Air Quality Monitoring and Analysis Based Predictive System

R24-078

Project Proposal Report

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B.Sc. (Hons) Degree in Information Technology specialized in Software Engineering.

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DECLARATION

We declare that this is our own work, and this proposal does not incorporate without acknowledgement any material previously submitted for a degree or diploma in any other university or Institute of higher learning and to the best of our knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

Group Member Name	Student ID	Signature
Pasan M.G.R	IT21057588	

Signature of the Supervisor
(Ms.Chathurangika kahandawaarachchi)

Date

29/02/2024

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ABSTRACT

A system can show the best way to travel without exposure to polluted air. A new algorithm is designed by combining Dijkstra's algorithm and dynamic mapping process to suggest the best method. The algorithm takes the nearest nonpolluted point for the given start as the starting point and Gas concentration (PPM) Description Interpretation Color Code 0-1000 Air pollution is little or no risk. Good Green 1001- 49999 Everyone may begin to affect health effects. Unhealthy Red 50000- 150000 Methane would explode and cause deaths to everyone around the area. Potentially explosive Dark red Over 500000 Methane would displace oxygen in confined areas, resulting in an oxygen deficient atmosphere and displace of oxygen in the blood. Hazardous Maroon Gas concentration (PPM) Description Interpretation Color Code 0-50 Air pollution is little or no risk. Good Green 51-70 Air quality is acceptable, but some people who are very sensitive to air pollution can be affected. Moderate Yellow 71-150 Everyone may begin to affect health effects. Unhealthy Red 151- 500 Everyone may be affected by serious health effects. Hazardous Maroon Authorized licensed use limited to: SLIIT - Sri Lanka Institute of Information Technology. Downloaded on January 27,2024 at 09:05:26 UTC from IEEE Xplore. Restrictions apply. 408 the nearest non-polluted point for the given destination as the endpoint for real-life applications. Finally, the suggested points for the route are sent to the Mobile application to display it on the map. When displaying the best route on the map, the red marker indicates the starting point, and the blue marker indicates the endpoint of a route. Furthermore, the green marker displays the non-polluted points within the route.

Keywords: Dijkstra’s algorithm,Hazardous Maroon Gas concentration

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LIST OF ABBREVIATIONS

API	Application Program Interface
SDLC	Software Development life Cycle
DB	Database
IT	Information Technology
IoT	Internet of thing

1. INTRODUCTION

1.1 Background Literature

The development of a real-time route generation system utilizing technology is crucial in aiding individuals to navigate efficiently through roads with minimal pollution. In the bustling Colombo district of Sri Lanka, rapid urbanization has led to environmental air pollution, impacting health negatively. By guiding travelers through routes that reduce air pollution, the adverse effects can be minimized. The goal is to create a system that directs travelers to cleaner routes based on air quality data and distance.

In order for the system to function, real-time air quality reports from 11 cities in the Colombo district are analyzed. The algorithm determines nodes that indicate regions with acceptable air quality levels by identifying the least polluted cities. For instance, the system dynamically constructs a map by eliminating Nodes1, Node3, and Node10 from consideration if they are deemed corrupt.

The system uses a new method that combines the dynamic mapping process with Dijkstra's algorithm to recommend best routes. The start and finish places of the trip are determined by this algorithm by looking for the closest uncontaminated spots. The algorithm makes sure that visitors are diverted away from areas with higher pollution levels by giving priority to clean-air towns, improving both the sustainability of the environment and the general well-being of travelers.

The suggested paths are easily incorporated into a mobile application interface in real-world applications. These routes are simple to access and see on a map, giving travelers the ability to plan their travels with knowledge in real time. The proactive approach to urban mobility that this integration of technology and environmental data reflects prioritizes the health of people and the environment.

All things considered, the Colombo district's use of real-time route development based on pollution levels shows the promise of technology-based solutions to urgent environmental problems. The method facilitates sustainable urban growth and fosters healthy communities in Sri Lanka and other countries by directing tourists along clean paths.

1.2 Research Gap

Application reference	Identification of Route map	Progression level detection		Mobile Application
		Identifying Polluted Route	Alter route with real time pollution data	
Research A	✓	✓	✗	✗
Research B	✓	✗	✗	✗
Research C	✓	✗	✓	✗
Proposed System	✓	✓	✓	✓

Research A:This paper proposes an integrated framework for reducing the number of congested traffic intersections in an urban setting. With the developed framework, the minimum pollution exposure to passengers in the trade-off of marginal increase in travel distance is investigated. Google map is used for route identification and polluted routes are identified by Dijkstra algorithm. Alter route with real time pollution data is not discussed.

Research B: This paper is a survey of air pollution monitoring system based on WSN with different homogeneous and heterogeneous protocols. It is easy to explain the comparative metrics of air pollution monitoring system to existing energy efficient routing protocols. Here the route analysis is indicated by the maps and the Polluted Route is not described. Alter route with real time pollution data. Not related. How to make a system is also not described.

Research C: In this paper, we focus on quiet route discovery and develop a new approach to design routes for pedestrians in traffic noise polluted environments, based on noise estimation. Here the road analysis is shown by maps and the polluted roads are described. Change course with real-time pollution data. Not applicable. How to build a system is also not explained.

1.3 Research Problem

The passage highlights the significant issue of air pollution, particularly in Sri Lanka, where it poses a severe threat to public health. Various pollutants, including Particulate Matter (PM), Carbon Dioxide (CO_2), Carbon Monoxide (CO), Ground-level Ozone (O_3), Nitrogen Oxides (NO_x), Sulfur Oxides (SO_x), and Lead (Pb), are identified as major contributors to air pollution, stemming mainly from motor vehicles, fuel burning, and industrial activities.

The detrimental health effects of air pollution, such as respiratory infections, asthma, and even lung cancer, are well-documented, with a significant number of deaths attributed to air pollution each year. School children, due to their vulnerability and exposure to high levels of pollutants, are particularly at risk, especially in urban areas like Colombo and Kandy.

Recognizing the urgency of the situation, the passage proposes an innovative solution—a real-time air quality monitoring and analysis system. This system aims to monitor ambient air quality, provide optimal routes with minimal pollution levels, generate heatmaps for easy identification of air quality in specific areas, and predict future air quality trends.

The prototype of this system utilizes gas sensors, an Arduino Uno board, and a Wi-Fi module deployed in open spaces between smart buildings. These sensors collect real-time air quality data, which is then transmitted to an information processing center using IoT technology. The data is stored in a database and used by the front-end system to generate real-time maps indicating air quality levels and predict less polluted routes.

In essence, this proposed system represents a proactive approach to addressing the air pollution crisis in Sri Lanka by leveraging IoT technology and predictive analytics to monitor, analyze, and mitigate the adverse effects of air pollution on public health and well-being.

The following research question was identified related to real-time route generation based on pollution

- How data service for accessing and processing road network information.
- How is polluted route identified.

- How is the Pollution Level Considered in the Route Map.

2 OBJECTIVES

2.1Main Objectives

The main Objective of the component is to Provide users with the most optimal routes to their destination.

2.2 Specific Objective

- Identification of Polluted Route Areas

Graph algorithms and machine learning techniques are used to analyze and interpret large pollution data. These techniques help identify patterns, correlations and anomalies in air quality measurements, facilitating the identification of polluted road areas.

- Writing algorithm to calculate the near distance level low polluted route

To calculate the approximate distance level of a less polluted route, an algorithm can be developed that evaluates the pollution levels along various candidate routes and selects the route with the least pollution level within a specified distance.

- Finding best route with low pollution level

Dijkstra's algorithm can be modified to consider both distance and pollution level as route selection criteria to find the best route with low pollution level.

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3.METHODOLOGY

3.1 System Architecture Diagram

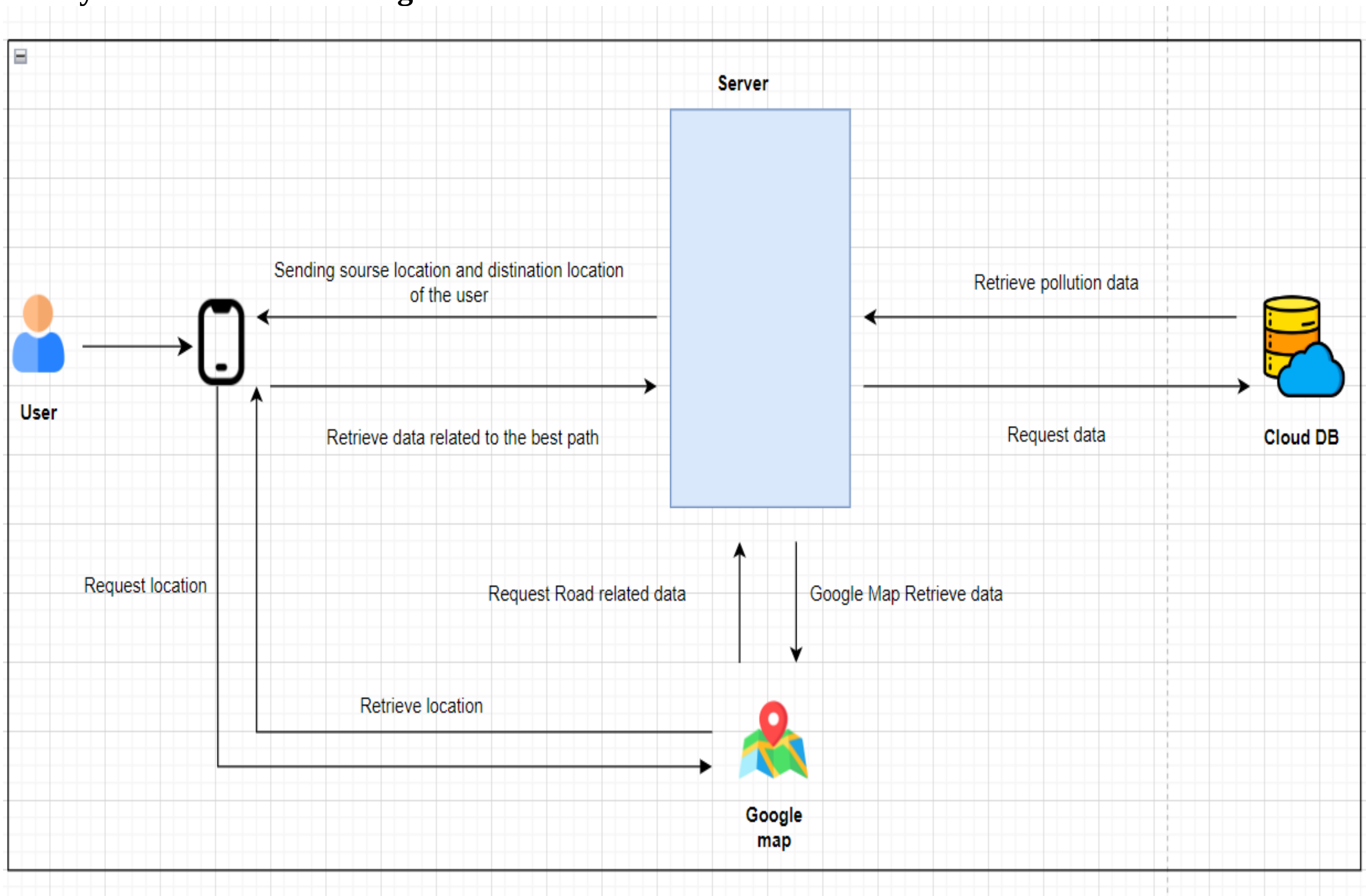

Figure 3.1: System Architecture Diagram

First the user's mobile application retrieve the location of the client and view the map interface in the mobile application. Then the user chooses the destination location. These data are passed to the server through an Api to be processed. After data related to source and destination location are submitted to the server, the server retrieves air pollution data related to the related area (which the source and destination location are covered). After the data is received, the server processes the data to find the path that has the minimal pollution and shortest at the same time. And finally the data related to the chosen path is sent to the client's mobile application. Then the mobile application renders the particular path in the map interface.

3.2 Project Requirements

3.2.1Functional Requirements and Non-Functional Requirements

Table 3. 1: Functional and Non-functional requirements

Functional Requirements	**Non-Functional Requirements**
Collecting polluted air data from the emission standard publication websites and Preprocessing, Cleaning, Transforming.	Interfaces should be User-friendly
Feature Selection and Analysis	Should properly work for android and IOS devices
Model Development Implement machine learning algorithms for pollution level prediction. Explore and select the most suitable predictive model based on performance metrics.	Application should be reliable.
Dynamic Predictions for Real-time Adjustments.	Higher accuracy of results
Real-time Pollution Data and Comparison and Visualization	Results should be more efficient.

3.2.2 System Requirements

- Software requirements
  - Python
  - Node JS
  - Jupyter Notebook
  - Intellij Idea
  - Visual Studio Code

3.3 Software Solution

The Software Development Life Cycle (SDLC) is a process or a plan with details for designing, developing, and testing high-quality software. However, the agile software development approach is one of the most simplistic and successful methods for delivering a high-quality product. Scrum is the most popular lightweight, an agile framework that assists individuals, groups, and organizations.

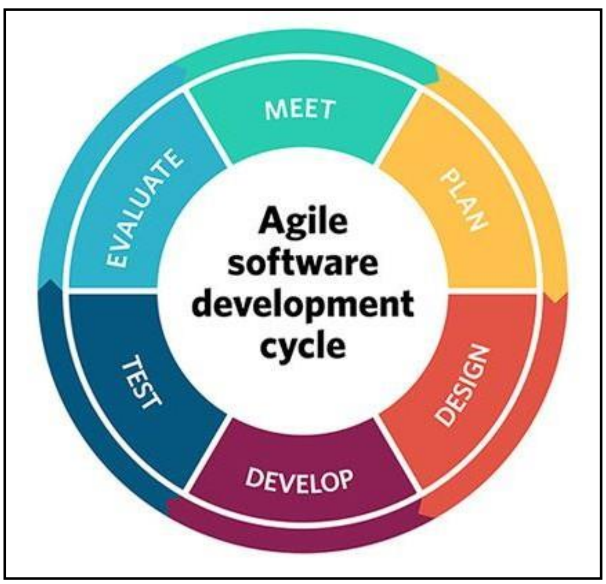

Figure 3. 2: Agile Software Development Cycle

3.3.1 Use Case Diagram

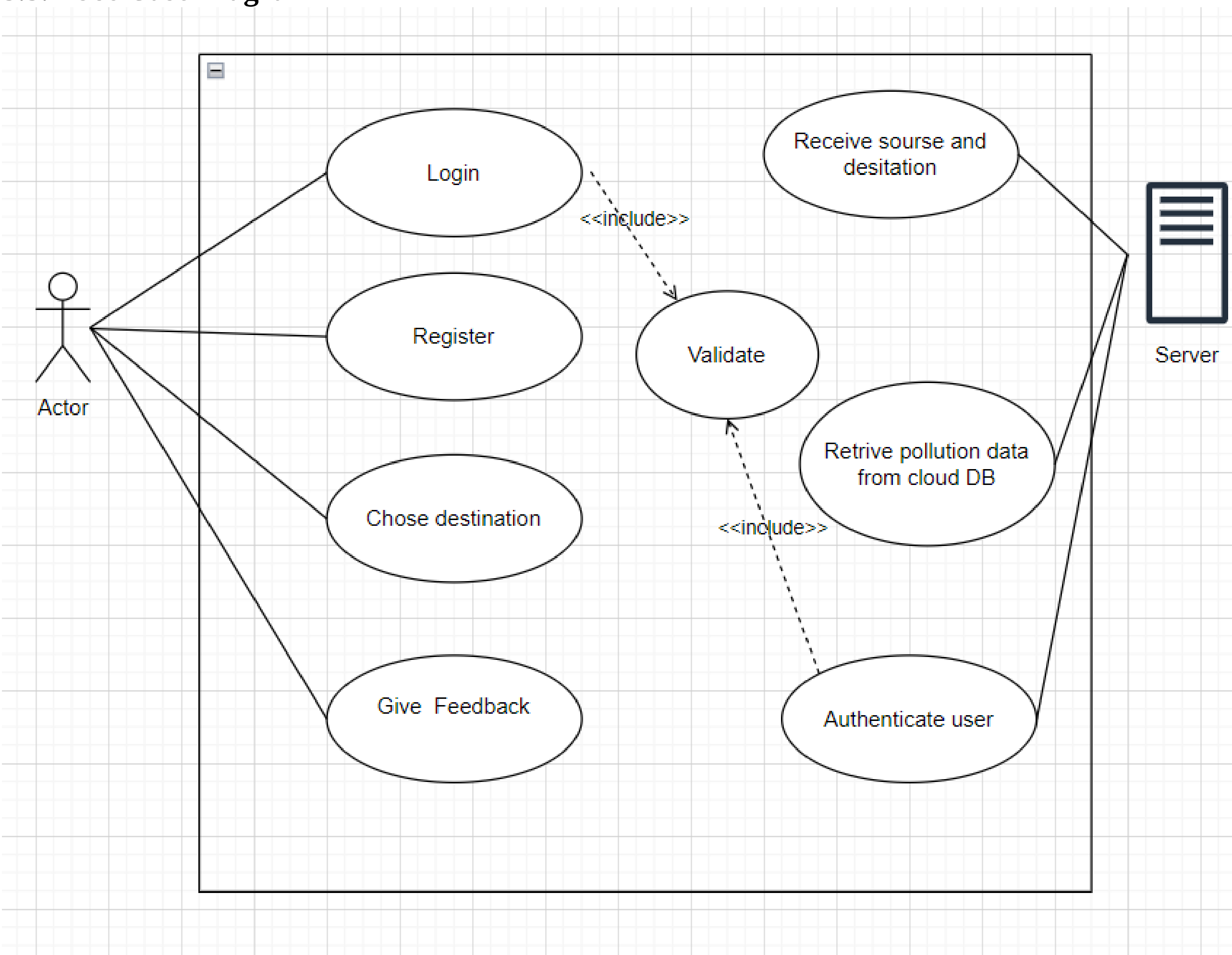

Figure 3. 3: Use Case Diagram for proposed component

3.3.2Work breakdown chart

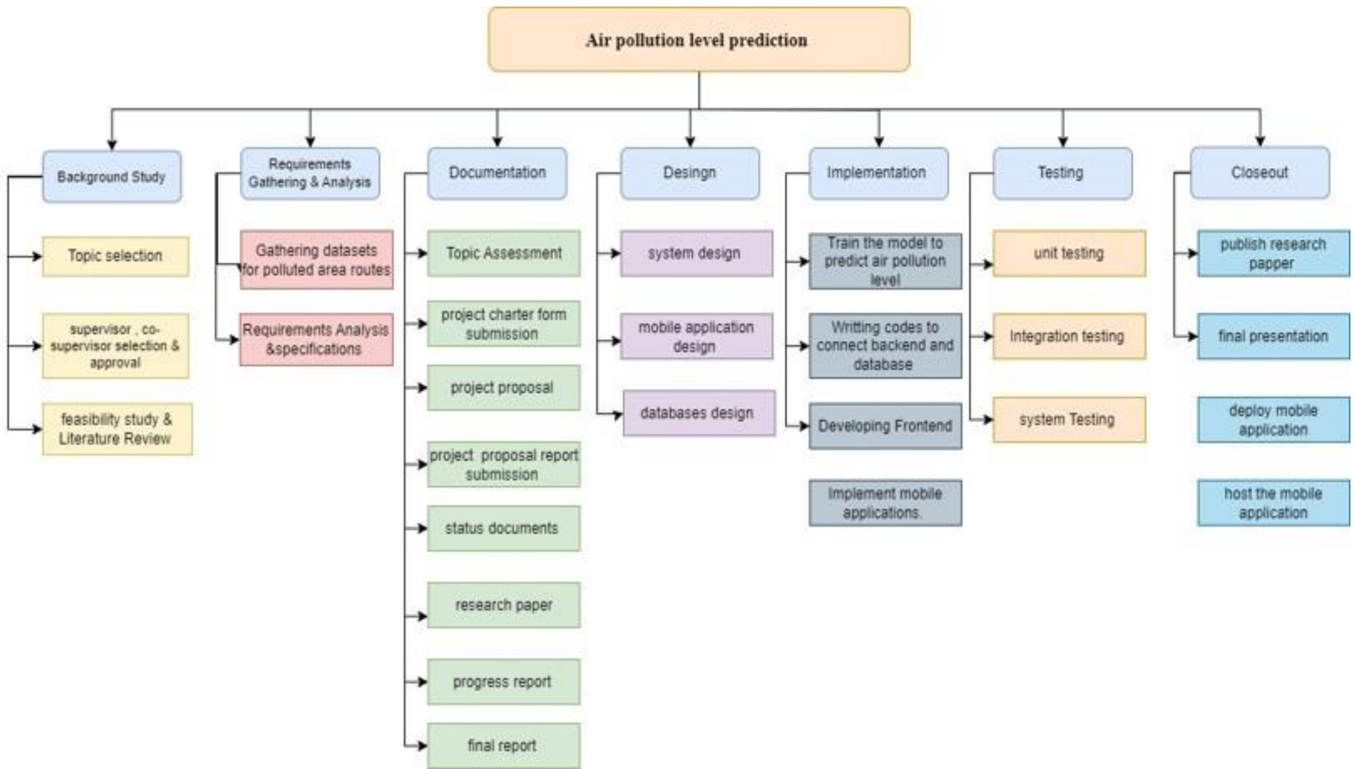

Figure 3. 4: Work breakdown chart

4. GANTT CHART

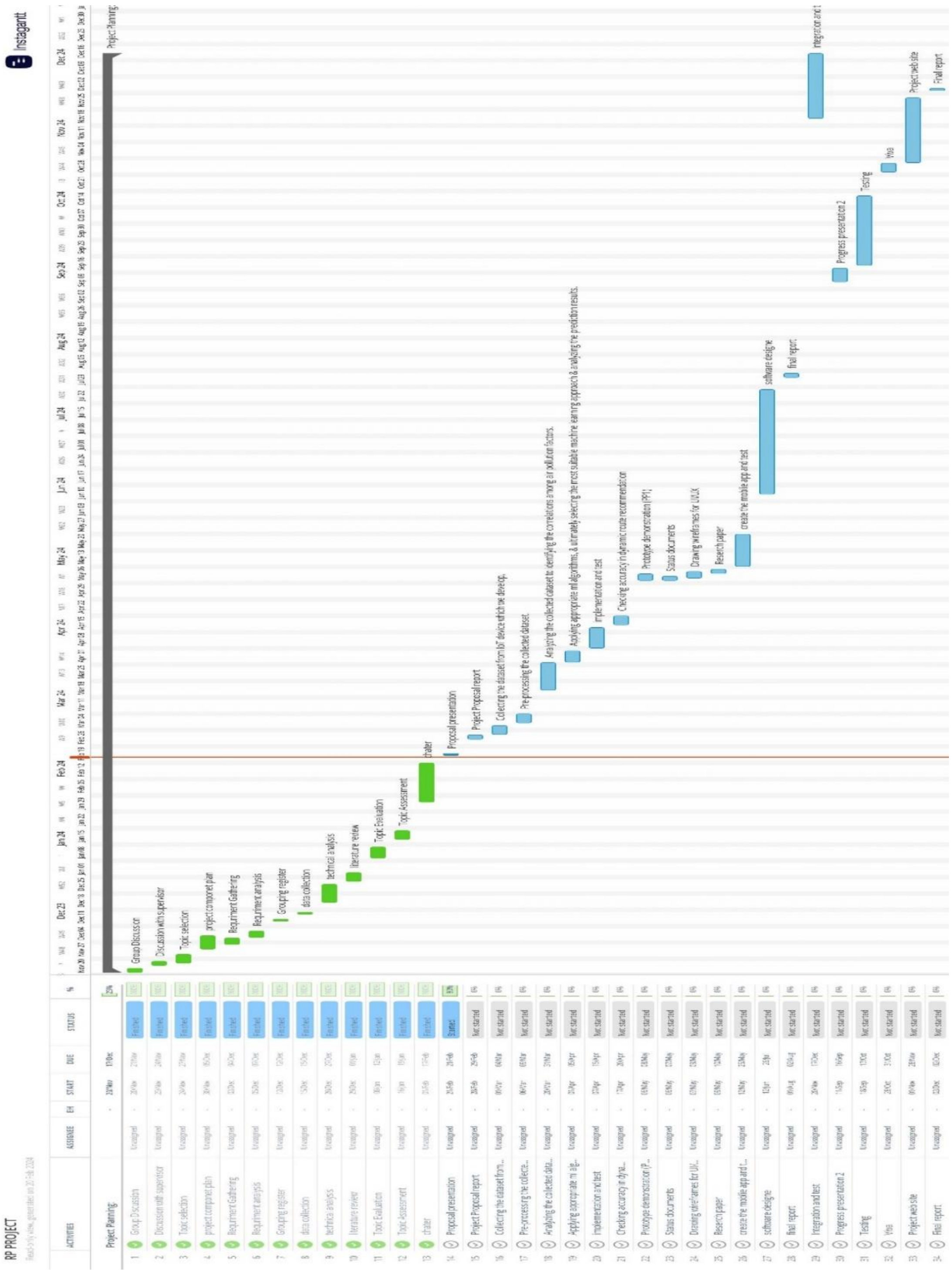

Figure 4.1: Gantt chart

5.Description of Personal and Facilities

Facilitators:

- Ms.Chathurangika Kahadawaarachchi – Sri Lanka Institute of Information Technology(SLIIT)
- Ms. Pipuni Wijesiri– Sri Lanka Institute of Information Technology (SLIIT)

Facilities:

- Central environment authority.
- National bulidng resource management

6.BUDGET AND BUDGET JUSTIFICATION

Table 6. 1: Budget Plan

Requirement	**Cost (Rs.)**
Travelling Cost	**2000.00**
Deployment Cost	7000.00/month
Mobile app hosting on PlayStore	4000.00
Mobile app hosting on AppStore	15425.00/annual
Total	28425.00

7 COMMERCIALIZATION

7.1 Target Audience and Market Space.

- **Target Audience.**

  Users.

  Stakeholders.

- **Market Space.**

  Don’t need for advanced knowledge in technology.

  No age limitation for the users.

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