SECD2613-05 SYSTEM ANALYSIS AND DESIGN

Bus Real-Time Tracking System

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PHASE 1: PROJECT PROPOSAL and PLANNING

1. Introduction

As a bustling metropolis and economic hub in Malaysia, Johor Bahru relies heavily on its public transportation network to facilitate the mobility of its residents and workforce. However, navigating the city's bus system often presents challenges for commuters, particularly in predicting bus arrival times and minimizing wait times at bus stops. The inherent variability of traffic conditions, coupled with the lack of real-time information, exacerbates the uncertainty and inconvenience experienced by passengers as they plan their journeys across the city.

Therefore, this project aims to enhance the user experience and efficiency of public bus systems in Johor Bahru by introducing a real-time tracking system. Specifically, our objectives include reducing average waiting times, increasing ridership levels, and improving overall satisfaction among commuters.

2. Organizational Background Study

The public bus system in Johor Bahru is primarily operated by multiple bus companies under the oversight of the Land Public Transport Commission (SPAD) and the Iskandar Regional Development Authority (IRDA). The system comprises a network of routes covering various areas within the city and its surrounding suburbs. Key bus terminals and hubs, such as Larkin Sentral and JB Sentral, serve as central points for passenger transfers and intermodal connectivity.

multiple bus operators manage different routes and services. These operators range from large corporations to smaller, independent companies, each responsible for specific routes or geographic areas.

2.1. Identified Problems

During the background study on Johor Bahru's current public bus system Two significant issues were identified:

Long Wait Times

The lack of real-time tracking capabilities results in unreliable bus arrival times and schedules. This lack of information contributes to longer wait times and missed connections.

Poor User Experience

Passengers' long wait time exacerbate uncertainty and frustration due to the absence of accurate information on bus locations and arrival times diminishing the overall user experience.

Inefficient Operations

Due to the absence of real-time tracking capabilities, transportation authority's encounter significant challenges in effectively monitoring and managing bus services. The lack of real-time data on bus operations impedes authorities' ability to promptly identify service disruptions, address operational issues, and uphold service quality standards.

2.2. Improvement Opportunities

The observation of the current system outlined Opportunities for system enhancement

Congestion and Traffic Delays

Addressing traffic congestion, especially during peak hours, is paramount to improving bus service reliability and reducing waiting times. Implementing real-time tracking systems can aid in dynamically adjusting bus routes and schedules to navigate around traffic bottlenecks, ultimately enhancing service efficiency.

Infrastructure Constraints

Improving infrastructure amenities such as bus shelters, signage, and digital displays can enhance the overall passenger experience and comfort while waiting for buses. Integrating technology solutions like smart bus stops equipped with real-time arrival information can mitigate uncertainty and provide commuters with timely updates on bus arrivals, contributing to a more seamless travel experience.

Technological Integration Opportunities

Leveraging technology solutions such as mobile applications and data analytics can significantly enhance the efficiency and effectiveness of public bus systems.

2.3 Problem Statement

The public bus system in Johor Bahru faces significant challenges that hinder its effectiveness in providing reliable, efficient, and user-friendly transportation services. Key issues include the lack of real-time tracking capabilities, resulting in unpredictable bus arrival times, inefficient route planning, and limited accessibility information for passengers and transportation authorities.

3. Objectives

Reduce Waiting Times

Minimize average waiting times at bus stops by enabling passengers to plan their journeys more effectively and by optimizing bus routes and schedules based on real-time data.

Enhance User Experience

Improve the overall experience for passengers by providing accurate and real-time information about bus locations and arrival times, reducing uncertainty and frustration associated with waiting for buses.

Increase Operational Efficiency

Optimize the efficiency of bus operations by enabling transportation authorities to monitor and manage bus services in real-time, allowing for better resource allocation and scheduling.

4. Proposed Solution

To address the identified problems and capitalize on the improvement opportunities for the public bus system in Johor Bahru, the proposed solution involves the implementation of a comprehensive real-time tracking system integrated with modern technology solutions. The key components of the proposed solution are as follows:

Real-Time Tracking System

Develop and deploy a real-time tracking system that utilizes GPS technology to accurately monitor the location and movement of buses in real-time. This system will provide passengers and transportation authorities with up-to-date information on bus locations, arrival times, and service updates through various channels, including mobile applications, web portals, and digital displays at bus stops.

Infrastructure Enhancement

Improve infrastructure amenities such as bus shelters, signage, and digital displays at bus stops to enhance the overall passenger experience and comfort. Integrating technology solutions like smart bus stops equipped with real-time arrival information will provide commuters with timely updates on bus arrivals and contribute to a more seamless travel experience.

Operational Optimization Tools

Implement tools and systems for transportation authorities to monitor and manage bus services in real-time. This includes software for better resource allocation, dynamic scheduling adjustments, and performance analytics to ensure efficient bus operations and reduced waiting times for passengers.

5. Feasibility Study

5.1 Economical Feasibility

Improving the bus system and user experience can result in several benefits, these benefits can be divided into Tangible and Intangible:

Tangible Benefits

I. **Increase the number of riders:** Enhancing the bus system's efficiency and user experience might motivate additional consumers to use the bus service, which will boost ticket revenue and sales.
II. **Reduce the operational cost**: Real-time monitoring of the system will help in optimizing bus routes which might result in reducing the operational costs of the bus service.
III. **Reduction in Waiting Time/Productivity Gain:** With precise bus arrival information, passengers can plan efficiently, enhancing productivity. This improvement optimizes time usage, leading to increased productivity and better economic efficiency citywide.

Intangible Benefits

I. **Enhanced User Experience**: Passengers appreciate accurate schedules, leading to higher satisfaction and loyalty.

Costs of the new system can be categorized into:

Development Costs

I. Hardware Acquisition: GPS devices, Communication equipment and LED digital displays.
II. Software development.
III. Staff training.

Production Costs

I. System maintenance.
II. Staff salaries.

-The Hardware cost is calculated for 60 busses and 20 bus stops; The number of busses is calculated based on the fact the total number of operating routes in Johor Bahru is 29 with an average of 2 busses operating in every route and the number of bus stops is based on the number of stops with largest number of riders.

-The assumed number of Johor Bahru bus users is 15000 passengers per day; the assumption is made by assuming that 1.4% of Johor Bahru population use public transport daily.

-The estimated base tickets sale revenue per year is 11250000rm.

Cost Benefit Analysis (CBA)

Estimated cost	
Development cost	
Hardware	40000
Software Development	50000
Staff training	10000
Production cost	
System maintenance	150000 per year
Staff salaries	120000 per year

Estimated Benefits	
Increased sales revenues	(First year = 112500) + 10% every year
Reduce the operational cost	2500 per week
Reduction in Waiting Time/Productivity Gain	3000 per week

Assumptions	
discount rate	10%
annual change in production costs	5%
annual change in benefits	10%
sensitivity factor (cost)	120%
sensitivity factor (benefit)	110%

Costs	Year 0	Year 1	Year 2	Year 3
Development Costs				
Hardware	48,000			
Software Development	60,000			
Staff training	12,000			
Total	120,000			
Production Costs				
System maintenance		18,000	18,900	19,845
Staff salaries		144,000	151,200	158,760
Annual prod. Cost		162,000	170,100	178,605
(PV)		147272.7	140579	134189
Accumulated cost		267,273	407,852	542,041
Benefits				
Increased sales revenues		123,750	148,500	178,200
Reduce the operational cost		132,000	145,200	159,720
Reduction in Waiting Time/Productivity Gain		158,400	174,240	191,664
Accumulated benefits		414,150	588,390	780,054
Gain or Loss		146,877	180,538	238,013
Profitability Index	1.98			

As our Profitability Index 1.98 is more than 1 it means that the new system is economically feasible and a good investment.

5.2 Technical Feasibility

The required hardware technical resources (GPS devices and communication devices) for the new system are already available in the current system but a few adjustments would be needed for them to be compatible with the new system operations. The only required hardware that is not available in the current system is the LED displays, but they can be acquired.

The staff with the technical skills needed to achieve the required hardware adjustments and develop the new software are available within the organization.

Thus, the project is Technically feasible.

5.3 Operational Feasibility

The new system will minimize users waiting time and reduce the uncertainty and frustration associated with it with simple and easy to use user interface, it will also enhance the user experience in the public bus and make it more reliable option. so, it will be liked and used by the users what makes it operationally feasible.

6. Project Planning

Revolutionizing Commuter Experience

Project Planning for Public Bus System Enhancement The enhancement of the Public Bus System is a critical endeavor aimed at mitigating issues pertaining to inaccurate appointments and unclear bus statuses. By integrating a GPS tracking system with bespoke software, the project aspires to furnish commuters with real-time bus locations and estimated arrival times, thereby amplifying user satisfaction and curtailing waiting durations.

6.1 Human Resources

Effective deployment of resources lies at the heart of project success. A strategic allocation of human resources is crucial, necessitating the inclusion of skilled professionals across various domains. Key personnel involved in the project include:

- **Project Manager**: Responsible for overall project oversight, coordination, and stakeholder management. (Moaz Jalal)
- **Software Developers:** Tasked with the development and implementation of custom software solutions tailored to the Public Bus System's requirements. (Loai Al- Alqadasi)
- **Hardware Engineers:** Engaged in the installation and configuration of GPS tracking systems and associated hardware components. (Ahmed Ali)
- **GPS Tracking System Experts:** Provide specialized knowledge and expertise in the deployment and operation of GPS tracking technology. (Ahmed Ali)
- **UI/UX Designers:** Design intuitive and user-friendly interfaces for the software application, enhancing user experience and accessibility. (Loai Al- Alqadasi)
- **Quality Assurance/Testers:** Conduct rigorous testing protocols to ensure the reliability, functionality, and performance of the implemented system. (Ahmed Kassem)

Each team member plays a crucial role in their respective domains, contributing to the seamless integration and operation of the enhanced Public Bus System. Clear communication channels

and protocols are established to facilitate effective collaboration and information exchange among team members, fostering a culture of accountability and excellence.

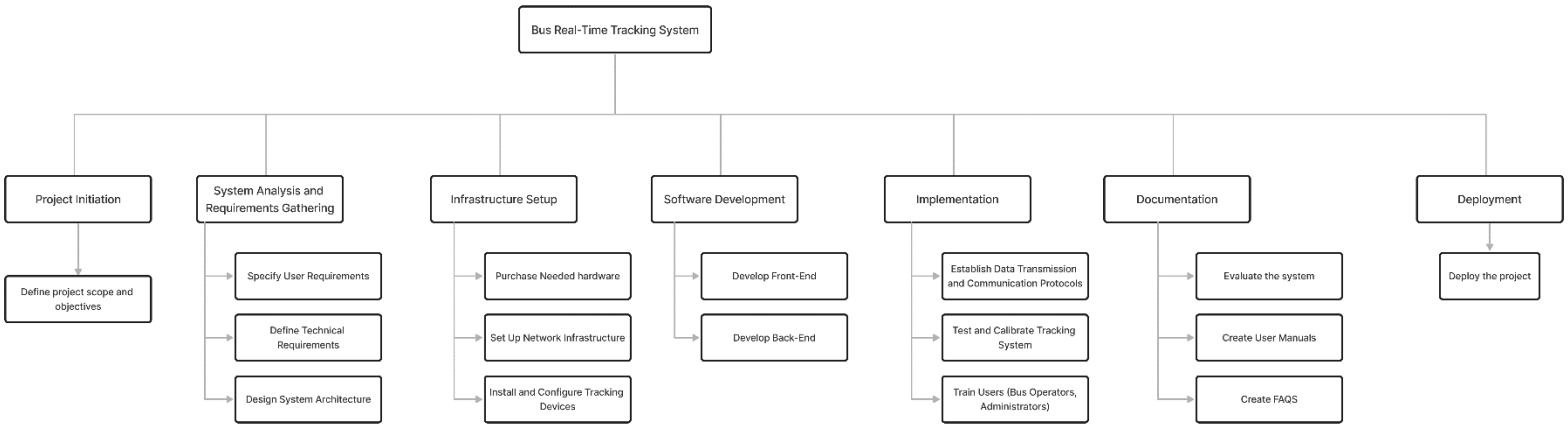
6.2 Work Breakdown Structure (WBS)

In delineating the Work Breakdown Structure (WBS), a comprehensive approach is adopted to systematically organize the project's intricacies. Beginning with the Project Initiation phase, tasks encompass defining project objectives and scope, assembling the project team, and crafting a comprehensive project charter to delineate project vision and objectives. Subsequent phases, including Requirement Analysis, Design, Development, Implementation, and Documentation, each entail a cascade of tasks meticulously designed to progress the project from conceptualization to fruition.

Within the Requirement Analysis phase, tasks revolve around collating user requirements, specifying data collection modalities, and identifying pertinent data sources essential for project success. Design endeavors encompass the development of user interfaces, database structures, and data collection mechanisms, supplemented by the formulation of plans for real-time monitoring features.

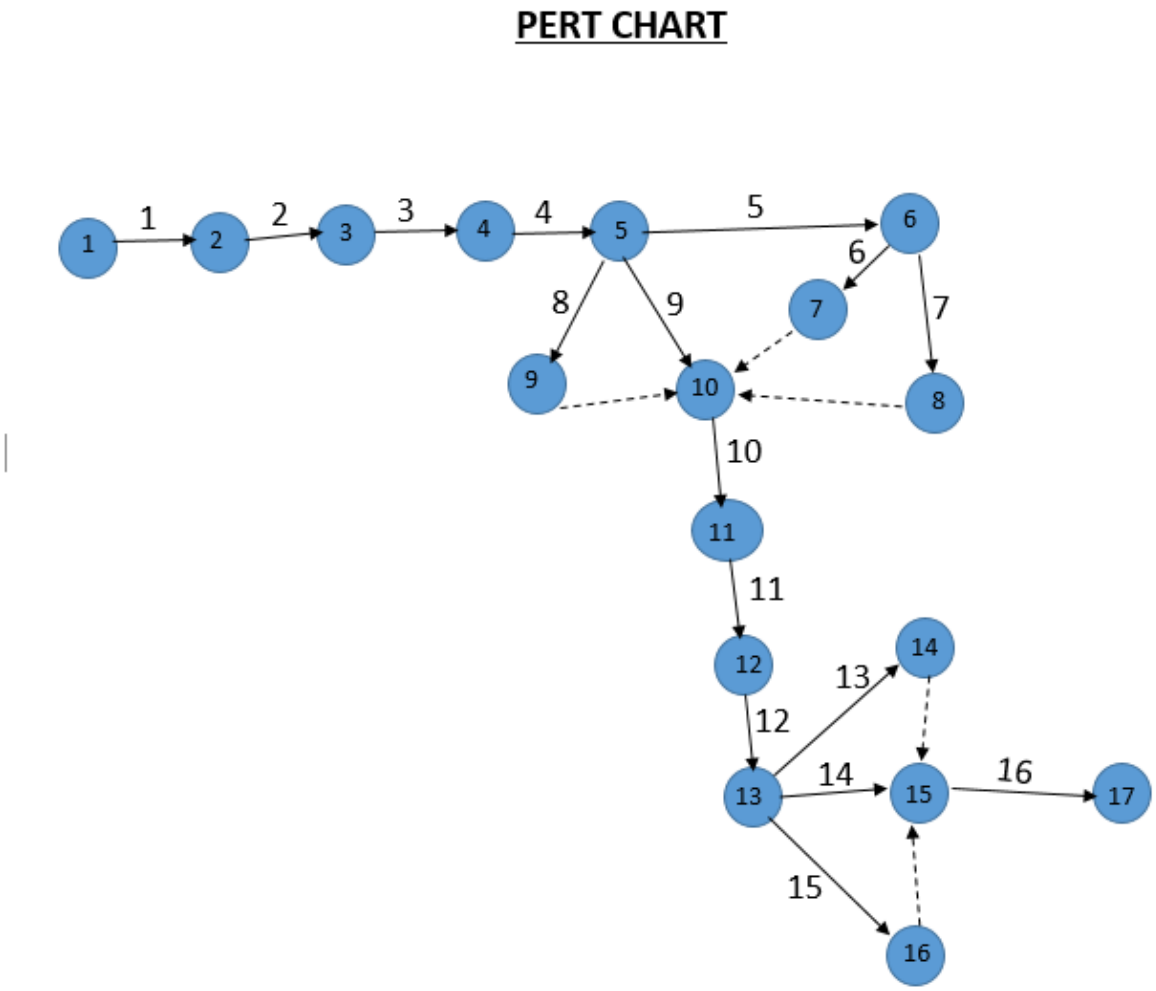
Development activities entail the actual construction of the user interface, implementation of monitoring features, and establishment of a robust database system. The subsequent Implementation phase encompasses user testing, training, and final implementation testing to ensure seamless integration and functionality. Finally, the Documentation phase involves project evaluation, lessons learned documentation, and the creation of comprehensive user manuals to facilitate system comprehension and utilization.

This structured approach ensures clarity, efficiency, and accountability throughout the project lifecycle, culminating in the enhancement of the Public Bus System to meet the evolving needs of commuters.



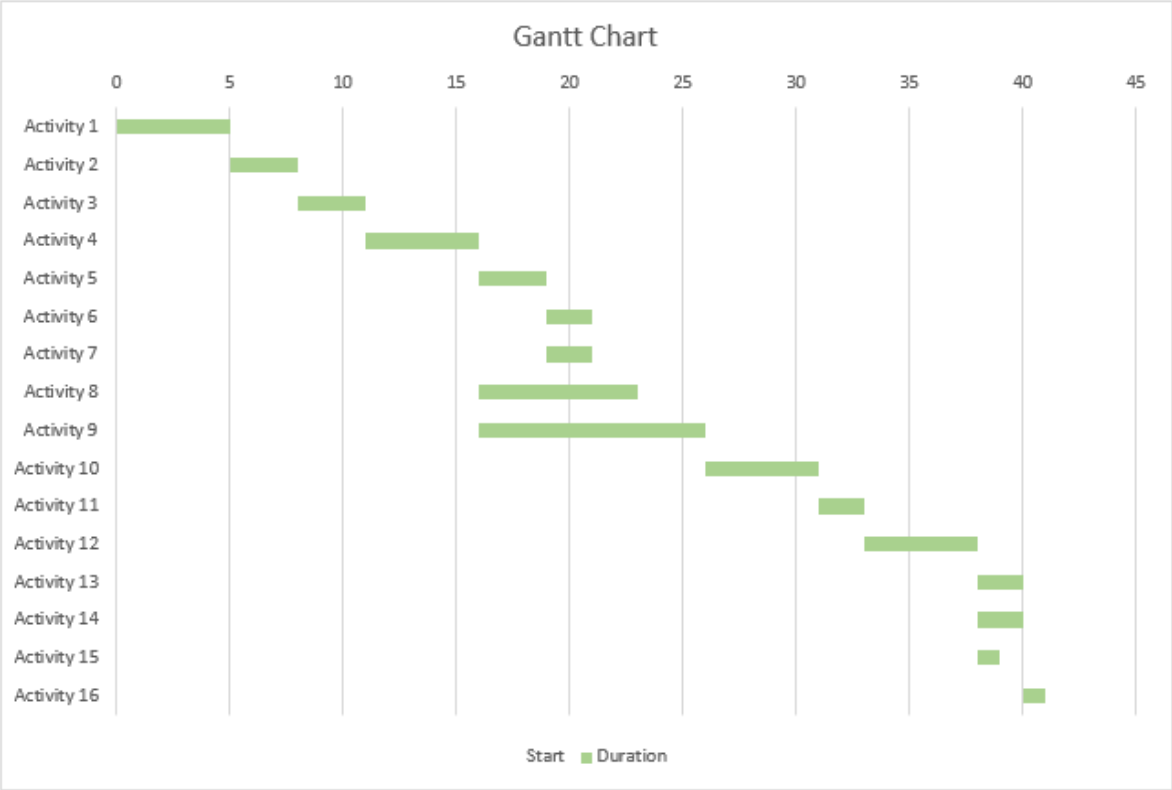
Task Description	Task Activity	Predecessor	Duration (days)
Project Initiation	1. Define project scope and objectives	-	5 days
System Analysis and Requirements Gathering	2. Specify User Requirements	1	3 days
	3. Define Technical Requirements	2	3 days
	4. Design System Architecture	3	5 days
Infrastructure Setup	5. Purchase Needed hardware	4	3 days
	6. Set Up Network Infrastructure	5	2 days
	7. Install and Configure Tracking Devices	5	2 days
Software Development	8. Develop Front-End	4	7 days
	9. Develop Back-End	4	10 days
Implementation	10. Establish Data Transmission and Communication Protocols	6, 7, 8, 9	5 days
	11. Test and Calibrate Tracking System	10	2 days
	12. Train Users (Bus Operators, Administrators)	11	5 days
Documentation	13. Evaluate the system	12	2 days
	14. Create User Manuals	12	2 days
	15. Create FAQS	12	1 day
Deployment	16. Deploy the project	13, 14, 15	1 day

6.3 PERT Chart



6.4 Gantt chart

GANTT CHART



Task Activity	Task Activity
1. Define project scope and objectives	9. Develop Back-End
2. Specify User Requirements	10. Establish Data Transmission and Communication Protocols
3. Define Technical Requirements	11. Test and Calibrate Tracking System
4. Design System Architecture	12. Train Users (Bus Operators, Administrators)
5. Purchase Needed hardware	13. Evaluate the system
6. Set Up Network Infrastructure	14. Create User Manuals
7. Install and Configure Tracking Devices	15. Create FAQS
8. Develop Front-End	16. Deploy the project

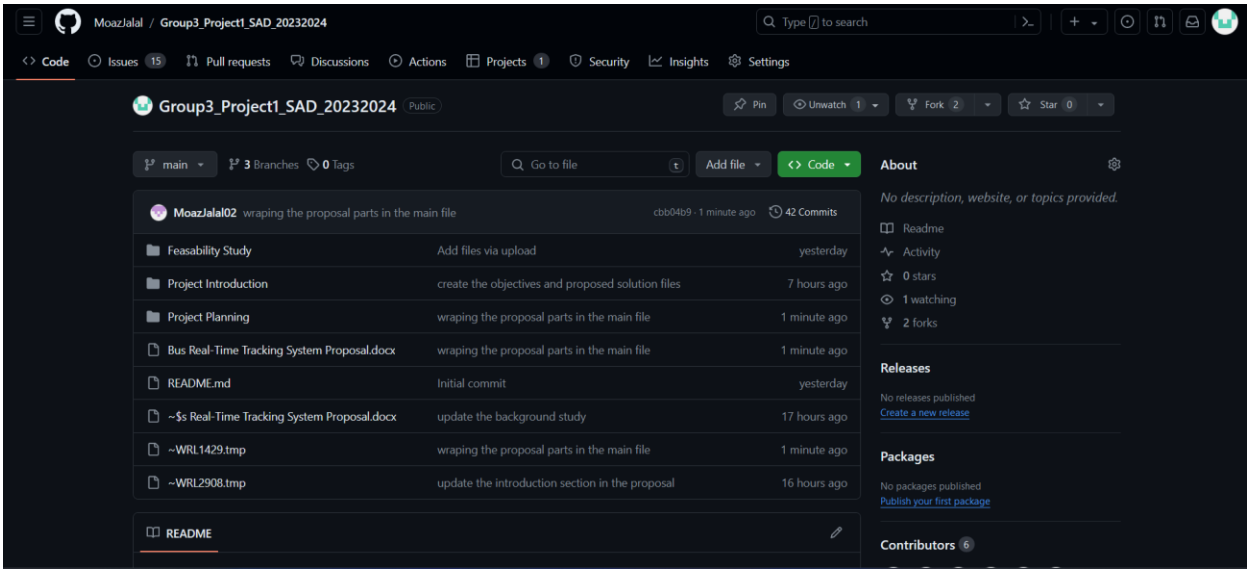
7. Benefit and Overall Summary of Proposed System

The proposed real-time tracking system for Johor Bahru's public bus system aims to revolutionize commuter experience by addressing existing challenges such as unreliable schedules and inadequate service monitoring. By leveraging modern technology solutions, the project seeks to enhance user satisfaction, increase ridership levels, and optimize operations, ultimately improving the efficiency and reliability of public transportation in the city. The proposed project has a Profitability index larger than 1 which means it’s economically feasible and can be a real improvement to Johor Bahru’s public bus system.

8. Project Management (Github)

8.1 Repository link: *https://github.com/MoazJalal/Group3_Project1_SAD_20232024*

8.2 Repository Snapshot



PHASE 2: Information System Gathering and Requirement Analysis

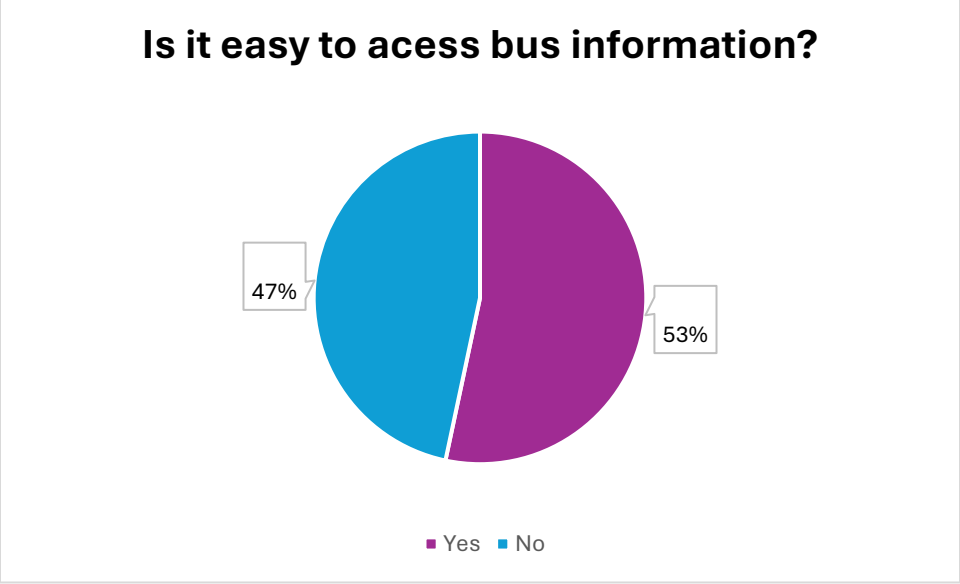
9. Information Gathering Process

An efficient public transport system is crucial in a modern city lifestyle. However, our city's current public transport system suffers from considerable issues. In this section we implemented two methods to gather information about the current system (AS-IS system) to outline and determine the requirements and focus points of the new system (TO-BE system)

This section explores the current system based on questionnaire-based and investigation-based approaches.

9.1. Questionnaire

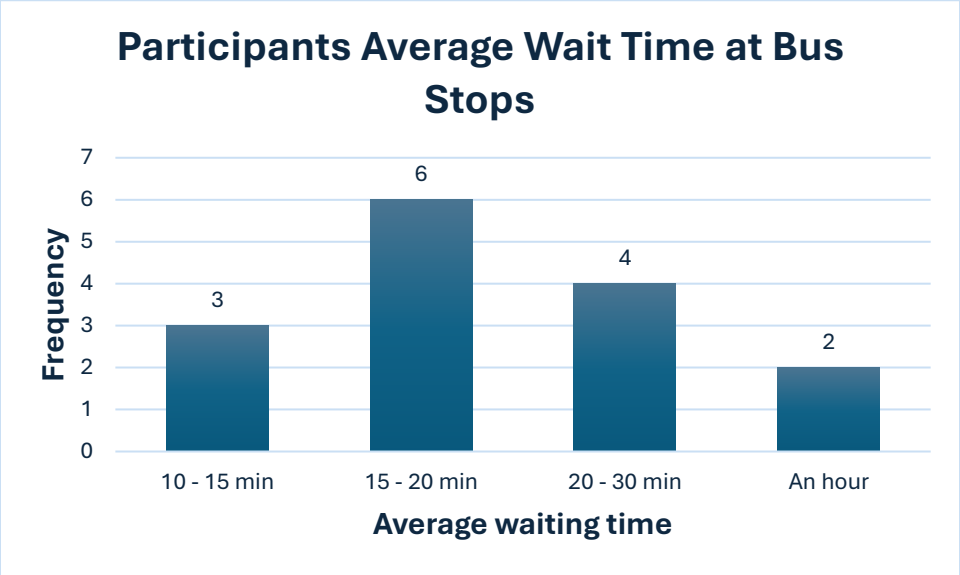
To understand the difficulties faced by passengers and to collect extensive information about passengers' experiences using the bus system, a detailed questionnaire-based study was done. The questionnaire was distributed both at significant bus stations and online to ensure a varied sample of responses. 15 passengers have participated in this questionnaire, In this section we'll delve into the outcomes of the participants' responses.



The responses showed several important difficulties. Many passengers experienced numerous delays. This irregularity in bus arrivals created frustration and difficulty, interfering with their

daily routines and trust in the public transit system. Many passengers also reported being unaware of schedule changes or delays, indicating a lack of effective communication from bus service providers. Overall, satisfaction was low. A majority of 60% participants (9) believe that the public bus schedule is not always correct; yet 53% (8) believe that the bus system's information is easily accessible, but it is not always accurate. The unpredictability of bus services wastes time and adds stress, especially for people who rely on them to get to university or school. More than half of the students used public buses on a daily basis.

Lack of communication exacerbates these issues, leaving travelers unsure and unable to plan their trips properly. Furthermore, 40% of respondents (6) stated they waited 15-20 minutes, while 26% (4) said they waited 20-30 minutes, and 13% (2) waited around an hour. This has an impact not only on individual passengers, but also on the overall perceived reliability of the public transit system.



Based on the questionnaire results, various recommendations can be made to solve these difficulties, as proposed by students who took the survey.

First, establishing real-time tracking systems on all buses would enable passengers to receive real-time updates via a smartphone app and digital displays at bus stops. This would greatly increase transparency and eliminate ambiguity.

Second, improving schedule adherence through better route design and traffic control tactics may help reduce delays. Adding dedicated bus lanes in high-traffic regions may also improve efficiency.

Improving communication channels is critical. Establishing clear communication rules and routinely informing passengers of any changes or delays will increase trust and improve the overall passenger experience.

Finally, increasing the frequency of preventative maintenance and providing drivers with further training in efficient boarding techniques and customer service would aid in resolving operating concerns and improving service quality.

9.2. Investigation

In order to obtain AS-IS information and to address the issues in the current system and discover the root causes of delays and inefficiencies, an in-depth investigation was carried out. This investigation includes firsthand observations, interviews with managers and operational workers and a thorough review of existing performance data such as Buses departure and arrival records.

Direct observations of bus operations during peak and off-peak hours were conducted. The observations revealed that traffic congestion in critical areas and longer boarding times during peak hours were significant factors to delays, Furthermore, mechanical issues with buses, though infrequent, resulted in unplanned stops also contributed to the unplanned delays.

Interviews with bus drivers and transportation officials revealed a lack of immediate communication between administrators and drivers, resulting in lack of updates and information about the factors and problems that are causing the delays and unreliability of schedules.

The analysis of buses' departure and arrival record data revealed patterns of unpredictability in schedule adherence, particularly during off-peak hours.

9.3. Conclusion

Conducting these interactive and unobtrusive methods provided us with great insights and information of the current system weak and strong points and the major issues within it. This information and understanding will help us to design a system that will fix and enhance the current system weak points.

The questionnaire method collected useful information from passengers, many of whom experienced regular delays that frustrated and interrupted their daily routines. A large proportion of passengers were uninformed of schedule changes or delays due to poor communication, resulting in low overall satisfaction. Long wait times were a prevalent complaint, with some passengers waiting 20-30 minutes or longer.

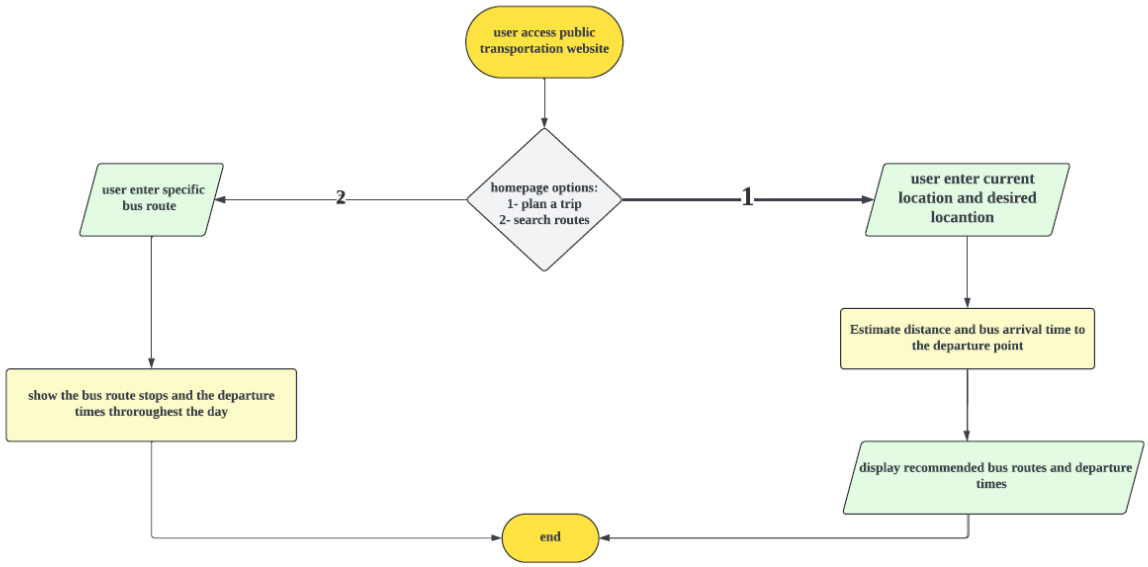
The major issues revealed by the investigation method are the traffic congestion and busses mechanical issues which result in unplanned stops that affect adherence to the schedules. Also, the lack of communication between the administration and bus drivers.

Here’s the link to the conducted survey
https://docs.google.com/forms/d/e/1FAIpQLScL4QsHdgx7eyyDHtrL_m0kirVJbfsZlQeWCiBJ4_1Cy7FL4Q/viewform?usp=sharing

10. Requirement Analysis

This section focuses on the requirement analysis for the AS-IS system.

10.1. Current Business Process (Workflow)



10.2. Functional Requirements (AS-IS)

The functional requirements for the current public bus system in Johor Bahru outline the essential operational aspects that are currently in place. These requirements focus on the existing capabilities and processes of the system.

Journey Planning

- **Basic Route Information:** Passengers can access basic information about bus routes, including the start and end points, through printed schedules and static displays at bus stops.
- **Timetable Availability:** Bus schedules are available in printed form and posted at major bus terminals and some bus stops.

Service Monitoring

- **Manual Tracking:** Bus operators and transportation authorities manually monitor bus schedules and operations without real-time tracking capabilities.
- **Incident Management:** Any delays or incidents are reported manually through phone calls or radio communication between bus drivers and the control center.

Drivers Notifications

- **Limited Notifications:** Drivers are informed of changes to the schedule through notices.

Administration

- **Schedule Management:** Transportation authorities manually create and update bus schedules based on historical data and operator experience.
- **Route Management:** Any changes to bus routes are made manually and communicated through printed materials and static displays.

10.3. Non-Functional Requirements (AS-IS)

The non-functional requirements for the current public bus system focus on the performance, reliability, and usability of the existing infrastructure and operations.

Performance

- **Operational Efficiency:** The current system operates with significant manual intervention, which can lead to inefficiencies and delays in service management and delivery.
- **Reliability:** The system's reliance on manual processes results in inconsistent service reliability and difficulties in maintaining schedule adherence.

Security

- **Data Management:** There is minimal digital data management, with most information being recorded and processed manually, leading to potential data loss or inaccuracies.
- **Access Control:** Access to scheduling and operational data is controlled manually, with limited security measures in place.

Usability

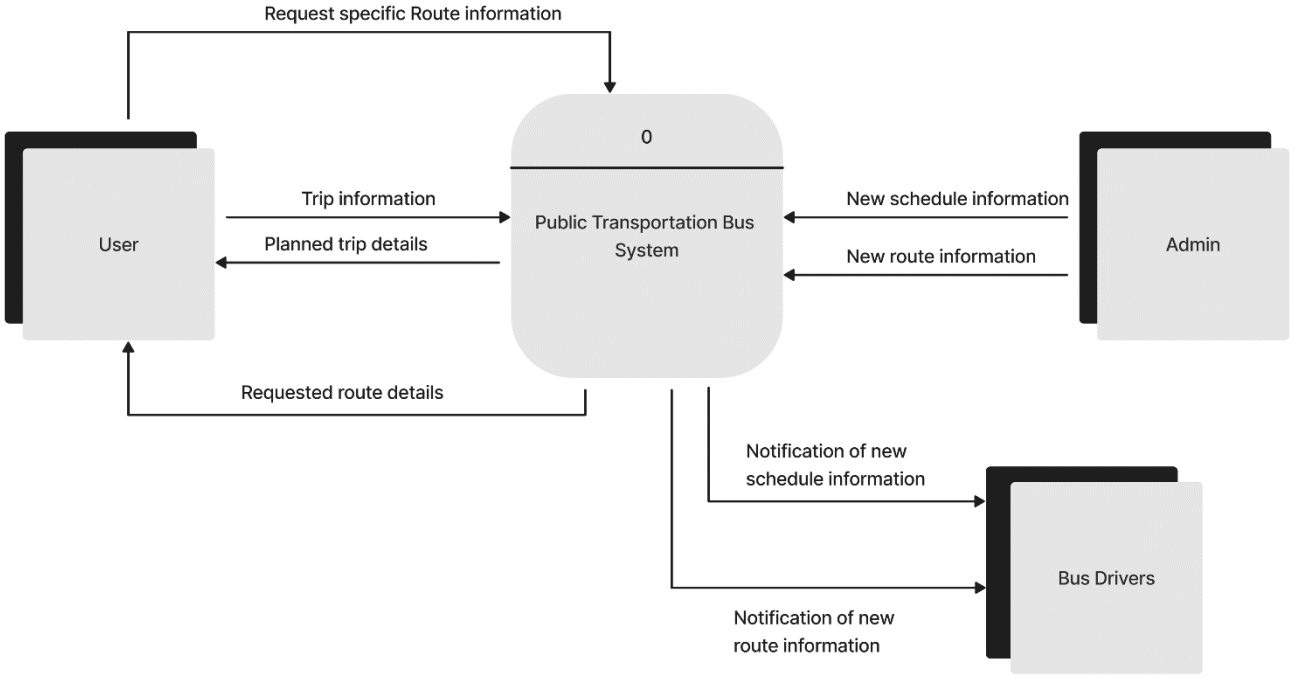
- **User Accessibility:** Passengers rely on static schedules and limited printed information, which can be difficult to access and interpret, especially during unexpected changes or delays.
- **Administrative Usability:** Bus operators and administrative staff face challenges in managing schedules and routes manually, leading to potential errors and inefficiencies.

Maintenance

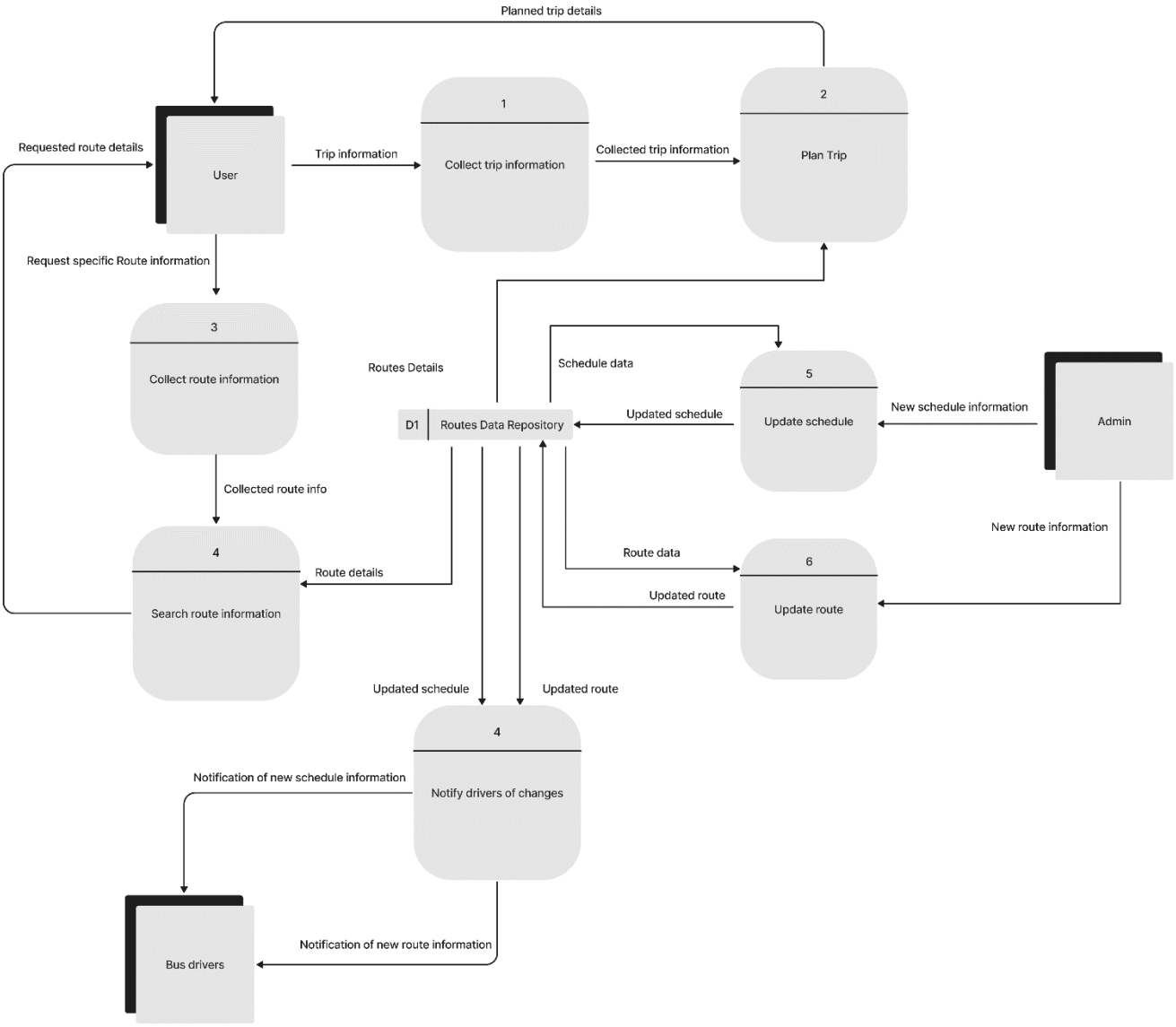
- **System Updates:** Any updates to schedules or routes require significant manual effort, including reprinting materials and physically updating information at bus stops.
- **Technical Support:** Limited technical support is available, primarily focused on addressing issues through manual intervention and communication.

10.3. LOGICAL DFD (AS-IS)

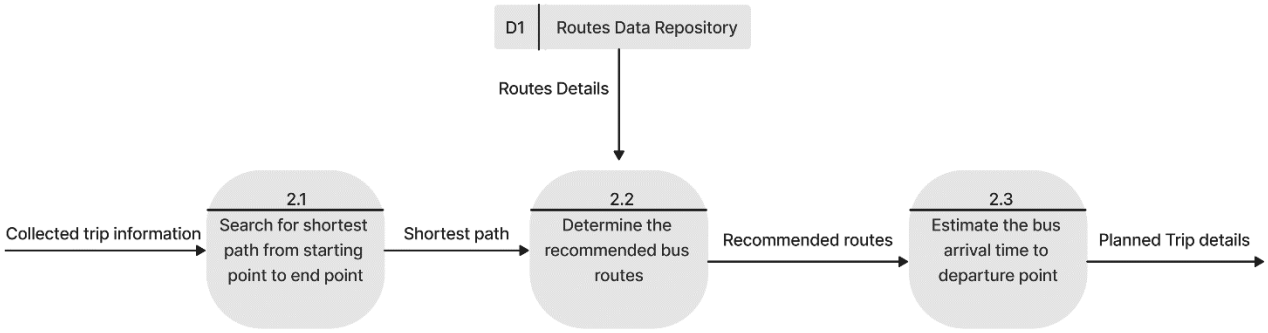
10.3.1. Context Diagram



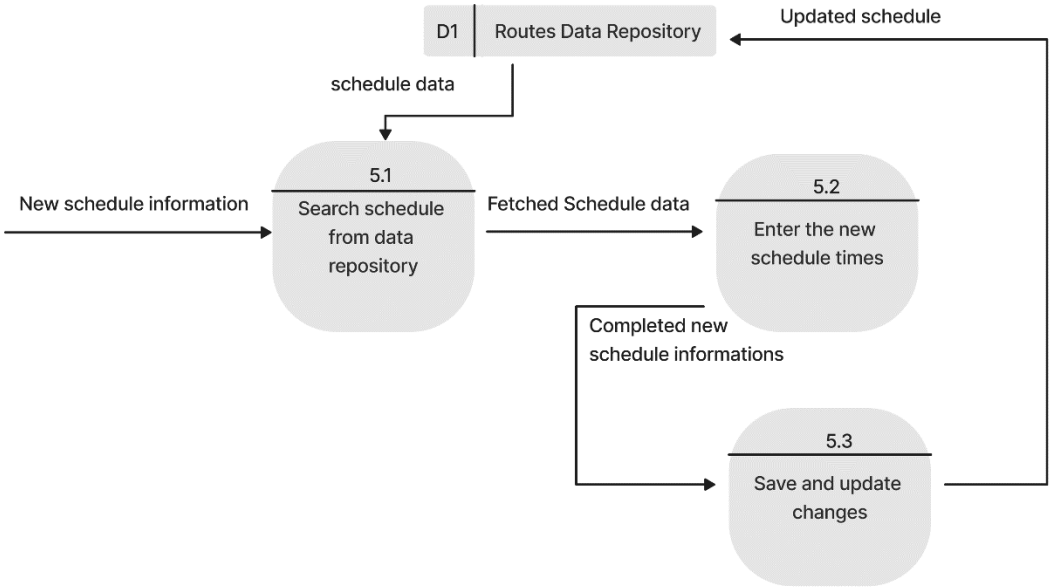
10.3.2. Level 0 Diagram



10.3.3. CHILD DIAGRAM FOR PROCESS 2 (Plan Trip)



10.3.4. CHILD DIAGRAM FOR PROCESS 5 (Update Schedule)



10.4. Summary (AS-IS)

The current public bus system in Johor Bahru is characterized by a lack of real-time tracking capabilities, reliance on manual processes for scheduling and route management, and limited passenger information accessibility. Functional requirements are focused on providing basic route and timetable information, monitoring services manually, and managing administrative tasks without automated systems. Non-functional requirements highlight the challenges in performance, reliability, security, usability, and maintenance due to the manual nature of the current system. These limitations contribute to longer waiting times, passenger frustration, and operational inefficiencies, underscoring the need for an upgraded solution that leverages modern technology to enhance the overall efficiency and user experience of the public bus system.

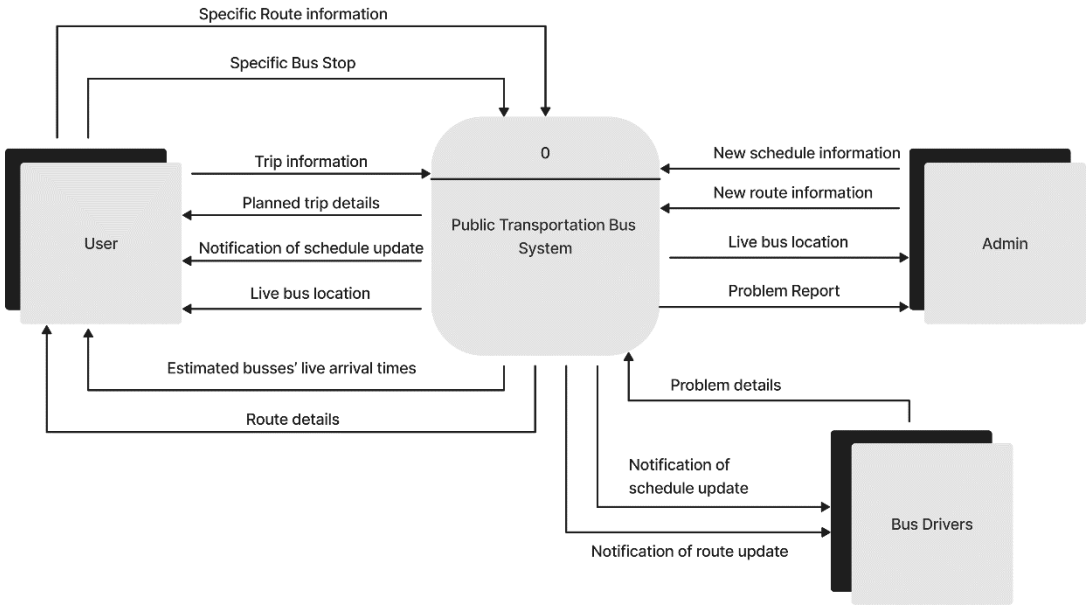
PHASE 3: Analysis and Design

11. System Analysis and Specification

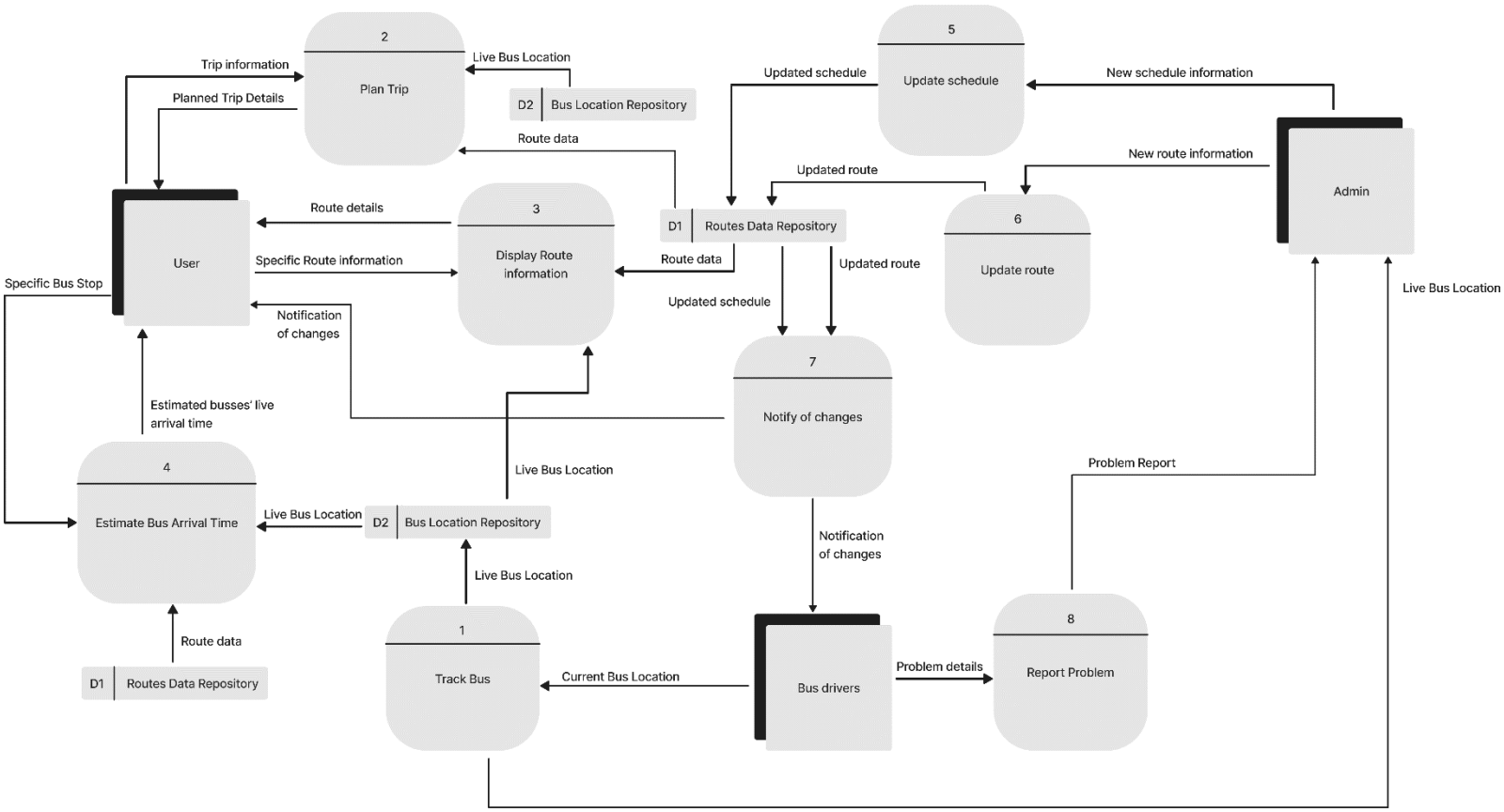
This section focuses on the analysis, process specification and generation of dataflow diagrams for the TO-BE system.

11.1. Logical DFD TO-BE System

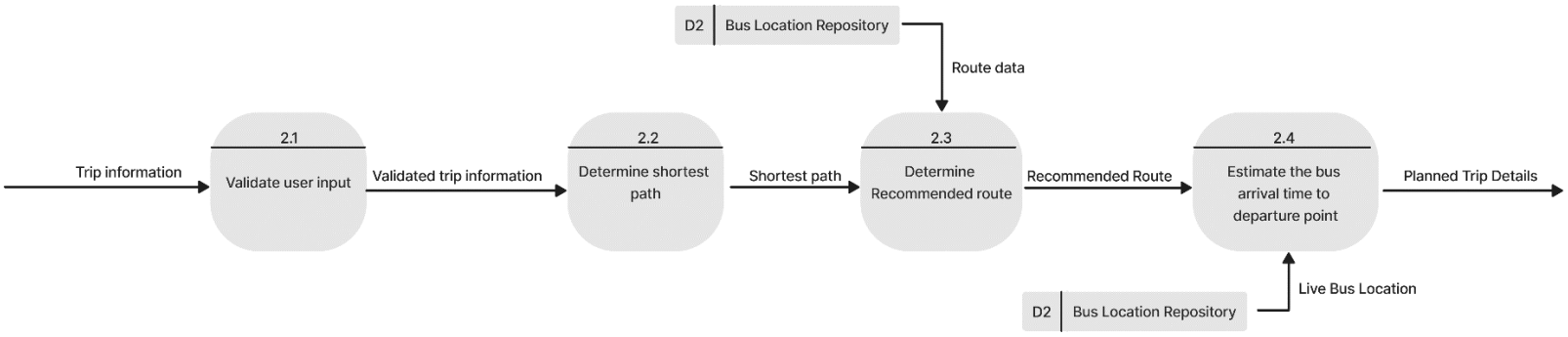
11.1.1. Context Diagram



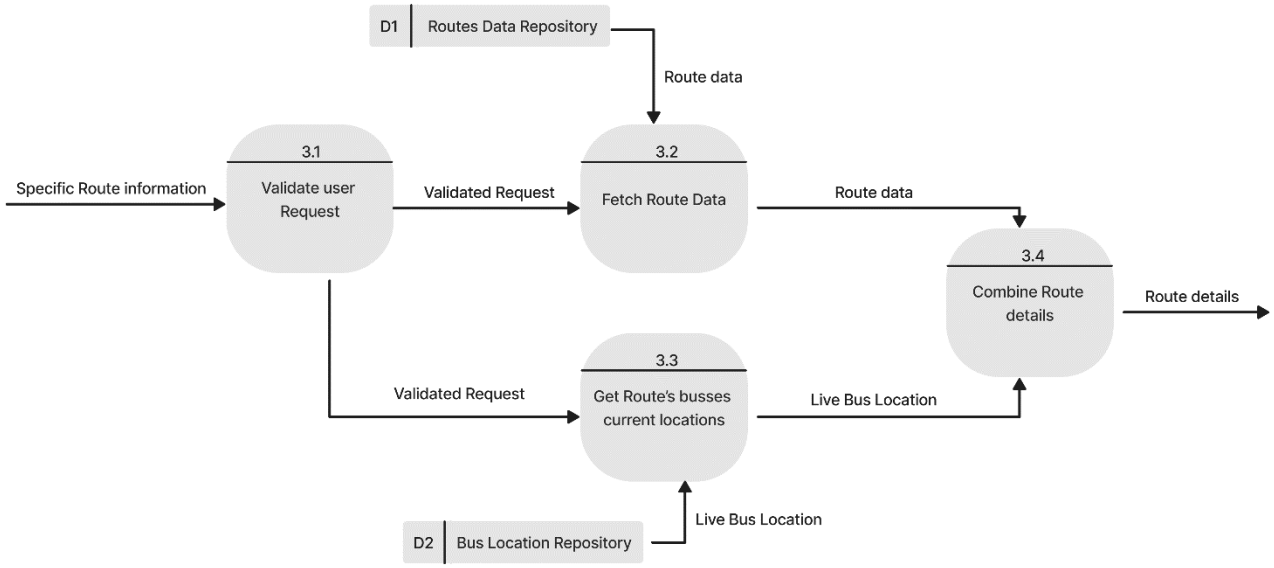
11.1.2. Level 0 Diagram



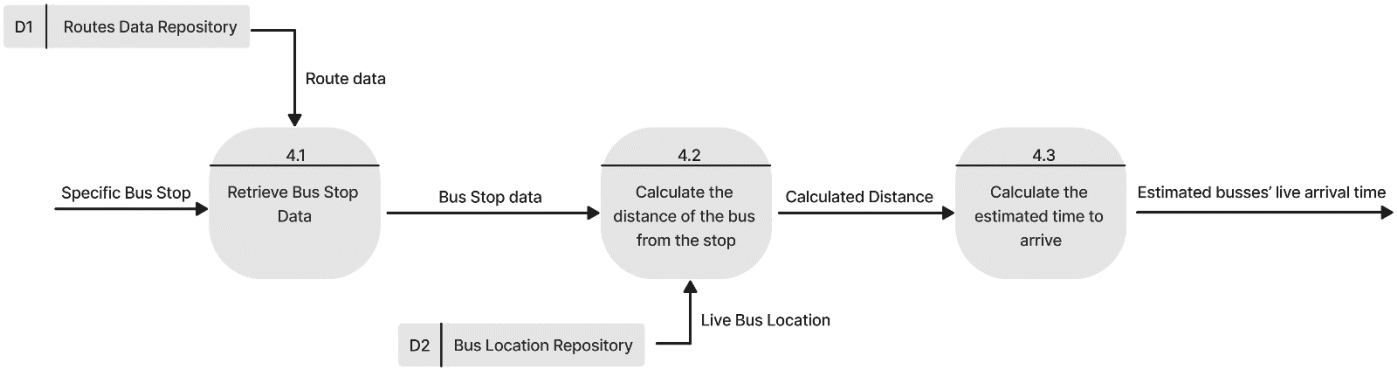
11.1.3. Child Diagram for Process 2 (Plan Trip)



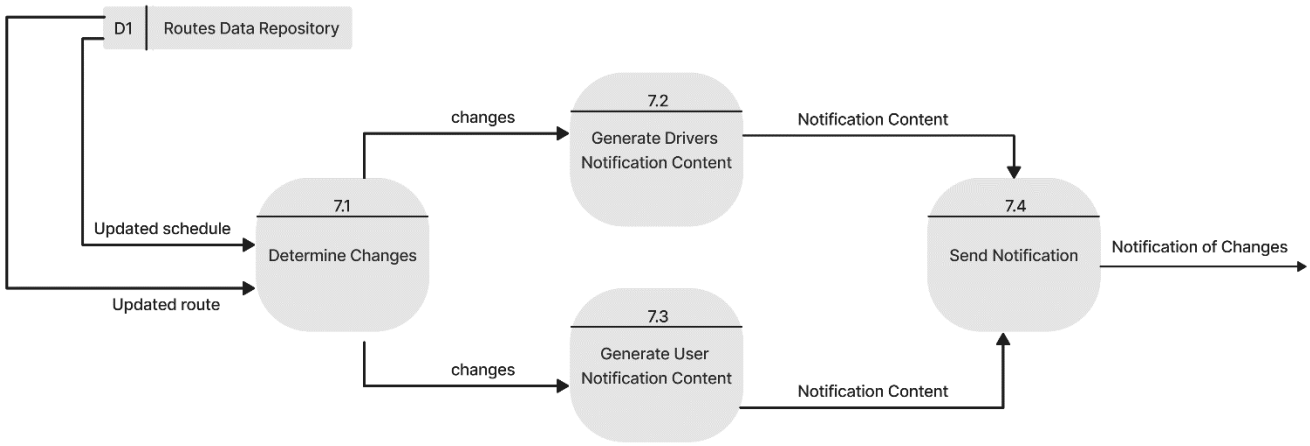
11.1.4. Child Diagram for Process 3 (Display Route Information)



11.1.5. Child Diagram for Process 4 (Estimate Bus Arrival Time)



11.1.6. Child Diagram for Process 7 (Notify of Changes)



11.2. Process Specification TO-BE System

In this part we describe the process specification for processes 1, 5, 6 and 8, using the Structured English method.

11.2.1. Process Specification for Process 1 (Track Bus)

DO WHILE tracking is active

    GET current bus location.

    COMPARE current location and previous location.

    IF new location **!=** previous location

        UPDATE bus location.

        SEND bus location.

    ELSE

        KEEP previous bus location.

    ENDIF

ENDDO

11.2.2. Process Specification for Process 5 (Update Schedule)

DO WHILE update is needed
  GET new schedule information.
  VALIDATE new schedule information.
  IF new schedule information is valid
    UPDATE schedule in the system.
    NOTIFY users about schedule update.
  ELSE
    DISCARD invalid schedule information.
  ENDIF
ENDDO

11.2.3. Process Specification for Process 6 (Update Route)

DO WHILE update is needed
  GET new route information.
  VALIDATE new route information.
  IF new route information is valid
    UPDATE route in the system.
    NOTIFY users about route update.
  ELSE
    DISCARD invalid route information.
  ENDIF
ENDDO

11.2.4. Process Specification for Process 8 (Report a Problem)

Number: 8

Name: Report a Problem.

Description: This process receives problem details from the user and then make problem report that can be reviewed by the administration.

Input data flow

Problem Details.

Output data flow

Problem Report.

Type of the process

Online ☑ Batch ☐ Manual ☐

Process Logic

FILL problem form.

VALIDATE form input

IF input is valid

GENERATE problem report
SET status of problem case
SEND confirmation of receiving the problem to user
UPDATE user with the updates of the problem
IF problem solved
CLOSE the problem case

ENDIF

ELSE

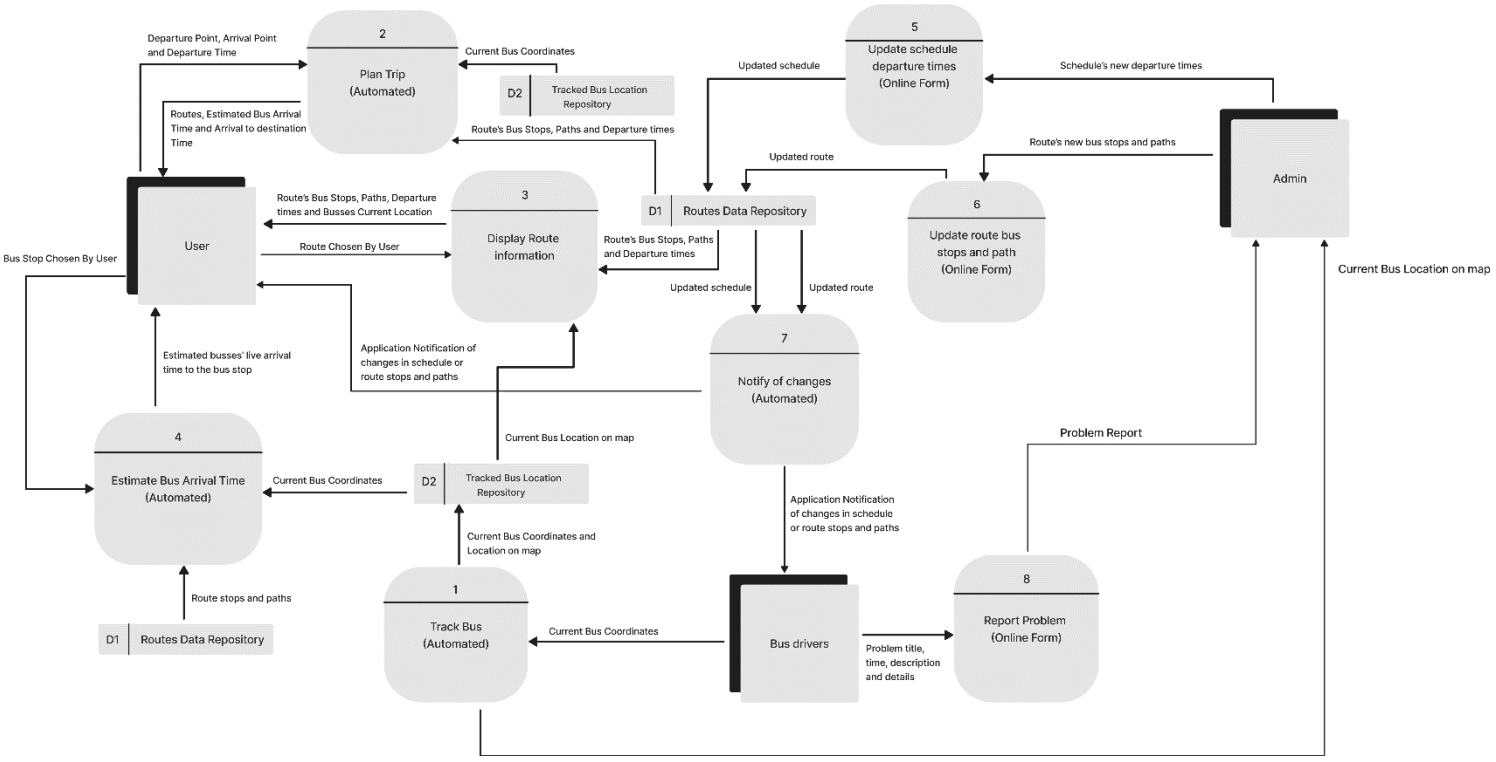
DISPLAY error message

ENDIF

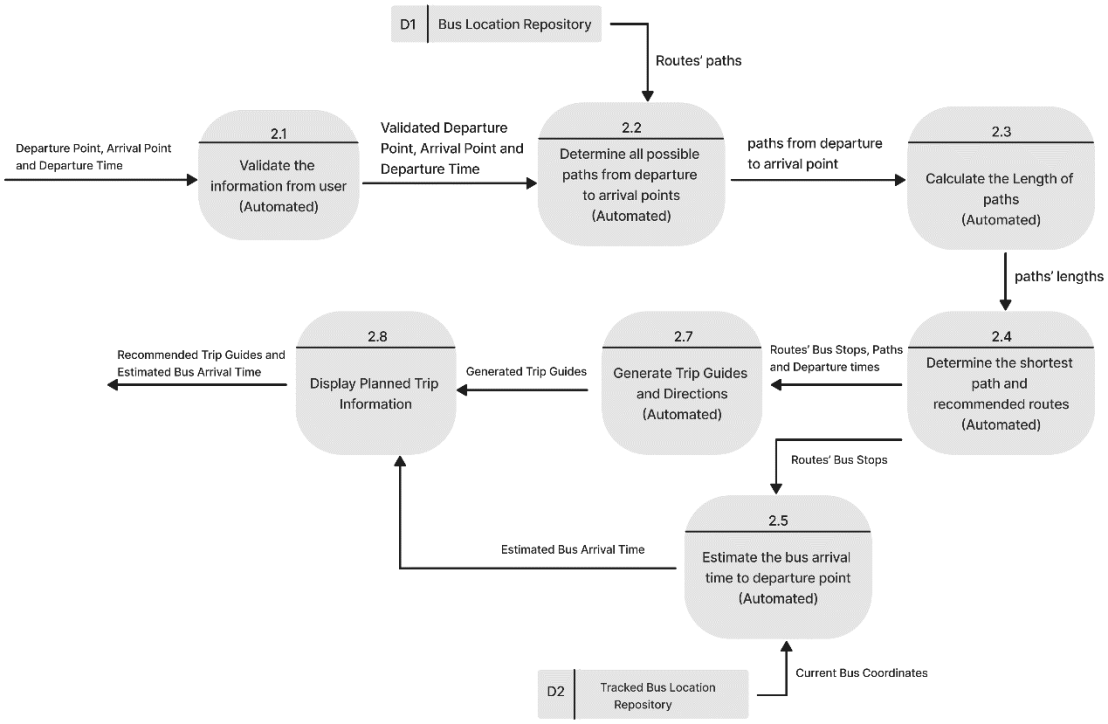
12. Physical System Design

12.1. Physical DFD TO-BE System

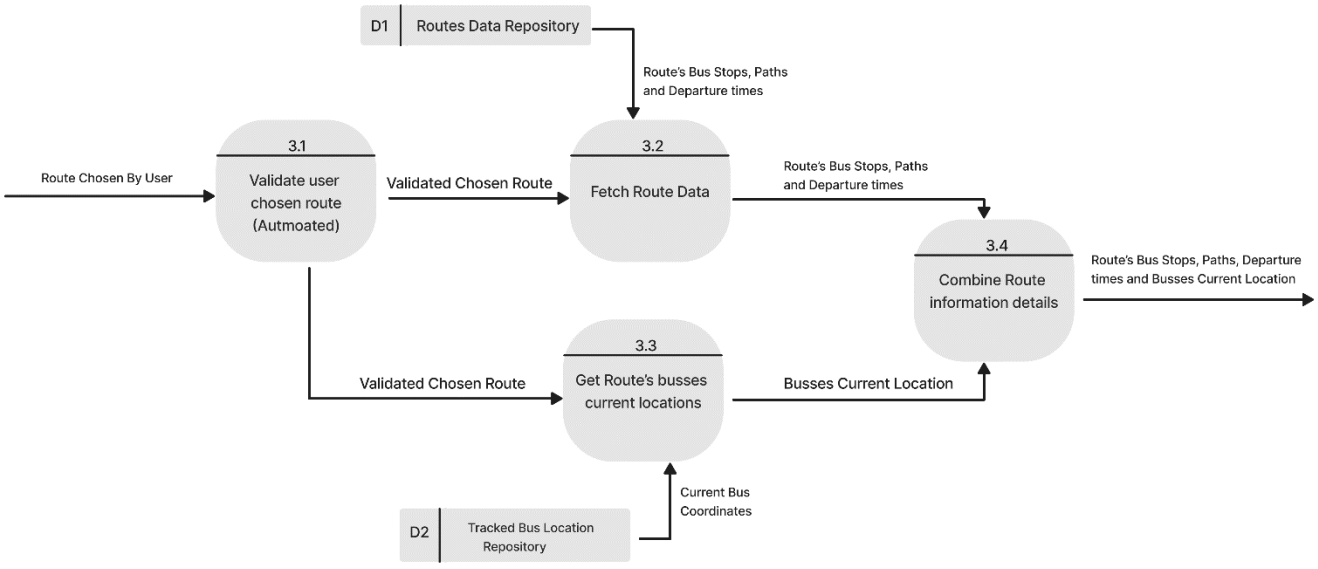
12.1.1. Level 0 Diagram



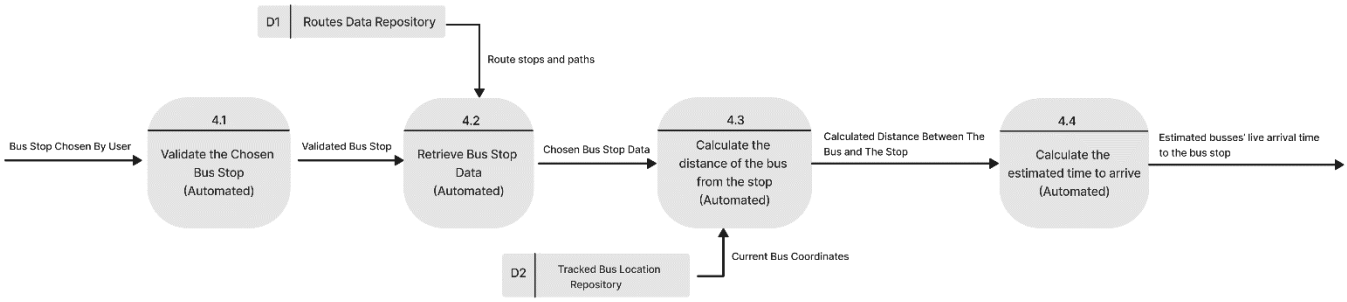
12.1.2. Physical Child Diagram for Process 2 (Plan Trip)



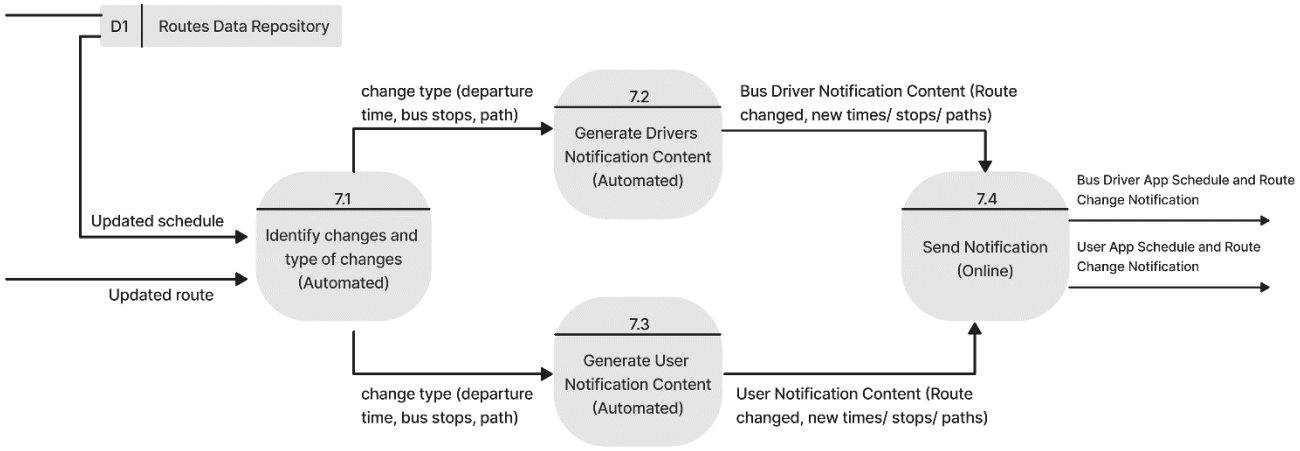
12.1.3. Physical Child Diagram for Process 3 (Display Route Information)



12.1.4. Physical Child Diagram for Process 4 (Estimate Bus Arrival Time)

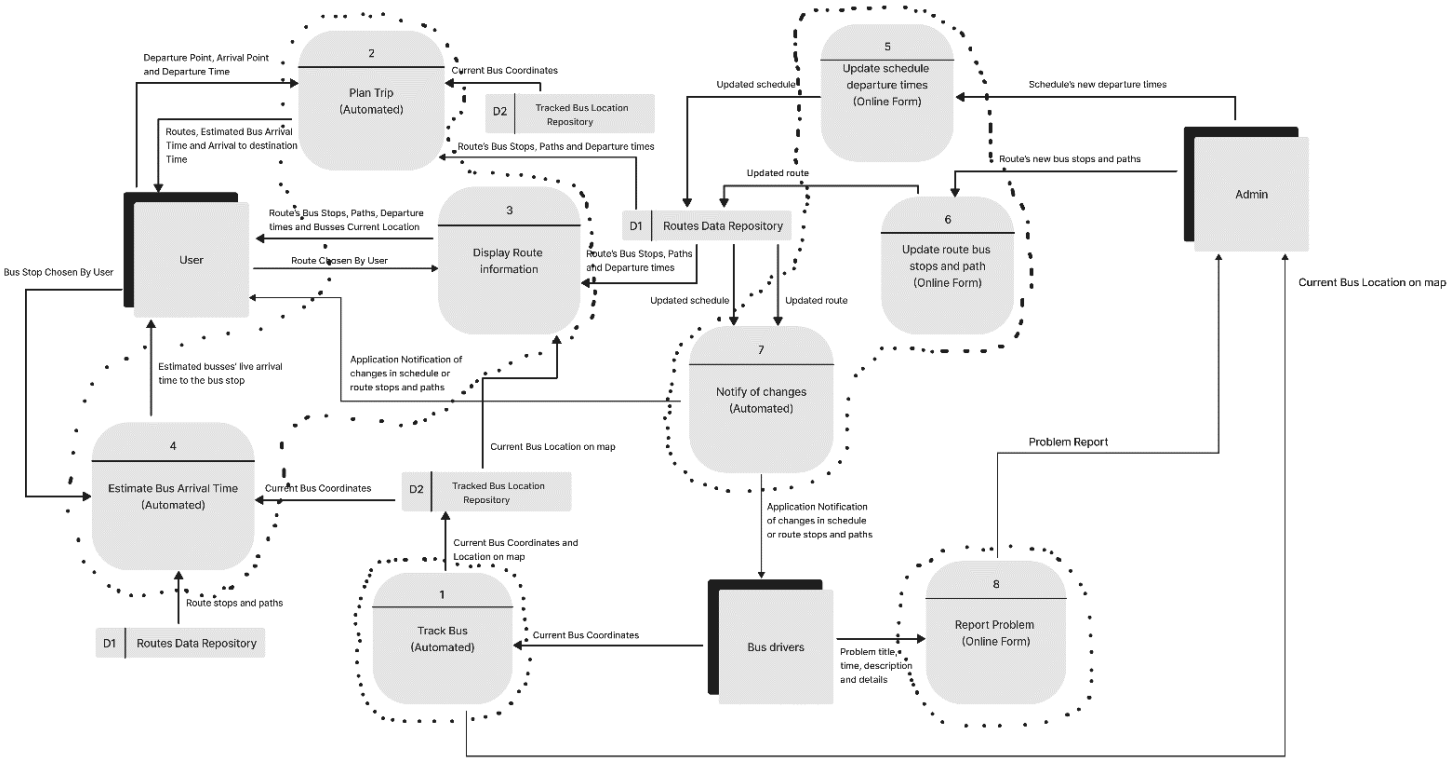


12.1.5. Physical Child Diagram for Process 7 (Notify of Changes)



12.1.6. DFD Partitioning

For the partitioning we grouped processes 2, 3 and 4 since they're used by the same user group (Passengers). Processes 5 and 6 are grouped together because they perform similar tasks and are used by the same user (Administration), process 7 is grouped with them for the consistency of data since they use related data. Processes 1 and 8 are individual because they're not directly related to other processes.



13. System Wireframe

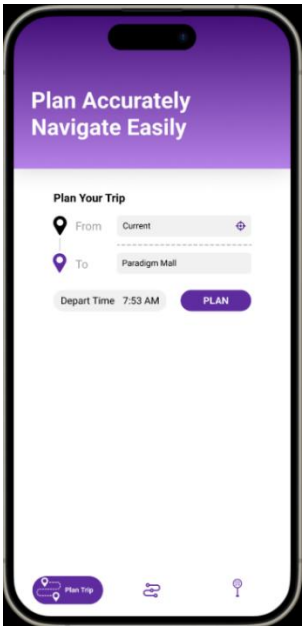
This part presents the developed prototype of the system. A link that leads to the prototype demo and screenshots of the design are included.

13.1. Figma Prototype link

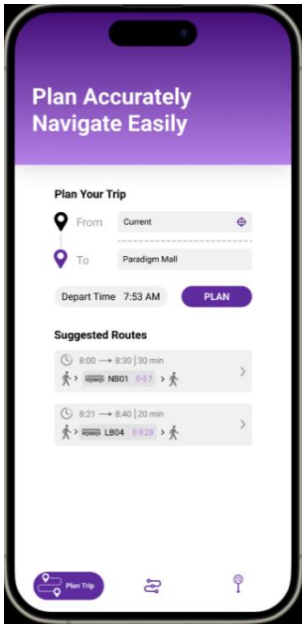
https://www.figma.com/proto/tXEZIyZzvSoCl17KCeXiqY/Bus_Real_Time_Tracking?node-id=11-2&t=NiN9i6UvsVpgjx24-1

13.2. Design Screenshots

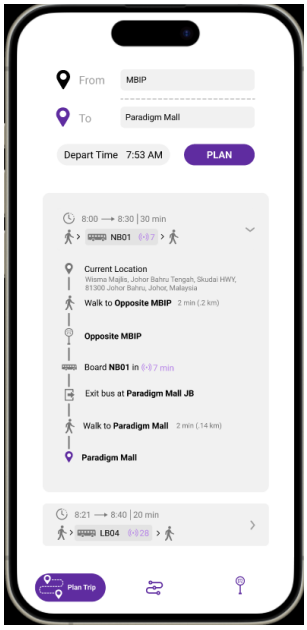
13.2.1. Plan Trip pages



Plan Trip page (Homepage)

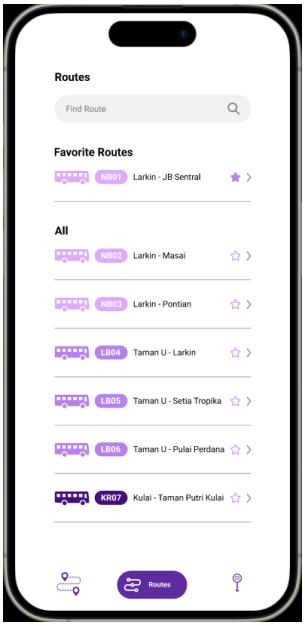


Plan Trip page (suggested routes)

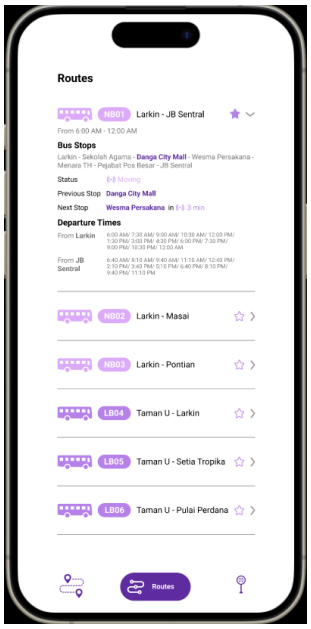


Plan Trip page (trip details)

13.2.2. Route pages

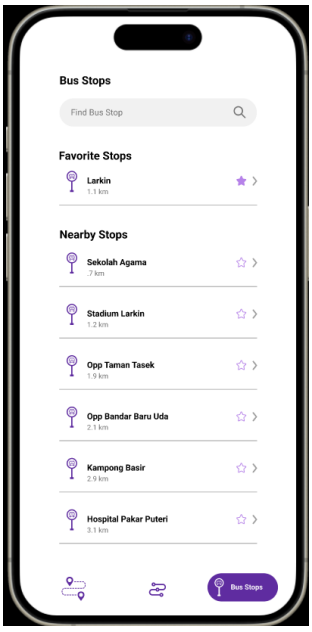


Routes page (Routes List)

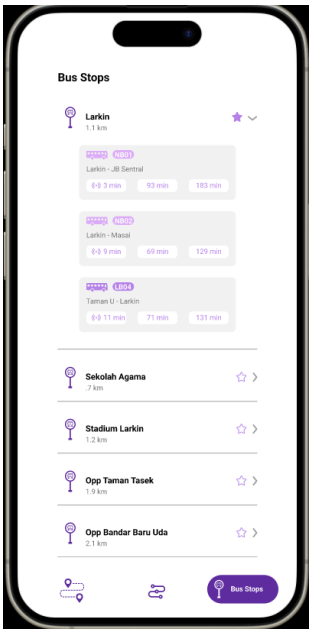


Route details page

13.2.3. Bus Stops pages

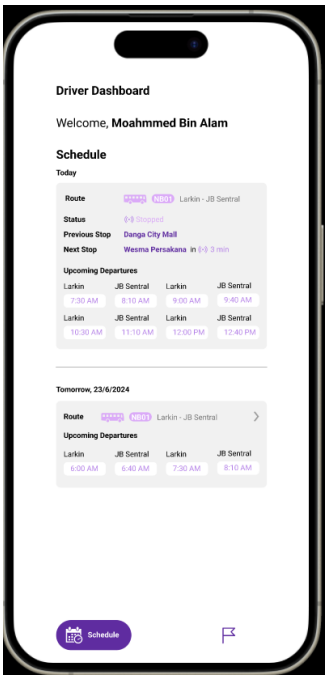


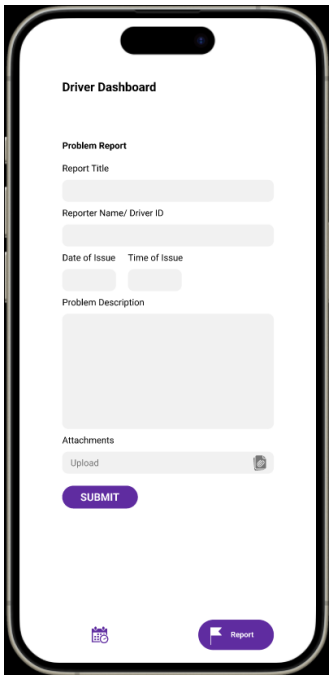
Bus Stops page (Bus Stops List)



Bus Stops page (Bus stop details)

13.2.1. Bus Driver pages





Bus Driver Schedule page

Bus Driver Report Problem page

14. Summary of Proposed System

The new system introduces bus tracking functionality which will enhance the planning capabilities for public transportation users, reducing delays and waiting times.
This system also improves the accessibility of information for both passengers and bus drivers. Also, an easy and simple way for drivers to report issues is introduced in this system which facilitates communication between drivers and administrators. Overall, the proposed system aims to greatly improve the user experience and the efficiency of public transportation.