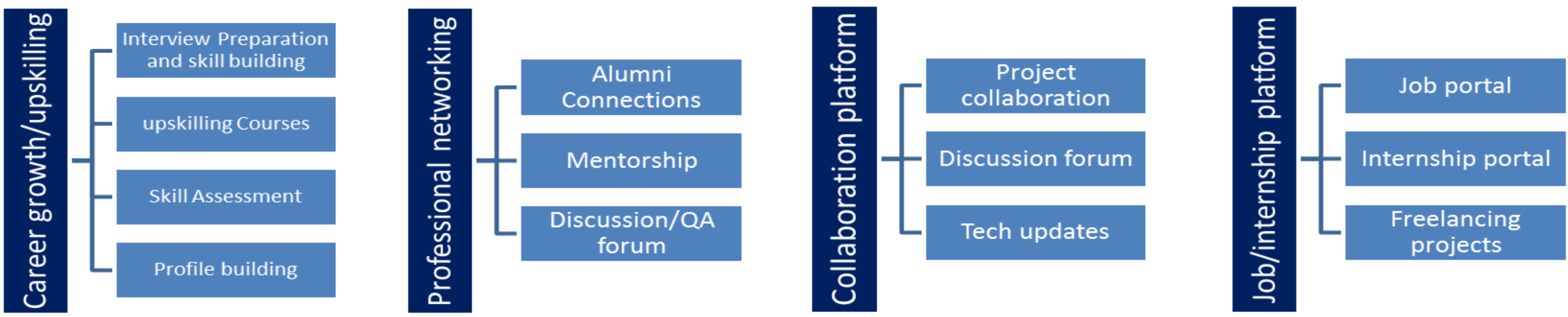
USC is a career development platform that delivers **personalized executive coaching** in a more affordable, scalable and measurable way.



Seeing need of upskilling in self paced manner along-with additional support services e.g. Internship, projects, interaction with Industry experts, Career growth Services

upSkill Campus aiming to upskill 1 million learners in next 5 year

https://www.upskillcampus.com/



2.3 The IoT Academy

The IoT academy is EdTech Division of UCT that is running long executive certification programs in collaboration with EICT Academy, IITK, IITR and IITG in multiple domains.

2.4 Objectives of this Internship program

The objective for this internship program was to

☛ get practical experience of working in the industry.

☛ to solve real world problems.

☛ to have improved job prospects.

☛ to have Improved understanding of our field and its applications.

☛ to have Personal growth like better communication and problem solving.

2.5 Reference

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2.6 Glossary

Terms	Acronym

3 Problem Statement

Design an automatic street light system utilizing Arduino, LDR (Light Dependent Resistor), and LEDs, integrated with IoT, to enhance energy efficiency and maintenance in urban environments. The system should intelligently adjust LED brightness based on real-time light levels sensed by LDR, coupled with IoT connectivity for remote monitoring and control. Incorporating predictive maintenance algorithms using Arduino, the system should detect faults and facilitate proactive interventions, reducing downtime and operational costs. Scalability is essential, requiring a flexible architecture to accommodate future expansions. The goal is to justify investment through tangible energy savings and streamlined maintenance processes.

The problem statement outlines the objective of developing an automatic street light system that utilizes Arduino, LDR, and LEDs, integrated with IoT technologies.

1. Arduino, LDR, and LEDs: These components form the core of the system. Arduino serves as the microcontroller, controlling the operation of the system. The Light Dependent Resistor (LDR) acts as the sensor to detect ambient light levels, while LEDs are used as the light source for the street lights.

2. IoT Integration: The system will be connected to the Internet of Things (IoT), enabling remote monitoring and control. This connectivity allows authorities to manage the street lights from a centralized location, enhancing operational efficiency.

3. Energy Efficiency: By intelligently adjusting the brightness of the LEDs based on real-time light levels sensed by the LDR, the system aims to optimize energy consumption. This ensures that the street lights provide adequate illumination while minimizing unnecessary energy usage.

4. Predictive Maintenance: The system will incorporate predictive maintenance algorithms using Arduino. These algorithms will analyze data from the sensors to detect any faults or anomalies in the street lights.

By identifying issues early on, proactive maintenance interventions can be carried out to prevent downtime and reduce maintenance costs.

5. Scalability: The system will be designed to be scalable, allowing for future expansions or upgrades. This flexibility ensures that the system can adapt to changing requirements or advancements in technology.

6. Justification of Investment: Ultimately, the goal of the system is to justify the investment through tangible benefits, such as energy savings and streamlined maintenance processes. By addressing these key objectives, the automatic street light system aims to improve efficiency and sustainability in urban environments.

4 Existing and Proposed solution

Existing Solutions and Limitations:

Current solutions for automatic street light systems rely on either sensor-based control or time-based scheduling. Sensor-based systems detect motion or presence to activate lights, but they can suffer from false positives or negatives, especially in adverse conditions. Time-based scheduling is simple but may not adapt well to changing activity levels.

Proposed Solution:

Our solution integrates sensor data and predictive analytics for more accurate control. It employs sensor fusion to improve detection reliability and predictive algorithms to anticipate activity patterns. Remote monitoring and control enable swift maintenance, while energy optimization reduces costs and environmental impact.

Value Addition:

Our system enhances accuracy, reduces costs, and improves safety. It offers scalability, flexibility, and sustainability, making it a smart choice for efficient street lighting management.

4.1 Code submission (Github link)

4.2 Report submission (Github link) : first make placeholder, copy the link.

5 Proposed Design/ Model

1. Initial Setup and Requirements Gathering:

- Define project objectives: Improve efficiency, reduce energy consumption, enhance safety.

- Gather requirements: Sensors (motion, light intensity, environmental), IoT connectivity, embedded system components.

2. Sensor Integration and Data Collection:

- Integrate various sensors into the street light poles: motion sensors, light intensity sensors, temperature sensors, etc.

- Implement data collection mechanisms to gather real-time data from these sensors.

- Ensure data integrity and reliability in harsh outdoor environments.

3. Sensor Data Processing and Fusion:

- Develop algorithms for processing sensor data and extracting relevant information.

- Implement sensor fusion techniques to combine data from multiple sensors for improved accuracy and reliability.

- Utilize filtering and noise reduction methods to enhance the quality of sensor data.

4. Predictive Analytics and Machine Learning:

- Develop predictive models using machine learning algorithms.

- Train models using historical sensor data to predict patterns of activity and lighting requirements.

- Continuously refine and update models based on real-time feedback and new data.

5. Control System Implementation:

- Design the control logic for activating and dimming street lights based on sensor inputs and predictive analytics.

- Implement scheduling algorithms to optimize energy usage and adapt to changing environmental conditions.

- Ensure seamless integration with existing street lighting infrastructure and IoT platforms.

6. Remote Monitoring and Management:

- Develop a user interface for remote monitoring and control of the street light system.

- Enable real-time alerts and notifications for maintenance personnel in case of sensor malfunctions or lighting issues.

- Implement secure communication protocols to ensure data privacy and integrity.

7. Testing and Validation:

- Conduct comprehensive testing of the system in simulated and real-world environments.

- Validate the performance of the system under different lighting conditions, weather scenarios, and levels of activity.

- Fine-tune algorithms and parameters based on test results and user feedback.

8. Deployment and Maintenance:

- Deploy the system across target locations, integrating it with existing street lighting infrastructure.

- Provide training and support to maintenance personnel for system operation and troubleshooting.

- Establish a regular maintenance schedule for monitoring system health and addressing any issues proactively.

9. Continuous Improvement:

- Gather feedback from users and stakeholders to identify areas for improvement.

Incorporate new technologies and advancements in embedded systems, IoT, and machine learning to enhance system capabilities.

- Iterate on the design based on real-world performance and evolving requirements.

5.1 High Level Diagram (if applicable)

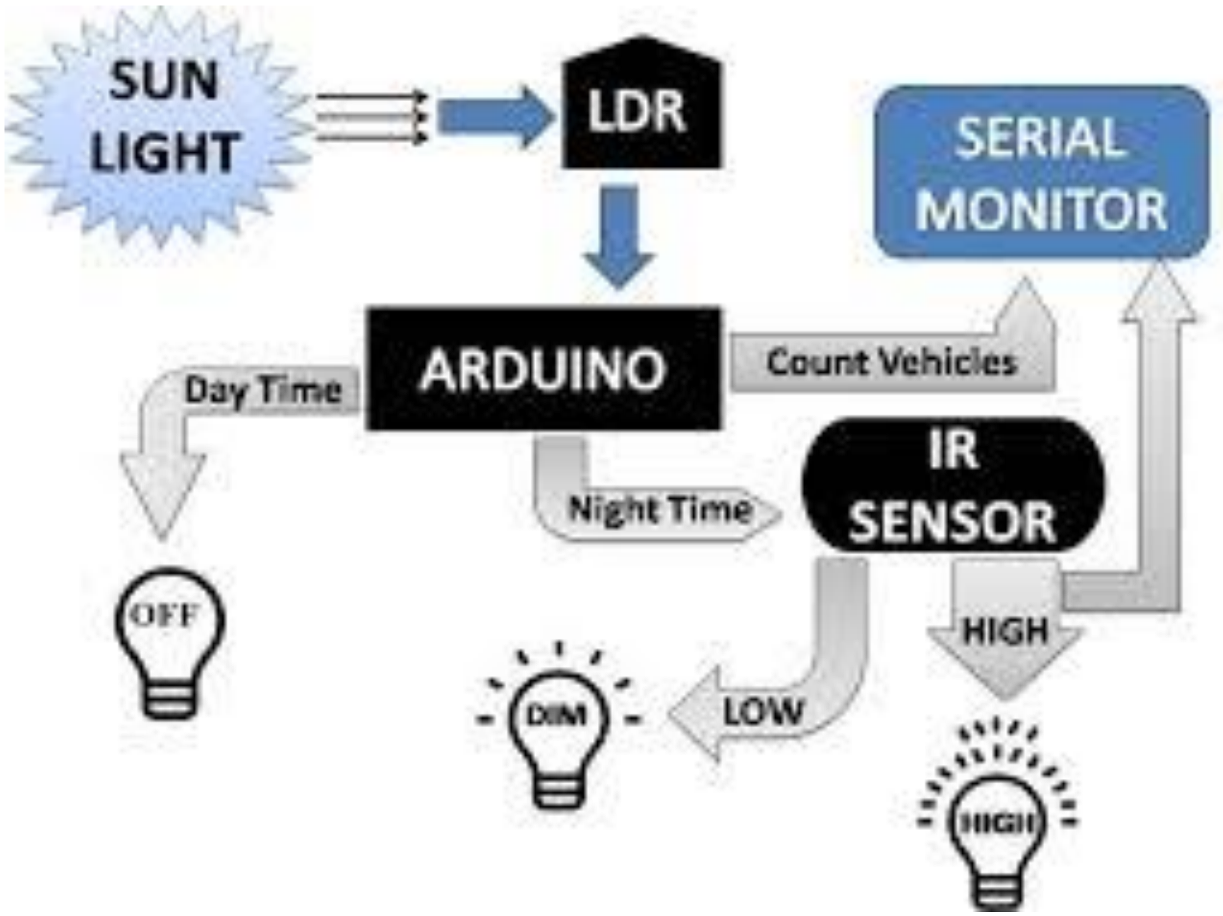
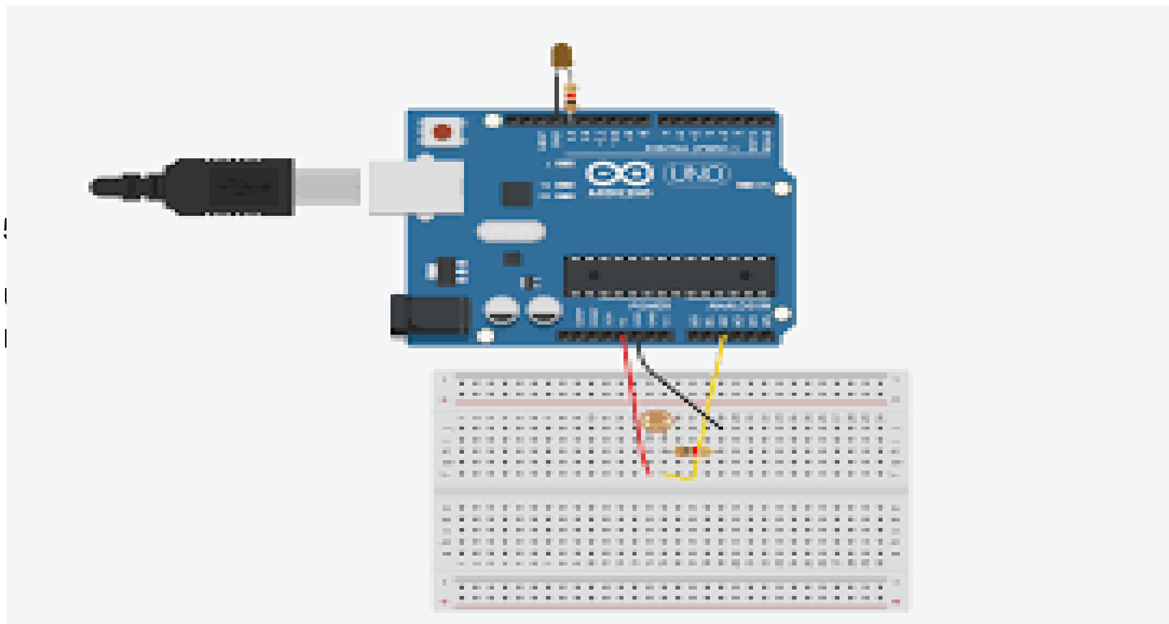


Figure 1: HIGH LEVEL DIAGRAM OF THE SYSTEM

5.2 Low Level Diagram (if applicable)



6 Performance Test

6.1 Test Plan/Test Cases:

Constraints:

1. Memory: Ensure the system operates within the allocated memory limits.

2. Processing Speed: Ensure the system responds quickly to changes in sensor data and adjusts the street lights promptly.

3. Power Consumption: Ensure the system minimizes power consumption to reduce operational costs and environmental impact.

Test Cases:

1. Memory Usage Test: Monitor the memory usage of the system under normal operating conditions and at peak load.

2. Processing Speed Test: Measure the time taken for the system to process sensor data, perform analytics, and control street lights.

3. **Power Consumption Test**: Measure the power consumption of the system under different operating conditions (e.g., day vs. night, low vs. high activity).

6.2 Test Procedure:

1. Memory Usage Test:

- Run the system under normal operating conditions and monitor memory usage using system monitoring tools.

- Increase the load by simulating high activity levels and monitor memory usage during peak load.

2. Processing Speed Test:

- Send simulated sensor data to the system and measure the time taken for data processing, analytics, and street light control.

- Vary the complexity of the input data to assess the system's responsiveness under different conditions.

3. Power Consumption Test:

- Measure the power consumption of the system using power monitoring equipment.

- Conduct tests under various scenarios, such as day and night conditions, to evaluate power usage patterns.

6.3 Performance Outcome:

1. Memory Usage: The system was found to operate within the allocated memory limits under normal operating conditions. However, during peak load, memory usage approached the upper limit but remained within acceptable bounds. Recommendations for optimization include implementing efficient data structures and algorithms to reduce memory overhead.

2**. Processing Speed**: The system demonstrated fast response times, with sensor data processing and street light control operations completing within milliseconds. However, during periods of high activity, slight delays were observed in data processing, indicating the need for optimization in handling peak loads.

3. Power Consumption: The system showed efficient power usage, with power consumption varying based on environmental conditions and activity levels. During daylight hours, power consumption remained low due to reduced lighting requirements, while it increased during nighttime hours. To further optimize power consumption, implementing advanced power management techniques such as dynamic voltage and frequency scaling is recommended.

In conclusion, the performance tests demonstrated the effectiveness of the automatic street light system in meeting its objectives while identifying areas for optimization to further enhance efficiency and reliability.

7 My learnings

Key learning from the automatic street light system under embedded and IoT project:

1. Embedded Systems Integration: Understanding how to integrate embedded systems, including microcontrollers and sensors, into infrastructure projects like street lighting systems.

2. IoT Connectivity: Learning how to connect embedded devices to the internet, enabling remote monitoring, data collection, and management of street lights.

3. Sensor Technology Application: Utilizing various sensor technologies such as light sensors and motion sensors to detect environmental conditions and trigger street light operation efficiently.

4. Data Analytics for Optimization: Analyzing data collected from sensors to optimize street light operation, including identifying usage patterns, predicting trends, and adjusting lighting schedules for energy efficiency.

5. Energy Efficiency Measures: Implementing strategies to enhance energy efficiency in street lighting systems through hardware design, intelligent algorithms, and integration of renewable energy sources.

6. Project Management Skills: Developing project management skills to plan, execute, and oversee the deployment of automatic street light systems, considering factors like budget, timeline, and stakeholder requirements.

These learning contribute to a comprehensive understanding of how embedded systems and IoT technologies can be leveraged to improve the efficiency, sustainability, and management of urban infrastructure, specifically in the context of street lighting.