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ASSIGNMENT-01

PROBLEM STATEMENT

Railway Tracking & Arrival Time Prediction System

Railway transportation is one of the most widely used modes of travel, especially in regions like India,
where millions of passengers rely on trains daily. However,
despite advancements in technology, passengers often face significant challenges in accessing reliable and accurate information about train locations, delays,
and platform details. This lack of transparency leads to frustration, missed connections, and poor travel planning.

Existing systems and applications, while helpful, often lack comprehensive features or fail to operate efficiently in low-connectivity areas. Passengers in rural or remote locations frequently struggle to track train movements in real-time. Moreover, the absence of an integrated platform for train schedules, delays, and platform numbers create inefficiencies for both passengers and railway staff.

The proposed Railway Tracking & Arrival Time Prediction System seeks to resolve these challenges by offering a real-time train tracking and prediction solution,
providing live updates on train locations, expected arrival times, platform information, and other critical travel details. By leveraging advanced GPS technology
and predictive algorithms, this solution aims to ensure seamless and stress-free travel for passengers.

SCOPE OF THE SYSTEM

The Railway Tracking & Arrival Time Prediction System is designed to provide passengers with accurate and real-time train information.
It will focus on the following:-

- Real-time tracking of trains using GPS technology.

- Accurate arrival time predictions based on speed, delays, and distance.

- Notifications about platform details and schedule changes.

- Offline functionality for passengers in low-connectivity areas.

- Integration of additional features such as seat availability and ticket booking assistance

KEY OBJECTIVES

1. Provide passengers with real-time updates about train locations and delays.

2. Enhance travel planning by offering accurate arrival and departure predictions.

3. Enable offline access to train tracking and updates.

4. Reduce passenger frustration by delivering timely notifications on schedule changes.

5. Support railway authorities in optimizing operations through data-driven insights.

ASSIGNMENT-02

Software Requirements Specification - Report (SRS-R)

1. Introduction

1.1 Purpose

Traveling by train can be stressful, especially when passengers don't have real-time updates on train locations, delays, or platform changes. Many people, especially in remote areas, struggle to get accurate and timely information, leading to missed connections and last-minute confusion.

This project aims to solve these issues by creating a Railway Tracking & Arrival Time Prediction System that provides live updates on train locations, expected arrival times, and platform details. Using GPS technology and smart prediction algorithms, the system will ensure that passengers always have the latest information at their fingertips. This will help make train travel more smooth, reliable, and stress-free, allowing people to plan their journeys with confidence.

1.2 Scope

Railways Tracking and Arrival Time Prediction System" is an attempt to simulate the basic concepts of an online tracking system. The system enables to perform the following functions:

- Tracking the Train
- Timing Details of the Train
- Expected Arrival and Departure Timings of the Train
- Improved and Optimised Service
- Remote Deployment to Travellers
- Time Saving

Intended Audience:

- Passengers travelling in train (any age group)
- Customers who are in the Station for pickup
- Passengers who have a linked train to board

1.3 Definitions, Acronyms and Abbreviations

- RTATP System: Railway Tracking & Arrival Time Prediction System – A system designed to provide real-time train tracking and estimated arrival times.
- GPS: Global Positioning System – A satellite-based system used to track train locations accurately.
- ETA: Estimated Time of Arrival – The predicted time at which a train is expected to reach a specific station.
- Admin: The system administrator responsible for maintaining the RTATP system and ensuring data accuracy.
- Passenger: Any individual using the railway services, including those traveling or waiting for arrivals.
- Platform Information: Details regarding which platform a train will arrive at, helping passengers plan their movement.
- Predictive Algorithm: A technology used to analyze historical data and real-time inputs to estimate train arrival times.

1.4 References

- Indian Railways Guidelines – Official regulations and protocols for train tracking and passenger information systems.
- GPS Technology Standards – Specifications and best practices for real-time location tracking using satellite systems.
- Machine Learning in Transportation – Research papers and case studies on predictive algorithms for arrival time estimation.

- Data Privacy and Security Laws – Compliance requirements for handling passenger data securely.
- Existing Railway Tracking Systems – Analysis of current solutions and their limitations in providing real-time updates.

2. Overall Description

2.1 Product Perspective

The Railway Tracking & Arrival Time Prediction (RTATP) System is a real-time train tracking solution designed to enhance passenger convenience by providing accurate train locations, estimated arrival times, and platform details. It is a stand-alone web and mobile-based application that integrates with existing railway infrastructure, including GPS tracking systems, railway databases, and scheduling platforms.

The system aims to address the challenges of train delays and lack of real-time updates, particularly in low-connectivity regions, ensuring seamless travel planning for passengers. By leveraging GPS technology and predictive algorithms, the RTATP system will improve efficiency, reduce uncertainty, and enhance the overall railway travel experience.

2.2 Product Functions

The major functions of this system that make it simple and user-friendly are:

1. LOGIN/REGISTER:

- Administrator
- Passenger/Customer

2. SEARCH

3. SELECTION

4. TRACKING

2.3 User Characteristics

This section ensures **passenger/customer comfort** while using the system.

- Educational Level
  - Users should be comfortable with **English or Hindi**.
- Technical Expertise
  - Users should be comfortable with **general-purpose applications** on **computers or mobile phones**.

2.4 Constraints

1. Real-Time Accuracy & Internet Dependency
   - The system must provide **accurate real-time tracking** with minimal delays but depends on a **stable internet connection**. Functionality may be limited in **low-connectivity** areas.

2. Scalability & Security
   - The system should handle **a large number of users and multiple trains** efficiently while ensuring **data privacy and security** by restricting modifications to **authorized personnel only**.

3. Specific Requirements

3.1 Functional Requirements

3.1.1 Performance Requirements:

- **User Satisfaction** – The system is such that it stands up to the user's expectations.
- **Response Time** – The response of all the operations is good. This has been made possible by careful programming.
- **Error Handling** – Response to user errors and undesired situations has been taken care of to ensure that the system operates without halting.
- **Safety and Robustness** – The system is able to avoid or tackle disastrous action. In other words, it should be foolproof. The system safeguards against undesired events, without human intervention.
- **Portable** – The software should not be architecture-specific. It should be easily transferable to other platforms if needed.
- **User Friendliness** – The system is easy to learn and understand. A native user can also use the system effectively, without any difficulties.

3.1.2 Design Constraints:

There are a number of factors in the client's environment that may restrict the choices of a designer. Such factors include standards that must be followed, resource limits, operating environment, reliability and security requirements, and policies that may have an impact on the design of the system.

- **Standard Compliance** – This specifies the requirements for the standards the system must follow. The standards may include the report format and accounting properties.

- **Hardware Limitations** – The software may have to operate on some existing or predetermined hardware, thus imposing restrictions on the design. Hardware limitations can include the types of machines to be used, the operating system available on the system, languages supported, and limits on primary and secondary storage.
- **Reliability and Fault Tolerance** – Fault tolerance requirements can place a major constraint on how the system is to be designed. Fault tolerance requirements often make the system more complex and expensive. Requirements about system behavior in the face of certain kinds of faults are specified. Recovery requirements are often an integral part here, detailing what the system should do if some failure occurs to ensure certain properties. Reliability requirements are very important for critical applications.
- **Security** – Security requirements are particularly significant in defense systems and database systems. They place restrictions on the use of certain commands, control access to data, provide different kinds of access requirements for different people, require the use of passwords and cryptography techniques, and maintain a log of activities in the system.

3.2 Non-Functional Requirements:

3.2.1 Performance Requirements:

- **Response Time:** The system should respond to user actions (e.g., page loads, button clicks) within 2 seconds. Critical operations, such as processing transactions or retrieving data, should complete within 5 seconds.

- **Scalability:** The system should be able to handle a growing number of users and requests without performance degradation. It should support at least 1,000 concurrent users.
- **Throughput:** The system should process at least 100 transactions per minute during peak hours.
- **Availability:** The system should be available 99.9% of the time, ensuring minimal downtime.
- **Resource Utilization:** The system should efficiently use server resources, keeping CPU and memory usage under 80% under normal load conditions.
- **Capacity:** The system should be capable of storing up to 1 million records in the database without performance issues.

3.2.2 Security Requirements:

The system must automatically log out all customers after a period of inactivity. The system should not leave any cookies on the customer's computer containing the user's password. The system's back-end servers shall only be accessible to authenticated management.

3.2.3 Usability Requirements:

- **Ease of Use:** The system should be easy to learn and use, even for non-technical users. It should follow intuitive navigation patterns and use familiar icons and buttons.
- **Consistency:** The user interface should maintain a consistent layout, color scheme, and design across all pages to provide a seamless experience.
- **Accessibility:** The system should be accessible to users with disabilities, complying with accessibility standards (e.g., WCAG 2.1).
- **Help and Documentation:** The system should provide on-screen help, tooltips, and comprehensive user documentation to assist users in navigating and using the application effectively.

- **Error Messages:** Error messages should be clear, concise, and provide guidance on how to resolve issues.
- **Feedback and Confirmation:** The system should provide immediate feedback for user actions (e.g., loading indicators, success messages) to confirm that actions have been processed.
- **Customization:** Users should be able to personalize their experience by adjusting settings such as themes, language preferences, and notification options.

3.2.4 Reliability Requirements:

The reliability of the overall project depends on the reliability of the separate components. The main pillar of reliability of the system is the backup of the database which is continuously maintained and updated to reflect the most recent changes. Also, the system will be functioning inside a container. Thus the overall stability of the system is ensured.

3.3 Interface Requirements:

3.3.1 User Interface:

- Layout and Design: The system should have a clean and intuitive user interface with a consistent layout across all pages. It should follow modern design principles for ease of navigation.
- Responsiveness: The UI should be responsive and adapt to different screen sizes, including desktops, tablets, and mobile devices.
- Navigation: The system should have a clear and consistent navigation menu, allowing users to easily move between different sections.

- Accessibility: The interface should support accessibility features, such as keyboard navigation and screen reader compatibility, ensuring usability for all users.
- Input Controls: The system should use standard input controls such as text fields, dropdowns, checkboxes, and radio buttons for user inputs.
- Visual Feedback: Actions like button clicks or form submissions should provide immediate feedback, such as loading indicators or success messages.
- Error Handling: The UI should display clear and helpful error messages with guidance on resolving issues.
- Branding and Aesthetics: The interface should align with the brand's color scheme, typography, and style guidelines.

3.3.2 Hardware Interface:

- Input Devices: The system should support standard input devices, including a keyboard, mouse, and touch input for touchscreen devices.
- Output Devices: The system should be compatible with various display resolutions and support both standard monitors and mobile screens.
- Network Requirements: A stable internet connection is required for accessing and interacting with the system.
- Compatibility: The system should work on standard hardware configurations, including desktops, laptops, tablets, and smartphones.

3.3.3 Software Interfaces:

- Operating Systems: The system should be compatible with major operating systems, including Windows, macOS, Android, and iOS.
- Web Browsers: The application should support modern web browsers like Google Chrome, Mozilla Firefox, Safari, and Microsoft Edge.

- Third-Party Integrations: The system should integrate with third-party services such as payment gateways, social media platforms, and email services through APIs.
- Database Management: The system should interact with a relational database (e.g., MySQL, PostgreSQL) for data storage and retrieval.
- Security and Authentication: The system should support secure authentication methods, including OAuth and JWT (JSON Web Tokens) for user sessions.
- APIs and Web Services: The system should provide RESTful APIs for interaction with client applications and third-party services.
- Development Frameworks: The front-end should be built using React.js or a similar modern JavaScript framework, while the back-end should use Node.js with Express for server-side logic

4. System Architecture

4.1 System Components

- **Frontend:** The user interface developed using HTML, CSS, JavaScript, and a frontend framework (e.g., React, Angular).
- **Backend:** Server-side logic developed using a programming language like Python, Java, or Node.js, connected to a database (e.g., MySQL, PostgreSQL).
- **Database:** Centralized database for storing course materials, student information, grades, and other data.
- **APIs:** REST APIs for communication between the frontend and backend.

5. Glossary:

This should define all technical terms and abbreviations used in the document:

- **NTES** - National Train Enquiry System
- **SRS** - Software Requirements Specifications
- **ART** - Accident Relief Trains
- **UML** - Unified Modelling Language
- **ETA** - Estimated Time of Arrival

6. REFERENCES

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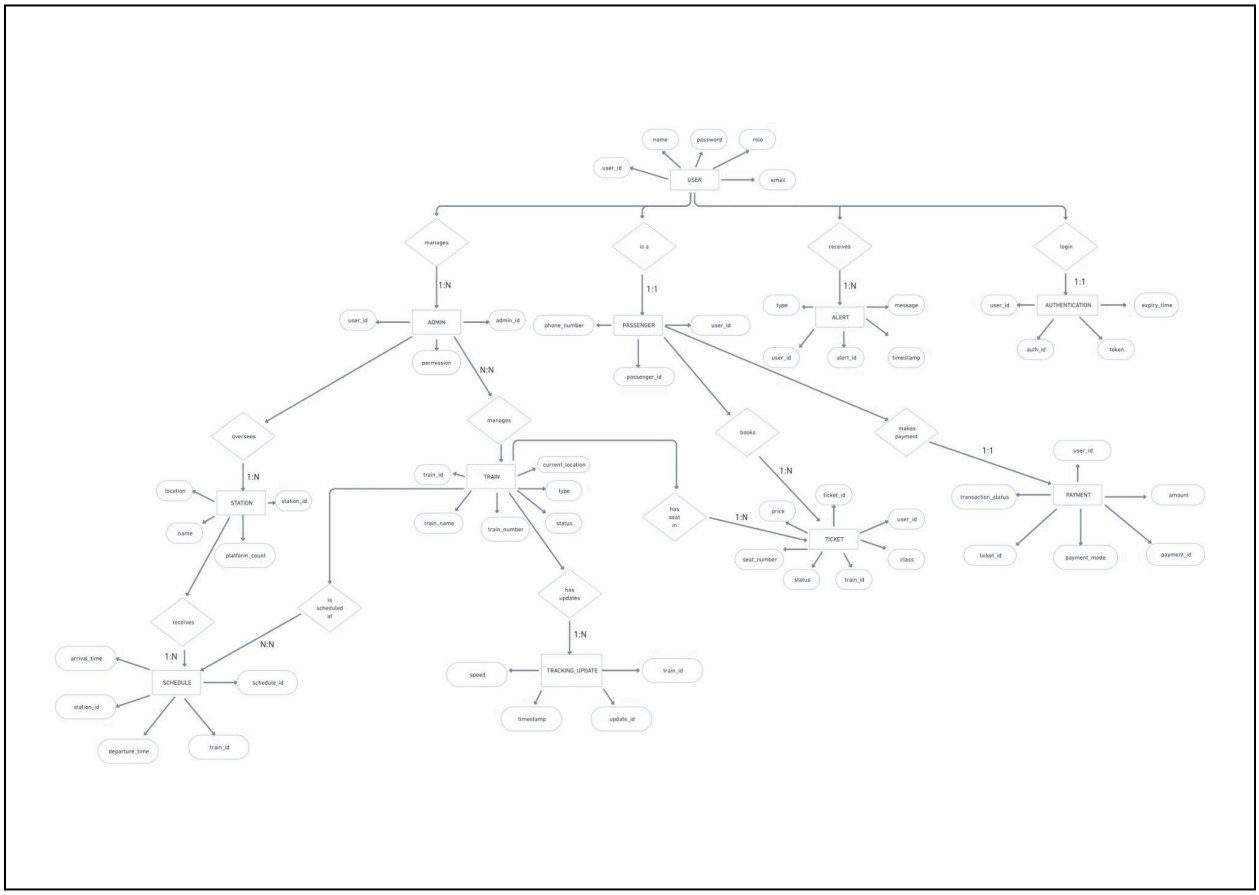
- www.irctc.co.in
- www.nationaltrainenquirysystem.com
- www.indianrail.gov.in
- www.academia.edu
- www.railyatri.com

ASSIGNMENT-03

Entity Relationship Diagram (ER Diagram)



Analysis of the Provided ER Diagram for the Railways Tracking and Arrival Time Prediction System

The ER (Entity-Relationship) diagram provided visually represents the database design for a Railway Tracking and Arrival Time Prediction System. It illustrates key entities (tables), their attributes (columns), and relationships among them. Below is a structured breakdown of the diagram's components:

Key Entities & Attributes

1. USER

Attributes: user_id (PK), name, email, password, role

Relationships:

A User logs in through the Authentication entity.
A User manages an Admin role.
A User receives alerts regarding train status.
A User can be a Passenger who books tickets.

2. AUTHENTICATION

Attributes: auth_id (PK), user_id (FK), token, expiry_time

Purpose: Handles secure login using authentication tokens.

3. ADMIN

Attributes: admin_id (PK), user_id (FK), permissions

Relationships:

Manages the railway operations, including train and station administration.

Oversees station and train schedules.

4. STATION

Attributes: station_id (PK), name, location, platform_count

Relationships:

A Station is scheduled in multiple trains' schedules.

Receives trains at specific times according to the schedule.

5. TRAIN

Attributes: train_id (PK), train_number, train_name, type, status, current_location

Relationships:

A train is scheduled at multiple stations in the Schedule entity.

Passengers book seats on a train via the Ticket entity.

Train updates its real-time location via the Tracking_Update entity.

6. SCHEDULE

Attributes: schedule_id (PK), train_id (FK), station_id (FK), arrival_time, departure_time

Purpose: Stores the arrival and departure times of trains at stations.

7. TRACKING_UPDATE

Attributes: update_id (PK), train_id (FK), timestamp, speed

Purpose: Provides real-time data on train movement.

8. PASSENGER

Attributes: passenger_id (PK), user_id (FK), phone_number

Relationships:

A Passenger books a Ticket for a train.

A Passenger makes a payment for a ticket.

9. TICKET

Attributes: ticket_id (PK), user_id (FK), train_id (FK), seat_number, class, price, status

Purpose: Represents a reserved seat on a train for a passenger.

10. PAYMENT

Attributes: payment_id (PK), ticket_id (FK), user_id (FK), amount, payment_mode, transaction_status

Purpose: Stores payment details for ticket bookings.

11. ALERT

Attributes: alert_id (PK), user_id (FK), message, timestamp, type

Purpose: Sends notifications to users about train status and schedule changes.

RELATIONSHIPS AND CARDINALITY :

One User can manage multiple Admins (1:N).

An Admin oversees multiple Stations and Trains (1:N).

A Train can be scheduled at multiple Stations (N:M).

A Train has multiple Tracking Updates (1:N).

A Passenger can book multiple Tickets (1:N).

A Ticket is associated with one Payment (1:1).

A User receives multiple Alerts (1:N).

Key Insights from the Diagram

1. Scalability & Efficiency

The system is designed to handle large-scale railway operations with real-time tracking and ticketing.

2. Data Integrity

Relationships between entities ensure consistency, preventing data duplication or mismatches.

3. Security

Authentication & role-based access control ensures secure login for users and admins.

4. Passenger Experience

Real-time train tracking and alerts improve user convenience.

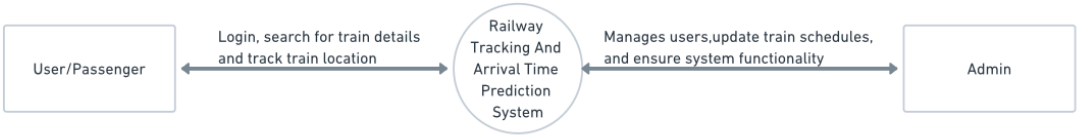
5. Revenue & Payments

A structured payment system ensures secure transactions.

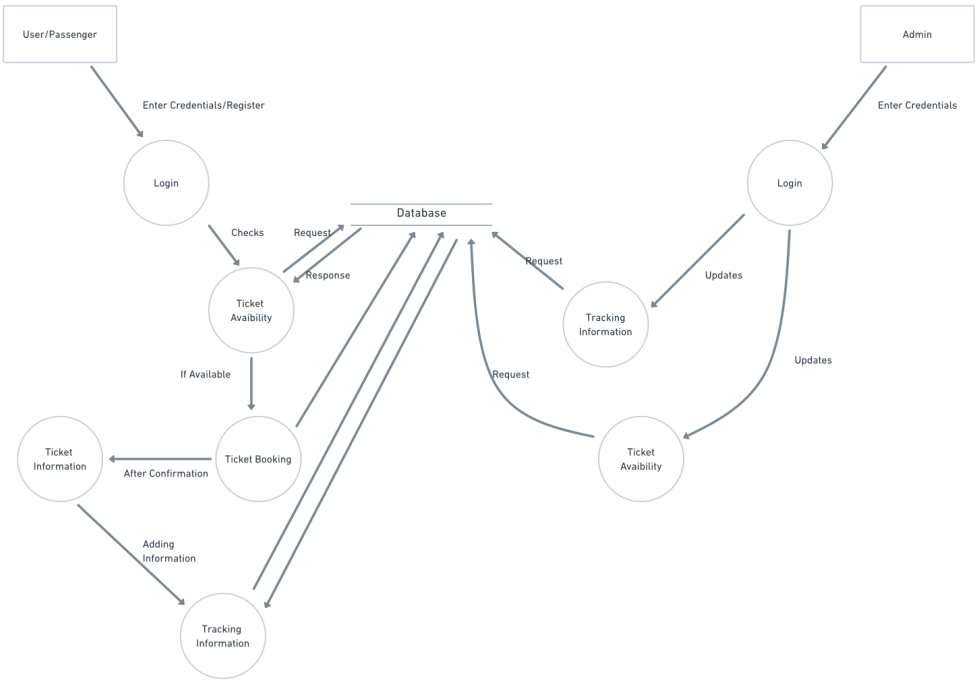
ASSIGNMENT-04

Data Flow Diagram

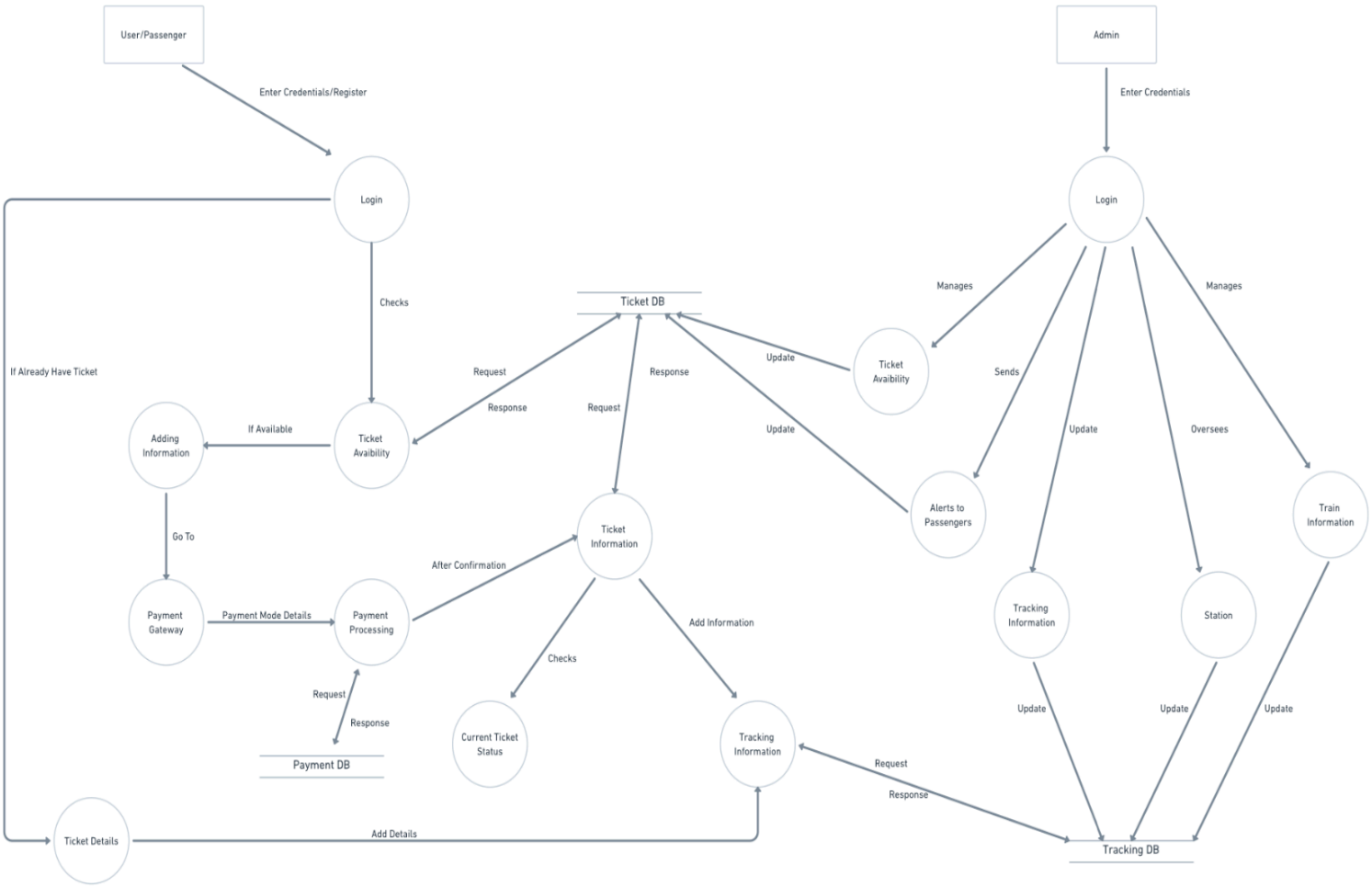
Level-0 Diagram



Level-1 Diagram



Level-2 Diagram



ASSIGNMENT-05

USE CASE DIAGRAM

USE CASE DESCRIPTION

User Login

Mainline Sequence:

1. Passenger selects the "Login" option.
2. System prompts for credentials.
3. Passenger enters username and password.
4. System verifies user existence and password authenticity.
5. If verified, the user gains access to the system.

Alternative Scenarios:

- **Forgot Password:**
    1. Passenger selects "Forgot Password."
    2. System prompts for email, phone, or username.
    3. Passenger provides required details.
    4. System checks for the user in the database.
    5. If found, a recovery key is sent via email/SMS.
    6. Passenger uses the key to reset the password.

- **Incorrect Credentials:** If the user enters incorrect credentials, the system displays an error message and prompts re-entry.

- **Already Registered User:** If the user is already registered, the system redirects them to the login page.

New User Registration

Mainline Sequence:

1. Passenger selects "Register."

2. System provides a registration form.

3. Passenger inputs details such as name, email, phone number, and password.

4. System registers the user and assigns a unique user ID.

5. A verification email is sent to confirm registration.

Alternative Scenario:

- **Invalid Input:** If the user provides incomplete or incorrect details, the system prompts them to correct the errors before proceeding.

Train Tracking Process

Mainline Sequence:

1. Passenger selects the "Track Train" option.

2. System prompts for train number or name.

3. Passenger inputs the train details.

4. System retrieves real-time location of the train using GPS and railway network data.

5. The system displays the live location on a map interface.

Alternative Scenario:

- **Invalid Train Details:** If the entered train number is incorrect or unavailable, the system displays an error message and prompts re-entry.

Arrival Time Prediction

Mainline Sequence:

1. Passenger selects "Check Arrival Time."

2. System prompts for train details and destination station.

3. Passenger inputs the required details.

4. System fetches real-time train speed, route data, and historical travel times.

5. AI-based prediction model calculates estimated arrival time.

6. System displays the predicted arrival time with accuracy indicators.

Alternative Scenario:

- **Data Unavailable:** If real-time data is missing, the system provides an estimated time based on historical trends.

Admin Train Data Management

Mainline Sequence:

1. Admin logs into the system using secure credentials.
2. Admin selects "Manage Train Data."
3. System displays train schedules and real-time tracking information.
4. Admin can update train schedules, status, or add new trains.
5. System processes and updates the data in the database.

Alternative Scenario:

- **Unauthorized Access:** If an unauthorized user attempts access, the system denies entry and logs the attempt for security monitoring.

Notification & Alerts

Mainline Sequence:

1. System continuously monitors live train data.
2. If a train is delayed, the system generates an alert.

3. System sends notifications to passengers who have subscribed for alerts via email or SMS.

4. Passengers receive real-time updates about delays or expected arrival time changes.

Alternative Scenario:

- **No Subscription:** If a passenger has not subscribed for alerts, the system does not send notifications.

Passenger Query & Feedback System

Mainline Sequence:

1. Passenger selects "Help & Support."

2. System presents options such as FAQs, live chat, and feedback forms.

3. Passengers can submit queries or feedback.

4. System routes queries to the relevant department for resolution.

5. Admin reviews and responds to passenger concerns.

Alternative Scenario:

- **Invalid Query:** If a query is not understandable, the system asks for clarification.

Emergency Alerts & Safety Features

Mainline Sequence:

1. If an emergency occurs, railway authorities trigger an alert.
2. System instantly broadcasts messages to passengers and staff.
3. Alerts include information on safety measures and alternative routes.
4. Emergency contacts are notified for necessary actions.

Alternative Scenario:

- **False Alarm:** If an alert is triggered by mistake, the system allows admins to cancel the alert with appropriate authorization.

Ticket Booking

Mainline Sequence:

1. Passenger logs in and selects the "Book Ticket" option.
2. System prompts for travel details (source, destination, date, train).
3. Passenger searches and selects an available train.
4. System displays available classes, seats, and fares.
5. Passenger selects seat/class and enters passenger details.
6. System calculates fare and prompts for payment.
7. Passenger makes a secure online payment.

8. System confirms booking, generates a PNR, and sends e-ticket via email/SMS.

Alternative Scenarios:

Payment Failure: If payment fails, the system rolls back the booking and prompts for retry.

No Availability: If no seats are available, the system suggests alternative trains or waitlisting options.

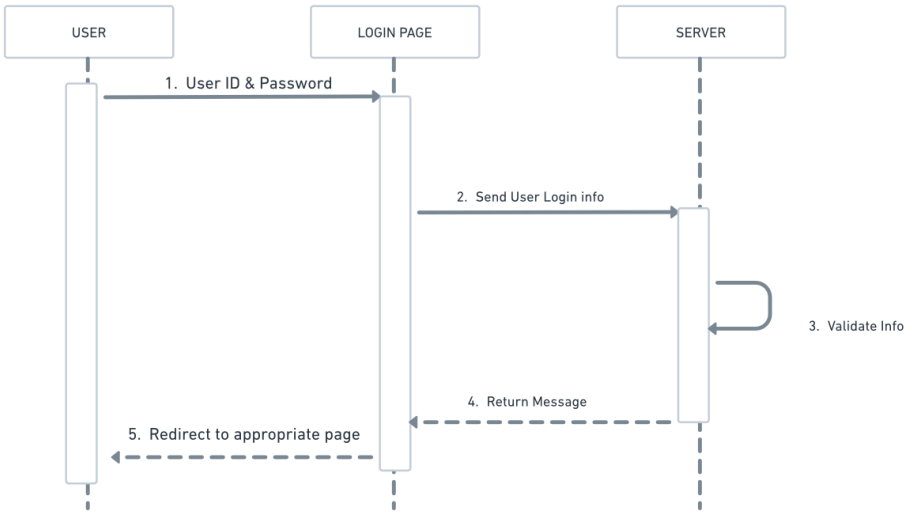
Conclusion

The Railway Tracking & Arrival Time Prediction System enhances railway travel by ensuring passengers receive accurate, real-time updates on train locations and arrival times. With features such as AI-based predictions, notifications, and emergency alerts, the system improves efficiency, safety, and passenger satisfaction. Railway administrators can manage schedules effectively, ensuring smooth operations and reduced delays. This system revolutionizes railway travel by integrating cutting-edge technology for real-time tracking and predictive analytics.

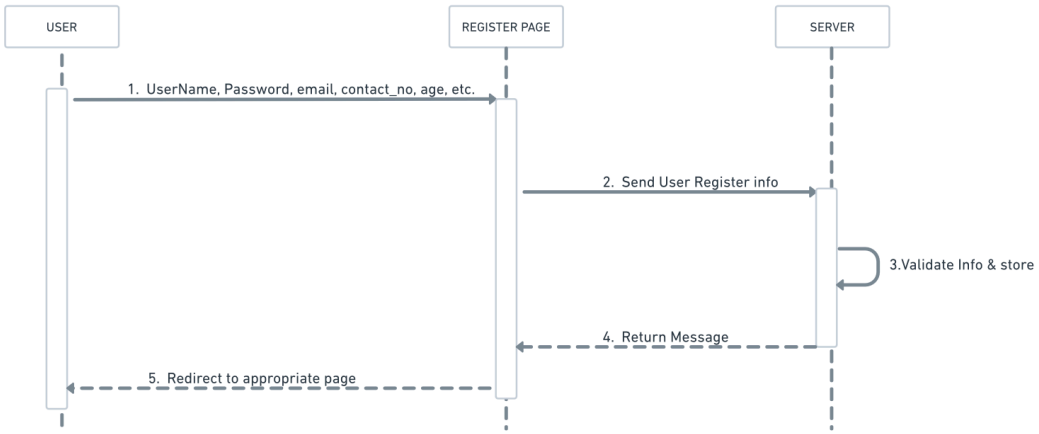
ASSIGNMENT-06

SEQUENCE DIAGRAM

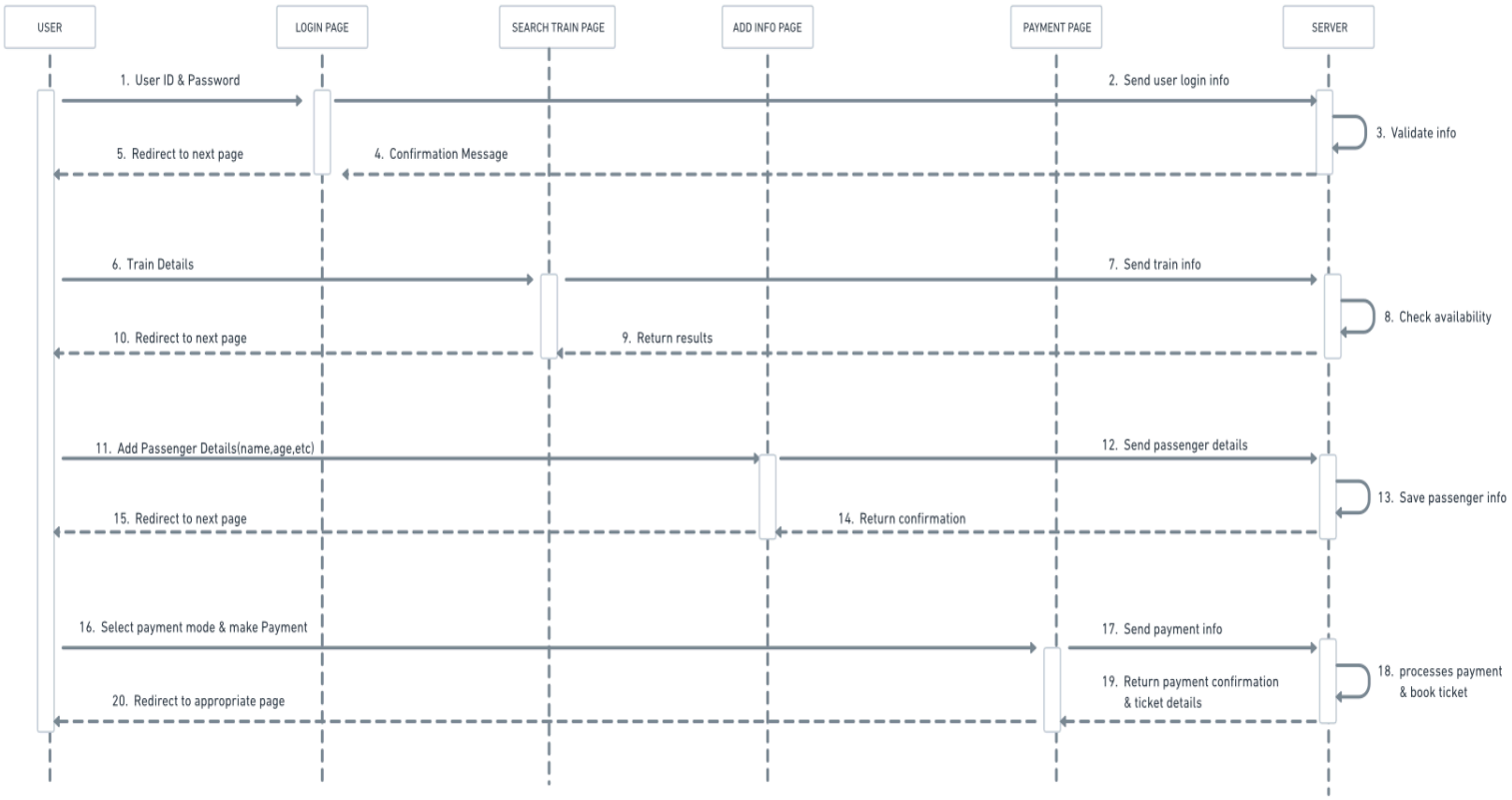
Login Diagram



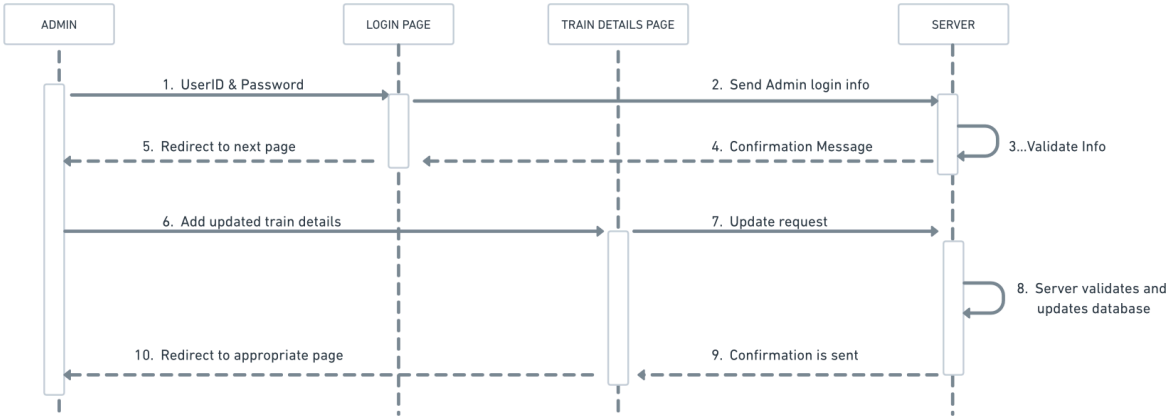
Register Diagram



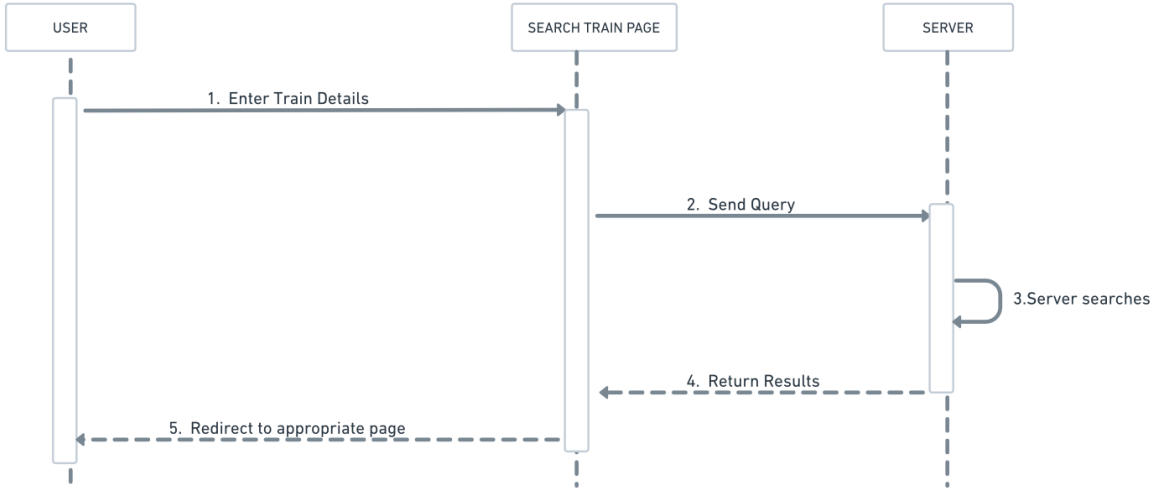
Ticket Booking Diagram



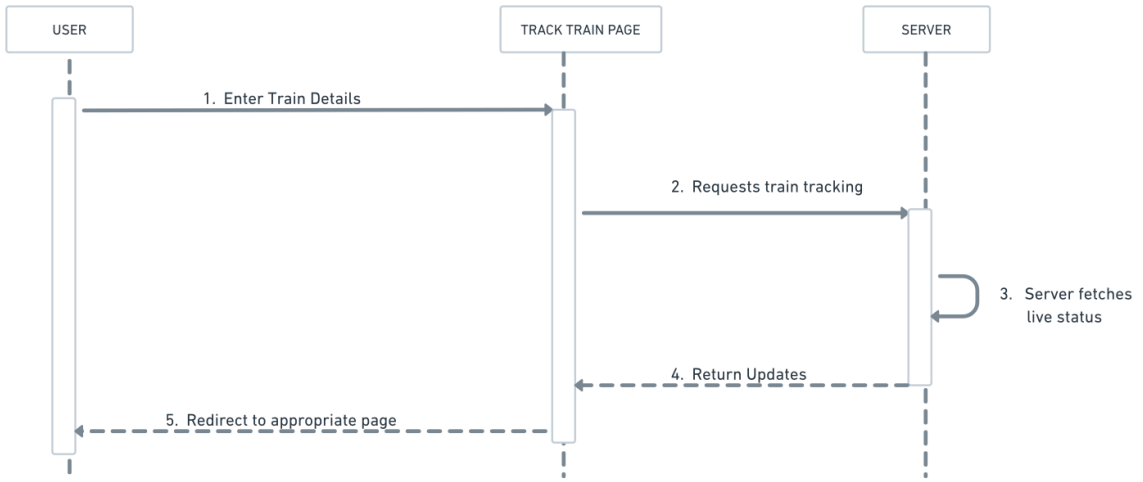
Update Train Details Diagram



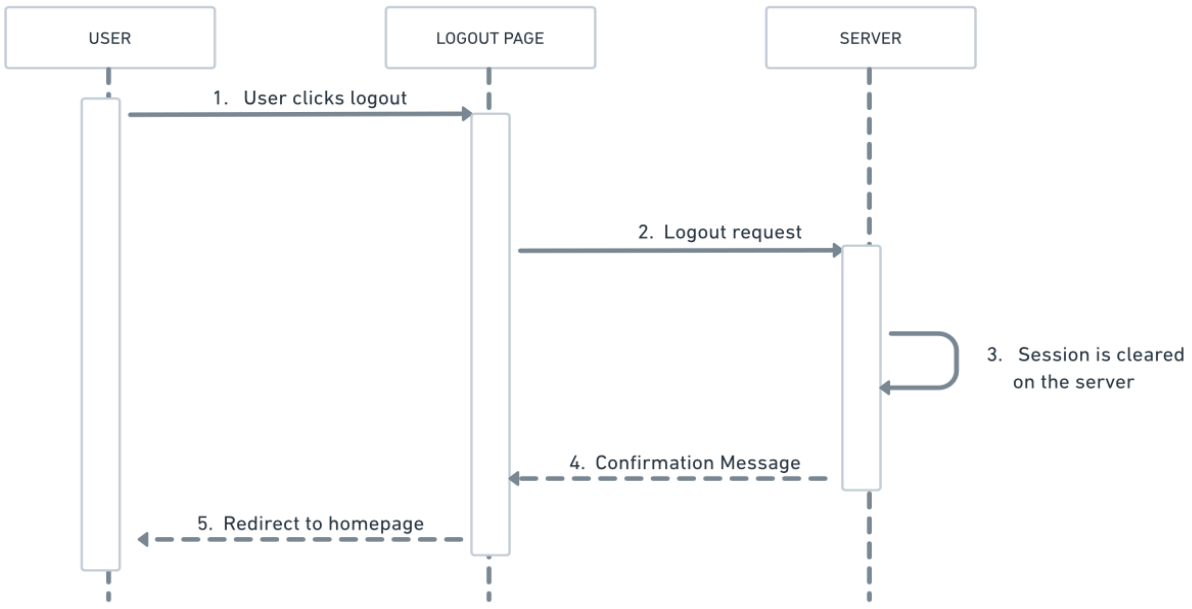
Search Train Diagram



Tracking Train Diagram



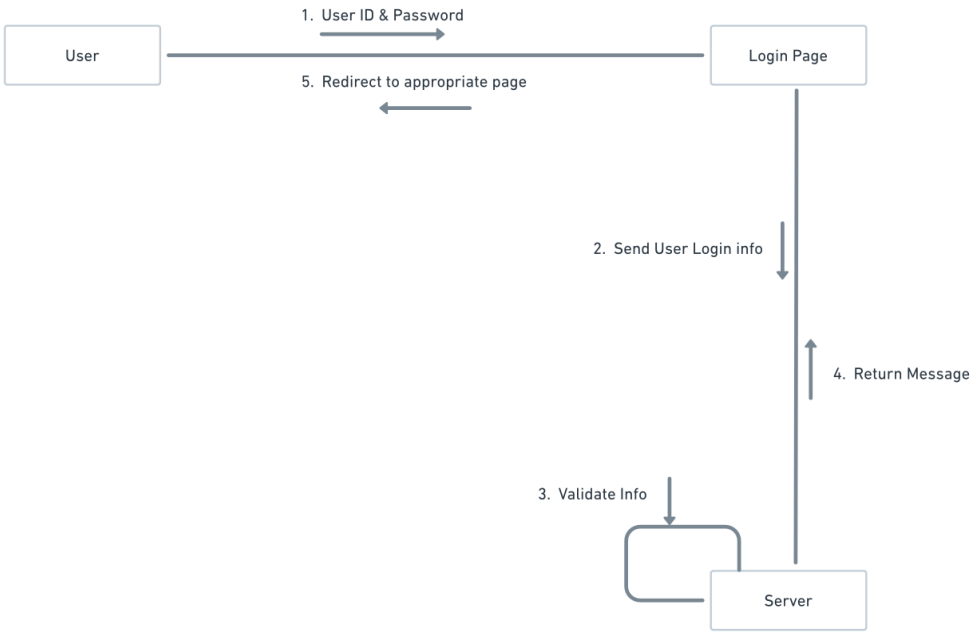
Logout Diagram



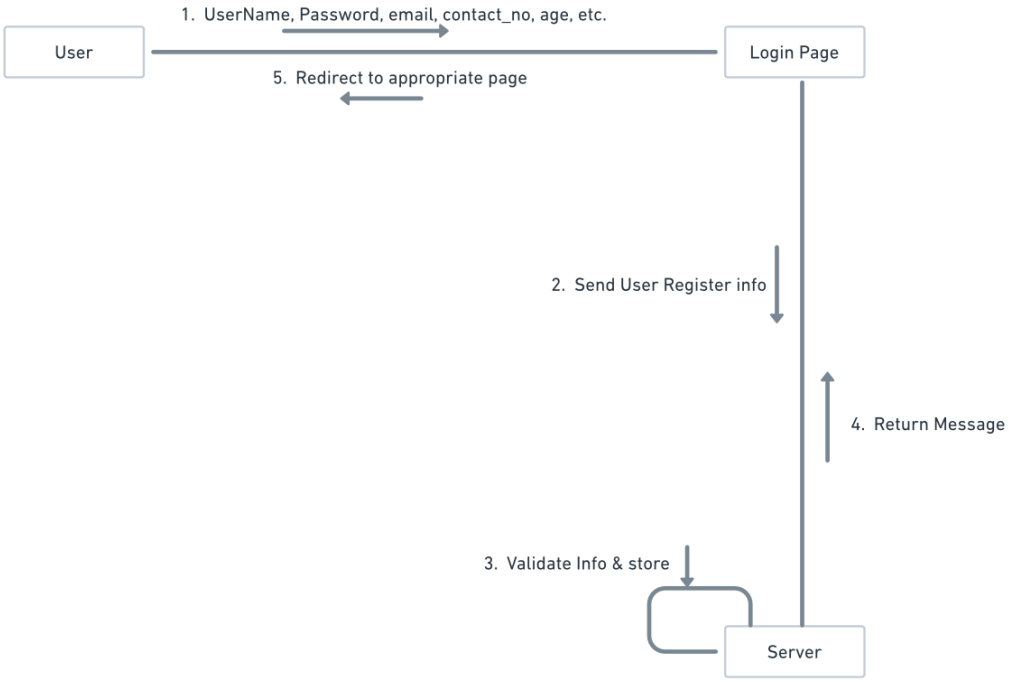
ASSIGNMENT-07

COLLABORATION DIAGRAM

Login Diagram

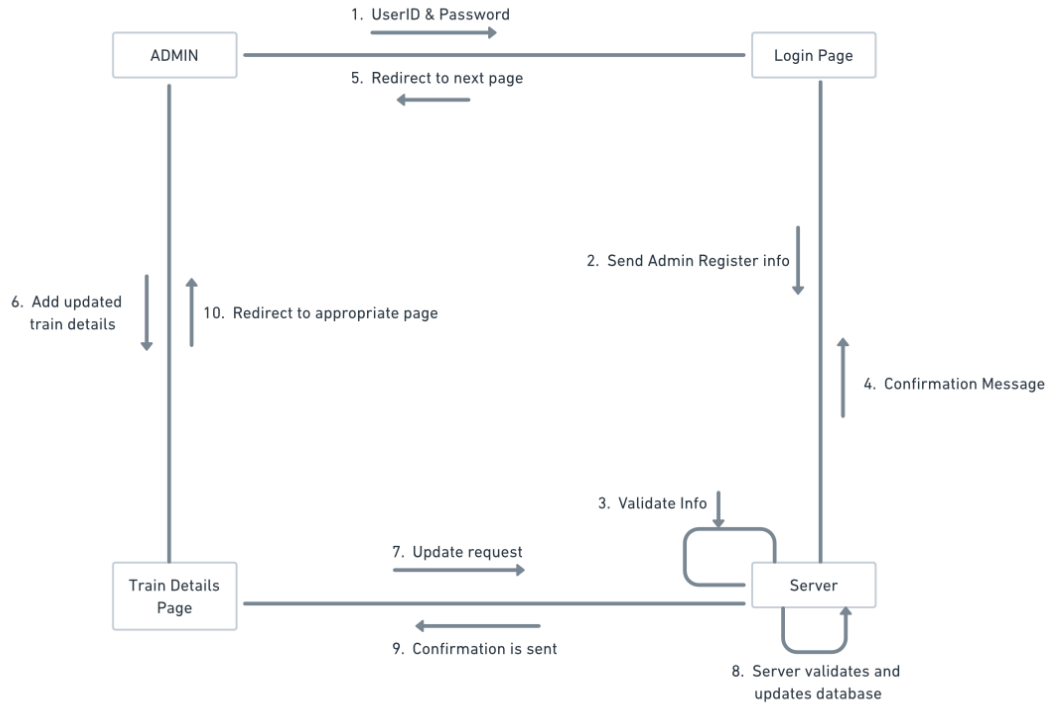


Register Diagram

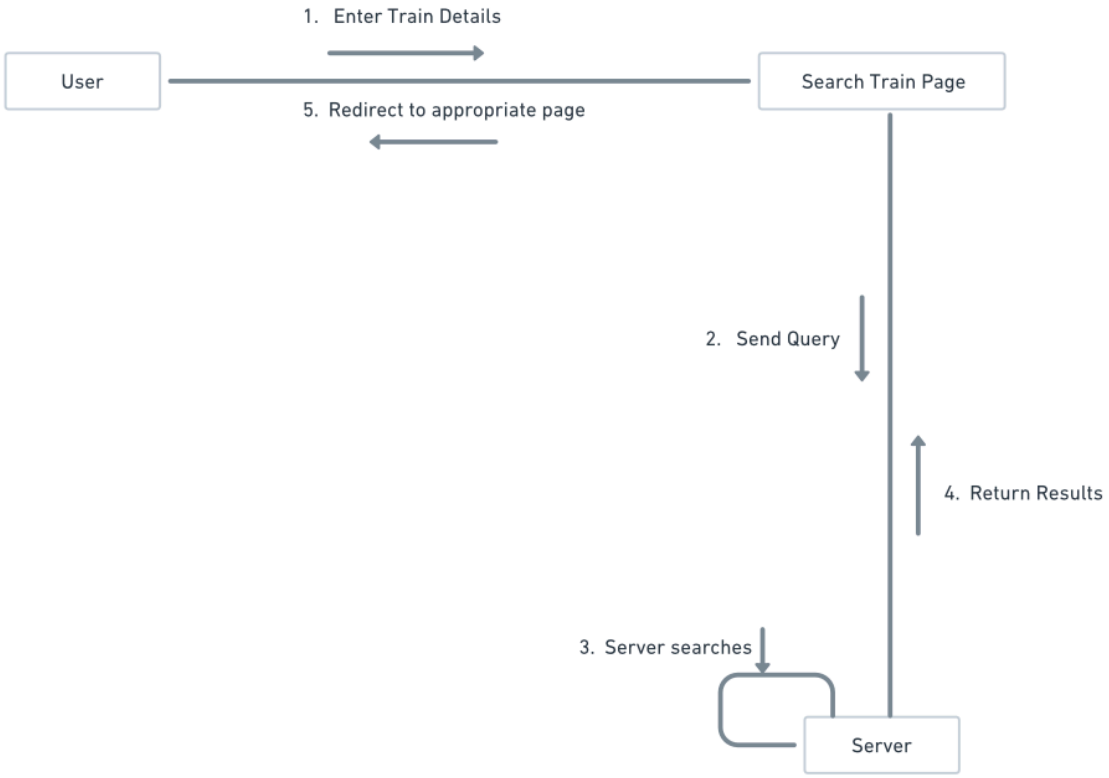


Ticket Booking Diagram

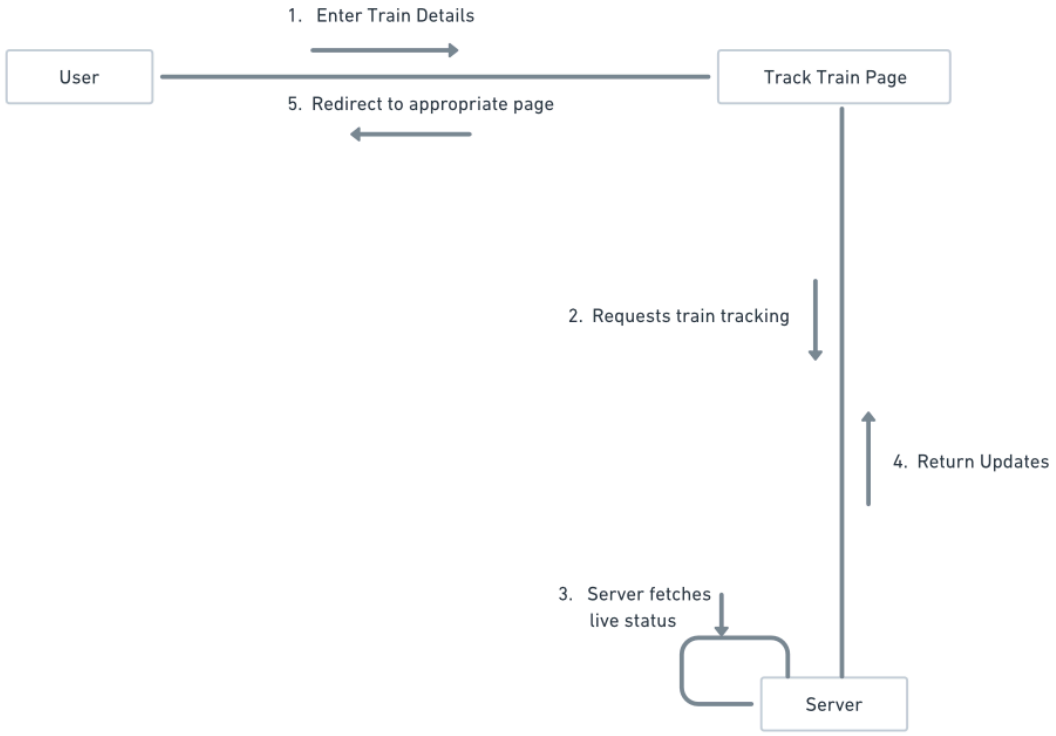
Update Train Details Diagram



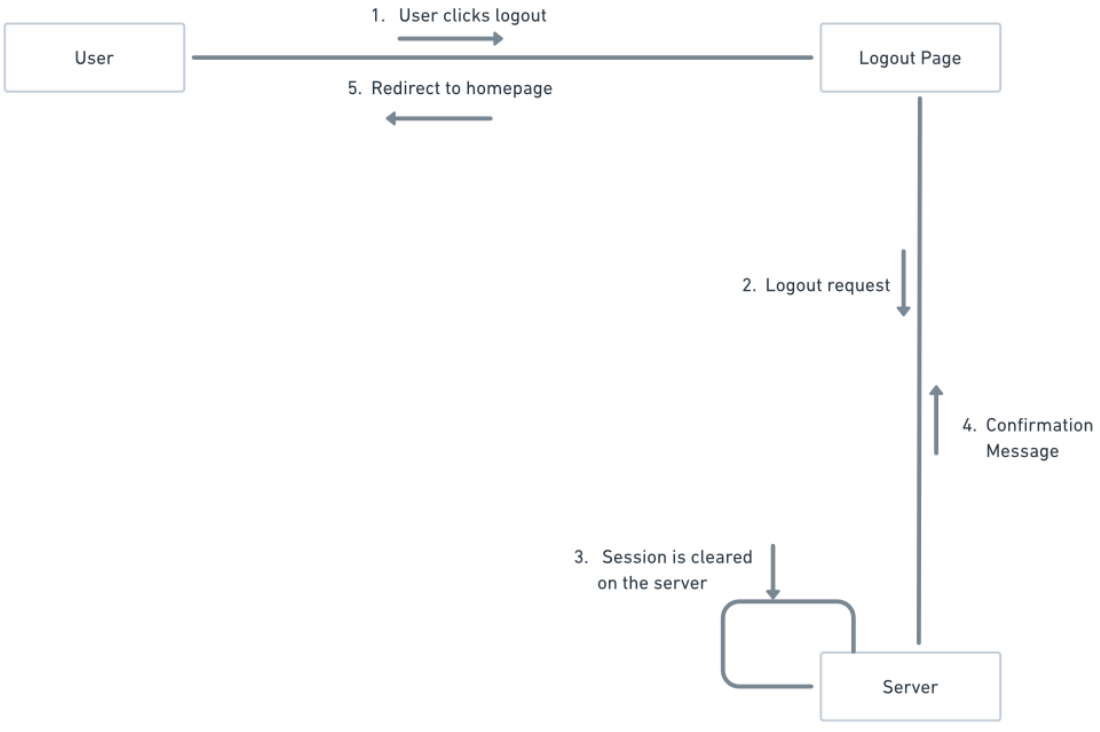
Search Train Diagram



Tracking Train Diagram



Logout Diagram



ASSIGNMENT-08

ACTIVITY DIAGRAM