Interim Report

Group 03

Chapter 01

Introduction.

1.1 Introduction

Number of cities that the streetlight is one of a huge expense. The cost of streetlight can spend another useful thing of the nation. Currently manual system is used to made manually switched On/off. The lights should be switch on the evening and should switch off the next day morning. Hence, there is a huge wastage of energy between on/off. This is the major problem that we are facing and because of that reason we are shifting to the automatic system, since there is less wastage of power and saving a lot monetarily expenses.

1.2 Definition of the problem.

The problem that a street light monitoring system aims to address is the inefficient and costly use of street lighting in urban areas. Many cities have outdated or inadequate street lighting systems that use energy inefficiently and do not provide adequate lighting for pedestrians and drivers. In addition, broken or malfunctioning street lights can pose safety risks and increase maintenance costs.

The lack of monitoring and control over street lighting can lead to unnecessary energy consumption, which not only results in higher energy bills for municipalities but also contributes to greenhouse gas emissions and environmental damage. Moreover, the traditional method of manual inspection for detecting malfunctioning or damaged street lights is time-consuming and labor-intensive.

1.3 Project objectives.

A street light monitoring system can solve above issues by providing real-time information on the energy consumption, brightness level, and maintenance needs of street lights. By analyzing data from sensors installed on each light, the system can automatically adjust the lighting levels according to the surrounding environment and reduce energy consumption. It can also detect when street lights are malfunctioning or have been damaged and alert maintenance crews to make repairs.

Overall, a street light monitoring system can improve the efficiency and effectiveness of urban street lighting while reducing costs and improving safety for pedestrians and drivers.

1.4 Scope of the project.

The scope of a street light monitoring system can vary depending on the specific needs and goals of the system, but generally it involves monitoring and managing street lights to improve their efficiency, reduce energy costs, and enhance public safety. Some potential components and features of a street light monitoring system could include:

Remote monitoring: The ability to monitor street lights from a central location, which could include information on whether a light is on or off, its energy usage, and any maintenance or repair needs.

Energy management: Tools for optimizing energy usage and reducing costs, such as adjusting brightness levels based on time of day or traffic flow.

Automated maintenance: Using data and analytics to predict when maintenance or repairs are needed, and automating the process of scheduling and dispatching crews to perform the work.

Environmental sensors: Incorporating sensors that can detect changes in weather or ambient light levels, and adjust street light brightness or color temperature accordingly.

Safety features: Integrating features like pedestrian and vehicle detection, emergency lighting, and other safety measures to enhance public safety.

Analytics and reporting: Collecting and analyzing data on energy usage, maintenance needs, and other factors to identify trends, optimize performance, and generate reports for stakeholders.

Overall, the scope of a street light monitoring system can be quite broad, encompassing everything from real-time monitoring and maintenance to long-term strategic planning for the efficient use of resources and enhancing public safety.

1.5 Chapter summary.

In this chapter we are discussing about current street light monitoring system is used to made manually and there is a wastage of energy ,green gas emission etc. Many cities have outdated street light systems because of that reason this system pose safety risk for pedestrians and drivers. This system can solve issues by providing real time information. Some potential components and features such as automated maintenance, safety features etc…long term strategic planning can efficient use of resources and enhancing public safety.

Chapter 02.

System Analysis.

2.1 Facts gathering techniques.

We have conducted some interviews with community members in Hanwalle area to reach out them through in-person meetings. Most of the people in the city facing a trouble to on/off the street lights manually and also do not provide adequate lightning for pedestrian and drivers.

Based on those interviews we analyzed the data we gathered and used them to inform the development and implementation of street light monitoring system.

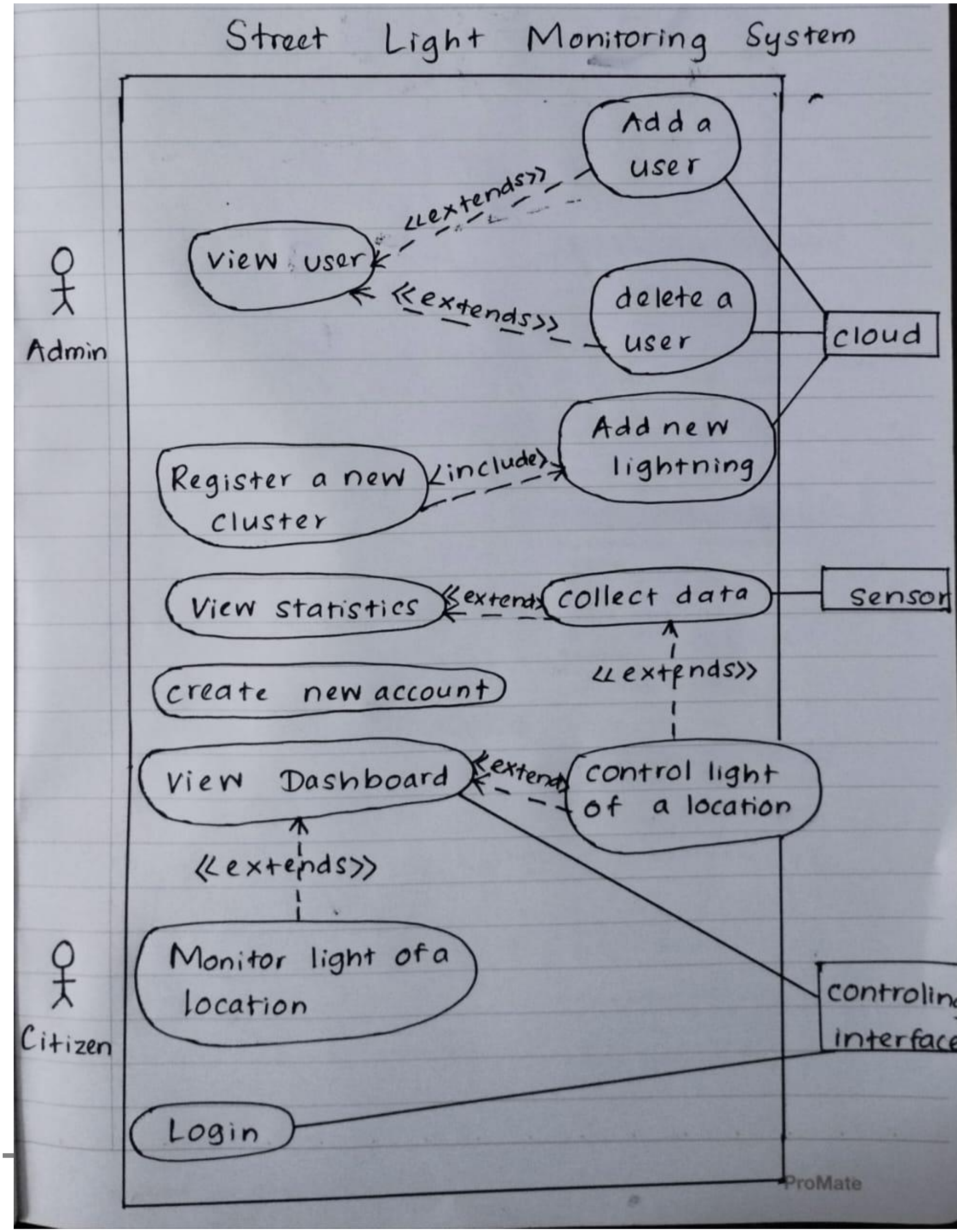
2.2 Current system.

The current system for monitoring street lights varies depending on the specific location and infrastructure. In general, street lights are often controlled by a centralized system that allows operators to remotely turn the lights on and off, adjust their brightness, and detect when a light has gone out or malfunctioned.

Some street light monitoring systems use sensors, such as photocells or motion detectors, to automatically turn lights on and off based on the level of ambient light or the presence of pedestrians or vehicles. Other systems may use timers or schedules to control the operation of the lights.

In terms of monitoring and maintenance, some street light systems rely on periodic inspections by maintenance crews or citizen reports of outages or problems. More advanced systems may use remote sensors to detect when a light has gone out, allowing maintenance crews to quickly respond and replace the bulb or repair the fixture.

2.3 Use case diagram.



2.4 Chapter summary.

In this system analysis chapter we have conducted some interviews with community members in hanwalle and gathered requirements from people and analyzed data that given by the people. This current system having so many issues because of that we planned current system it can control centralized system remotely. Use case diagram have two actors called admin and citizen. Based on the role they have specific roles .Cloud, sensor and controlling system are connect with use cases.

Chapter 03.

Requirement specification.

3.1 & 3.2 functional and non-functional requirements.

Functional requierements	Non-functional requierments
The system should be able to detect the status of street lights, whether they are on or off.	Reliability: The system must be highly reliable to ensure that it can detect and report any faults or failures accurately and quickly.
The system should be able to monitor the energy consumption of each street light.	Security: The system must be secure to prevent unauthorized access or tampering with the monitoring equipment.
The system should be able to provide real-time updates on the status of each street ligh	Scalability: The system must be able to scale up or down depending on the number of street lights being monitored.
The system should be able to generate reports on the energy consumption and maintenance of street lights.	Availability: The system must be available 24/7 to ensure that any faults or failures can be detected and reported in a timely manner.
The system should be able to control the street lights remotely.	Performance: The system must be able to process and analyze data in real-time to ensure that any issues can be detected and reported quickly
The system should be able to send alerts to maintenance personnel if a street light is not functioning properly.	User Interface: The system must have an easy-to-use and intuitive user interface to allow for easy monitoring and management of the street lights.
The system should be able to integrate with other systems such as traffic monitoring	Maintainability: The system must be designed for easy maintenance and troubleshooting, with

systems.	clear documentation and support resources available.
-	Integration: The system must be designed to integrate with other systems, such as the local power grid or other monitoring systems, to provide a comprehensive view of street light performance.
-	Compatibility: The system must be compatible with a range of different street light models and types, to ensure that it can be used in a variety of locations.
-	Power Efficiency: The system should be designed to minimize power consumption to avoid adding to the energy burden of the street light system.

3.3 Performance requirement.

A street light monitoring system is designed to monitor and control the street lights in a given area. The performance requirements for such a system may vary based on the specific needs of the users and the environment in which the system will operate. However, some general performance requirements for a street light monitoring system might include:

Real-time monitoring: The system should be capable of monitoring the status of all street lights in real-time. This will help in identifying faulty lights, detecting power outages, and scheduling maintenance.

Remote control: The system should allow remote control of street lights, allowing the user to turn on, off or dim street lights from a central location. This feature will help in reducing energy consumption and maintenance costs.

Energy efficiency: The system should be designed to optimize energy usage, by automatically dimming or turning off lights when they are not required, and turning them back on when needed.

Scalability: The system should be designed to accommodate new street lights as they are installed, without requiring major changes to the existing infrastructure.

Data analysis: The system should be capable of generating reports and analysis on energy consumption, maintenance costs, and other parameters. This will help in identifying areas where improvements can be made.

Fault detection and notification: The system should be capable of detecting faults and notifying maintenance personnel, so that repairs can be carried out quickly.

Security: The system should be designed to be secure and tamper-proof, so that unauthorized access to the system can be prevented.

Compatibility: The system should be compatible with different types of street lights, so that it can be used in different locations with different lighting infrastructure.

These are just some of the performance requirements that might be considered for a street light monitoring system. The specific requirements will depend on the needs of the users and the environment in which the system will operate.

3.4 Security requirements.

A street light monitoring system should have several security requirements to ensure the protection of sensitive data and prevent unauthorized access. Here are some of the key security requirements for a street light monitoring system:

Access control: The system should have a robust access control mechanism to prevent unauthorized access. The access control mechanism should include secure login credentials and multi-factor authentication.

Encryption: The system should use encryption to protect data in transit and at rest. All communication between the system components and the backend server should be encrypted using secure protocols such as TLS.

Authentication and authorization: The system should use authentication and authorization mechanisms to ensure that only authorized personnel can access and modify the system settings and data.

Secure communication: The system should use secure communication protocols to ensure that data transmitted between the street lights and the backend server is secure.

Secure storage: The system should store all data securely, using encryption and secure storage mechanisms to prevent unauthorized access.

Auditing: The system should have an auditing mechanism to monitor and record all system activities, including user access, data modification, and system events.

Disaster recovery: The system should have a disaster recovery plan in place to ensure that data can be recovered in case of a system failure or data loss.

Regular updates: The system should be regularly updated with security patches and software updates to ensure that it remains secure against emerging threats.

Overall, a robust street light monitoring system should have a comprehensive security plan to protect sensitive data and ensure the system's security and reliability.

3.5 Hardware requirements.

A street light monitoring system typically consists of hardware components such as sensors, communication devices, and a central processing unit. The specific hardware requirements may vary depending on the design of the system and the specific features desired, but here are some general considerations:

Sensors: Street light monitoring systems typically use sensors to detect the presence of vehicles or pedestrians, ambient light levels, and other environmental conditions. The type of sensor needed will depend on the specific requirements of the system. For example, a motion sensor may be used to detect the presence of vehicles or pedestrians, while a light sensor may be used to measure ambient light levels.

Communication devices: To transmit data from the sensors to the central processing unit, the street light monitoring system will require some form of communication device, such as a wireless transceiver or Ethernet connection. The communication device should be able to transmit data reliably over long distances and in various weather conditions.

Central processing unit: The central processing unit is the brain of the street light monitoring system. It receives data from the sensors and analyzes it to determine whether the street lights need to be turned on or off, and if so, at what brightness level. The central processing unit should be powerful enough to handle the processing requirements of the system and should be designed to handle large amounts of data.

Power supply: The street light monitoring system will require a stable and reliable power supply to operate. Depending on the specific design of the system, this may include a battery backup system to ensure that the system continues to operate even in the event of a power outage.

Enclosure: The hardware components of the street light monitoring system should be housed in a weather-resistant enclosure to protect them from the elements.

3.6 Networking requirements.

A street light monitoring system typically consists of a network of sensors, controllers, and other devices that communicate with each other to monitor and control street lights. To support this system, the following networking requirements should be considered:

Connectivity: The system requires a reliable and robust network that can connect all the devices in the system. The network can be wired or wireless, depending on the deployment scenario and the distance between the devices.

Bandwidth: The network should have enough bandwidth to handle the data generated by the sensors and controllers. The amount of data depends on the number of devices in the system and the frequency at which they report data.

Latency: The network should have low latency to enable real-time monitoring and control of the street lights. High latency can result in delayed responses, which can affect the efficiency and effectiveness of the system.

Security: The network should be secure to prevent unauthorized access and protect the data transmitted over the network. This can be achieved through encryption, authentication, and access control.

Scalability: The network should be scalable to support future expansion of the system. The network should be designed to handle additional devices and data without compromising performance.

Reliability: The network should be reliable to ensure that the system is always available and operational. The network should have redundancy and failover mechanisms to ensure continuity of operations in case of network failures.

3.7 Chapter summary.

Functional requirements defines the what the product must do and the features of street light monitoring system .Non-functional requirements describes about general functions .Performance requirements can monitor real time monitoring ,remote control, scalability etc. Security requirements ensure the protection of sensitive data and prevent unauthorized access. Hardware components are depend on the design of the system and networking requirements are typically consist of communication with each other monitor and control street light.

Chapter 04.

Feasibility study.

4.1 Economic feasibility.

A street light monitoring system can have several economic benefits, both in terms of cost savings and revenue generation.

Cost savings: A street light monitoring system can help to reduce energy consumption and maintenance costs. By using sensors and controls, the system can detect when the lights are not needed and adjust the brightness or turn them off, resulting in significant energy savings. This can also reduce maintenance costs by identifying faulty or malfunctioning lights before they become a major issue.

Revenue generation: A street light monitoring system can also generate revenue by providing data to other entities. For example, data on traffic flow or pedestrian movement can be sold to local authorities or businesses, which can use it to inform planning decisions and improve the efficiency of operations.

Improved safety: A street light monitoring system can also improve safety by providing better lighting, which can reduce crime rates and improve pedestrian and driver visibility. This can have economic benefits by reducing the cost of crime and accidents.

Enhanced quality of life: A street light monitoring system can also enhance the quality of life for residents by providing better lighting in public areas. This can make streets and sidewalks more inviting and encourage people to spend more time outdoors, which can have economic benefits for local businesses.

While the initial cost of installing a street light monitoring system may be high, the long-term cost savings and revenue generation potential make it an economically feasible solution. However, it is important to conduct a cost-benefit analysis to determine the potential return on investment for a specific location and ensure that the system is designed and implemented in a way that maximizes its economic benefits.

4.2 Operational feasibility.

A street light monitoring system can be considered operationally feasible if it can be implemented and maintained in a way that is practical, cost-effective, and efficient.

Here are some factors that can affect the operational feasibility of a street light monitoring system:

Availability of technology: The technology used in the street light monitoring system must be available and accessible to be deployed on a large scale. It must also be scalable to accommodate a large number of street lights.

Infrastructure: The infrastructure required to support the street light monitoring system, such as network connectivity and power supply, must be in place and reliable.

Cost: The cost of implementing and maintaining the street light monitoring system should be affordable and justifiable in terms of the benefits it provides.

Maintenance: The street light monitoring system must be easy to maintain, and any issues that arise must be able to be resolved in a timely and cost-effective manner.

User acceptance: The street light monitoring system must be user-friendly and easily understandable by the stakeholders who will be using it, including municipal authorities, maintenance personnel, and residents.

Integration with existing systems: The street light monitoring system should be able to integrate with existing municipal systems such as GIS, asset management, and maintenance systems.

4.3 Technical feasibility.

A street light monitoring system is technically feasible, and several approaches can be used to implement such a system. Here are some key components and considerations for a street light monitoring system:

Hardware: The system would require hardware such as sensors, cameras, and communication equipment. Sensors can be used to detect ambient light levels, motion, and other environmental factors, while cameras can be used to capture images or video footage of the area.

Connectivity: The system would need to be connected to a network in order to transmit data and receive commands. This could be achieved through a wired or wireless connection, such as Wi-Fi or cellular data.

Data processing: The system would need to process the data collected by the sensors and cameras, and analyze it to determine whether a light needs to be turned on or off. This could be achieved through a combination of software and artificial intelligence (AI) algorithms.

Control system: The system would need to have a control mechanism in place to turn the lights on or off based on the data collected and analyzed. This could be achieved through a centralized control system or through local control systems at each individual light pole.

Power supply: The system would require a reliable power supply to keep the lights on and the sensors and cameras running. This could be achieved through a combination of grid power and renewable energy sources, such as solar panels.

4.4 Organizational feasibility.

To assess the organizational feasibility of a street light monitoring system, the following factors should be considered:

Management Support: The success of the system depends on management support. Management should be willing to invest time, money, and resources into the development, implementation, and maintenance of the system.

Budget: Adequate funding must be allocated to develop and maintain the system. The budget must cover the cost of hardware, software, maintenance, and personnel.

Personnel: The system will require a dedicated team to manage, maintain, and troubleshoot it. This team should be adequately trained and have the necessary skills and knowledge to manage the system.

Infrastructure: The system will require an appropriate infrastructure to support it. This includes servers, storage, and networking equipment. The infrastructure must be reliable, scalable, and secure.

Stakeholder Involvement: The stakeholders, including the municipality, residents, and businesses, must be involved in the development and implementation of the system. This will help to ensure that the system meets the needs of all stakeholders and is accepted by the community.

Legal and Regulatory Requirements: The system must comply with all legal and regulatory requirements, including data privacy and security laws.

Integration with Existing Systems: The system must be integrated with existing systems and processes within the municipality. This will help to ensure that the system is adopted and used effectively.

4.5 Outline budget.

Hardware components.

- Arduino UNO WI-FI Rs.2800.00
- 3 lights of LED Rs.18.00
- LDR Rs.180.00
- Diligent IR proximity sensor Rs.880.00
- Espressif ESP8266 ESP-12E Rs.400.00
- 3 Registers 1k ohm Rs.750.00
- Breadboard 170pin Rs.115.00

Total =Rs.5143.00

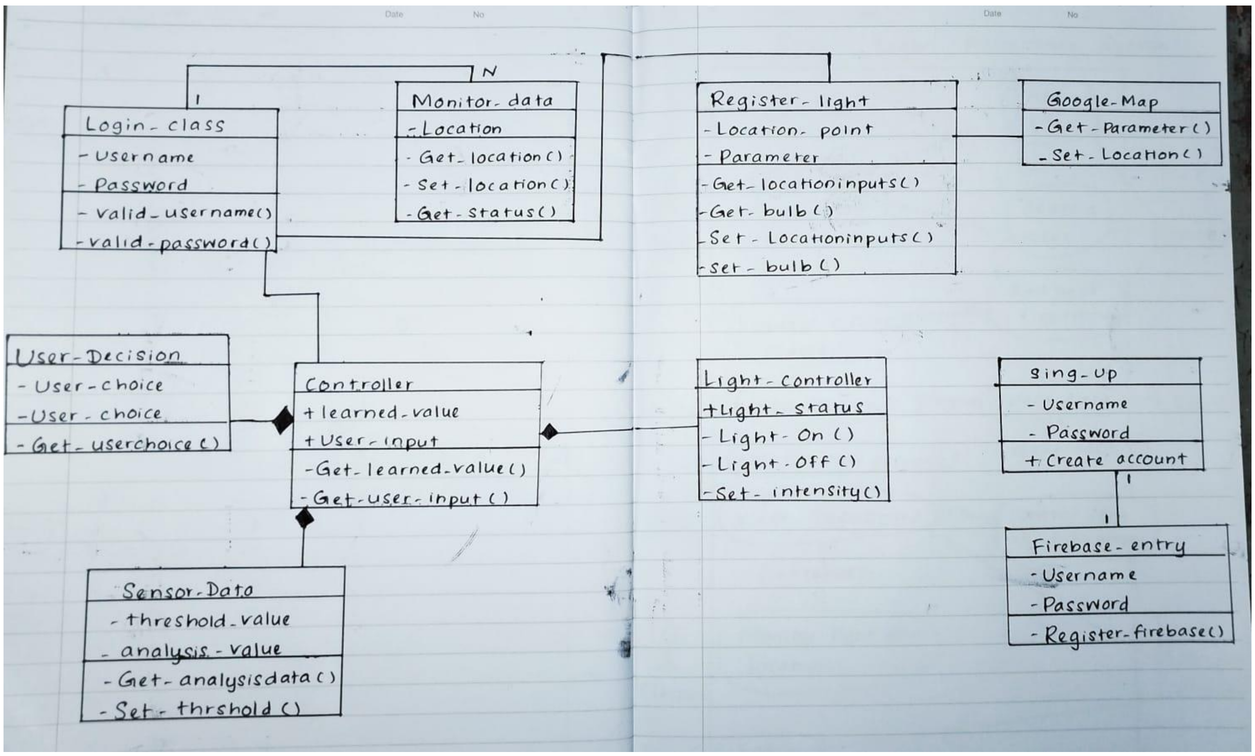
4.6 Chapter summary.

In this chapter we discuss about economic benefits of the system. Such as energy consumptions, revenue generation etc. Operational feasibility describes about infrastructure and how to handle cost effectively. In technical feasibility describes hardware, connectivity, data processing, power supply etc. Budget, stakeholder involment etc. .We estimated outline budget as Rs.5143.00.

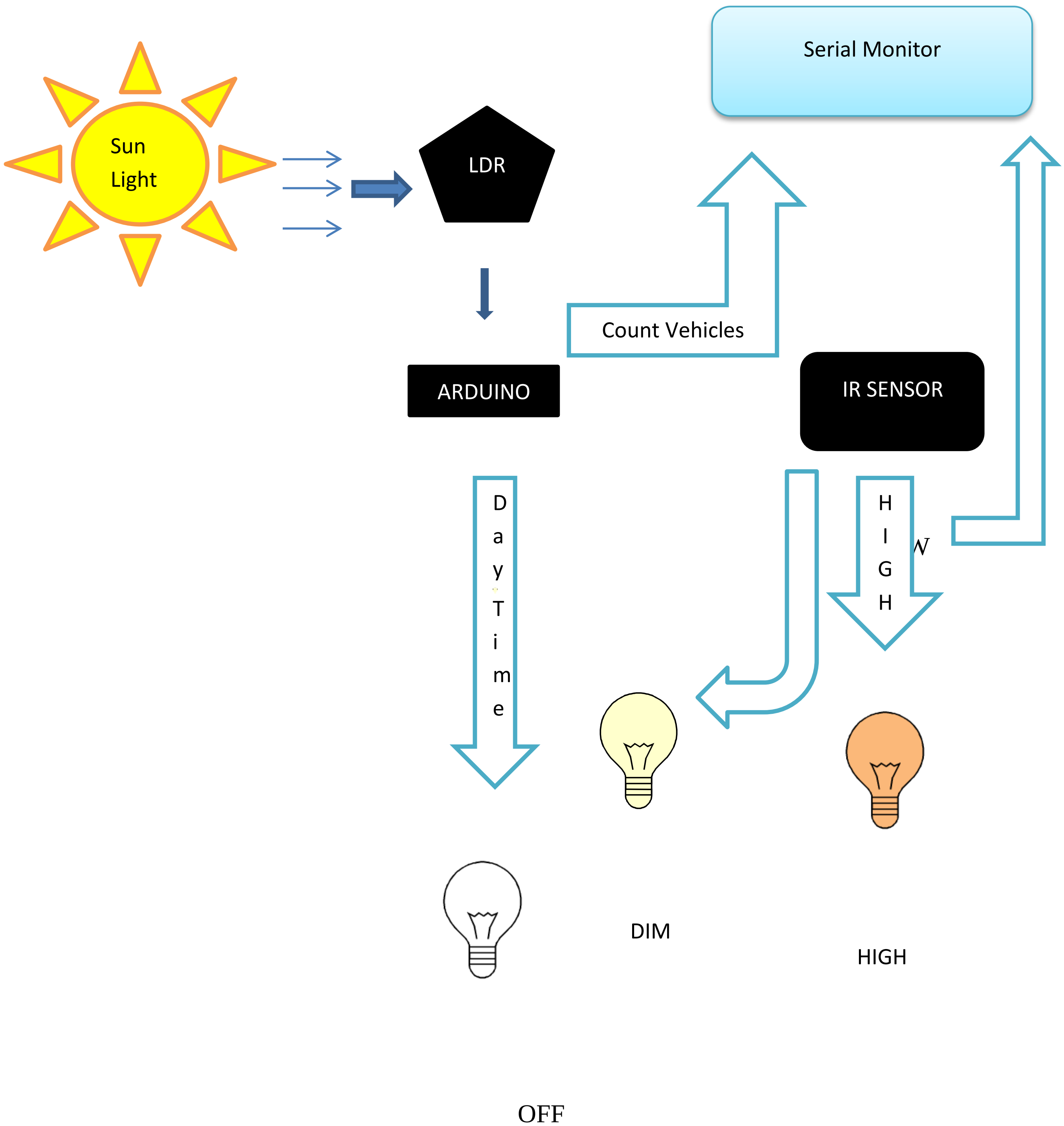
Chapter 05.

System architecture.

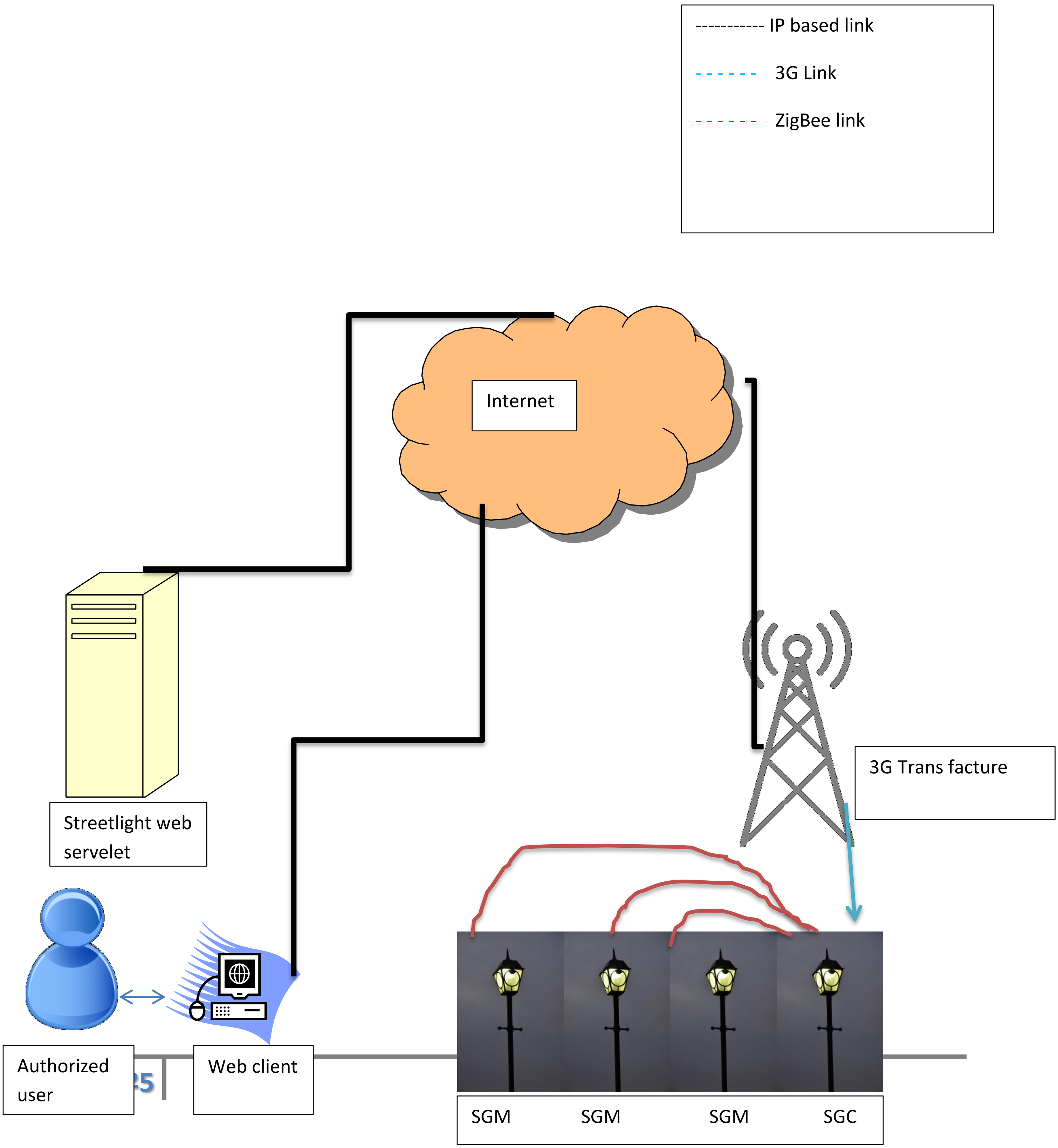
5.1 Class diagram.



5.2 High level architecture diagram.



5.3 Network diagram.



Chapter 6

Development tools & techniques

6.1 Development methodologies.

The development of a street light monitoring system can be carried out using various software development methodologies. Some of the commonly used methodologies are:

Waterfall Model: This is a linear sequential model, where each phase must be completed before the next phase can begin. The phases include requirements gathering, design, implementation, testing, and maintenance. The Waterfall Model is a good fit for projects with well-defined requirements and a fixed scope.

Agile Methodology: This is an iterative approach that focuses on delivering small, incremental releases of the software. Agile Methodology is a good fit for projects where the requirements are not well-defined, and the scope can change frequently. It involves continuous feedback from stakeholders, collaborative teamwork, and constant testing.

Scrum: This is a subset of Agile Methodology and is a popular framework for managing and completing complex projects. It involves a cross-functional team, including a product owner, a scrum master, and development team members who work in short iterations called sprints. Scrum emphasizes collaboration, flexibility, and continuous improvement.

Rapid Application Development (RAD): This methodology focuses on rapid prototyping and iterative development. It involves building a prototype quickly and testing it with users to gather feedback, which is then used to refine the product. RAD is a good fit for projects where speed and time-to-market are critical.

Prototype Model: This methodology involves building a working prototype of the software before development. The prototype is used to test and validate the design and requirements before proceeding with full-scale development.

6.2 Programming languages & tools.

- JavaScript: JavaScript is a widely-used programming language that is ideal for developing interactive web applications. It can be used for both front-end and back-end development, making it a good choice for a monitoring system that includes a web interface.
- C: C is a low-level programming language that commonly used for embedded systems. They are
  ideal for programming the firmware that controls the street light hardware.

6.3 Third party components & libraries.

Internet of Things (IoT) Platforms: There are many IoT platforms that can be used to connect and manage devices in a street light monitoring system, Microsoft Azure IoT, and Google Cloud IoT we planned to use in this system.

Data Visualization Libraries: To display the street light data, data visualization libraries such as D3.js, Chart.js, and chart.js can be used to create interactive and informative visualizations.

Real-Time Database: Real-time databases such as Firebase Real time Database can be used to store and manage data from the street lights, enabling real-time data analysis and alerting.

6.4 Algorithms.

Data structures for storing sensor data:

a. Queue: A queue can be used to store sensor data from each street light. As new data comes in, it can be added to the end of the queue, and old data can be removed from the front.

Algorithms for controlling the street lights:

a) Greedy algorithm: The system can use a greedy algorithm to turn on/off the street lights, based on the sensor data. For example, if the system detects that there is no traffic on a particular street, it can turn off the lights to save energy.

Data structures for storing control information:

a) Binary tree: A binary tree can be used to store the on/off schedule of the street lights, with each node representing a time interval and its children representing the on/off status of the lights.

6.5 Chapter summary.

This chapter we are discussing about waterfall method, agile method and scrum as development methods of the system.C,javascript as programming languages. Microsoft azure and Google cloud as platforms and data visualization libraries such as D3.js, chart.js etc. We planned to use Queue as a data structure and greedy algorithm and also binary tree as a data structure.