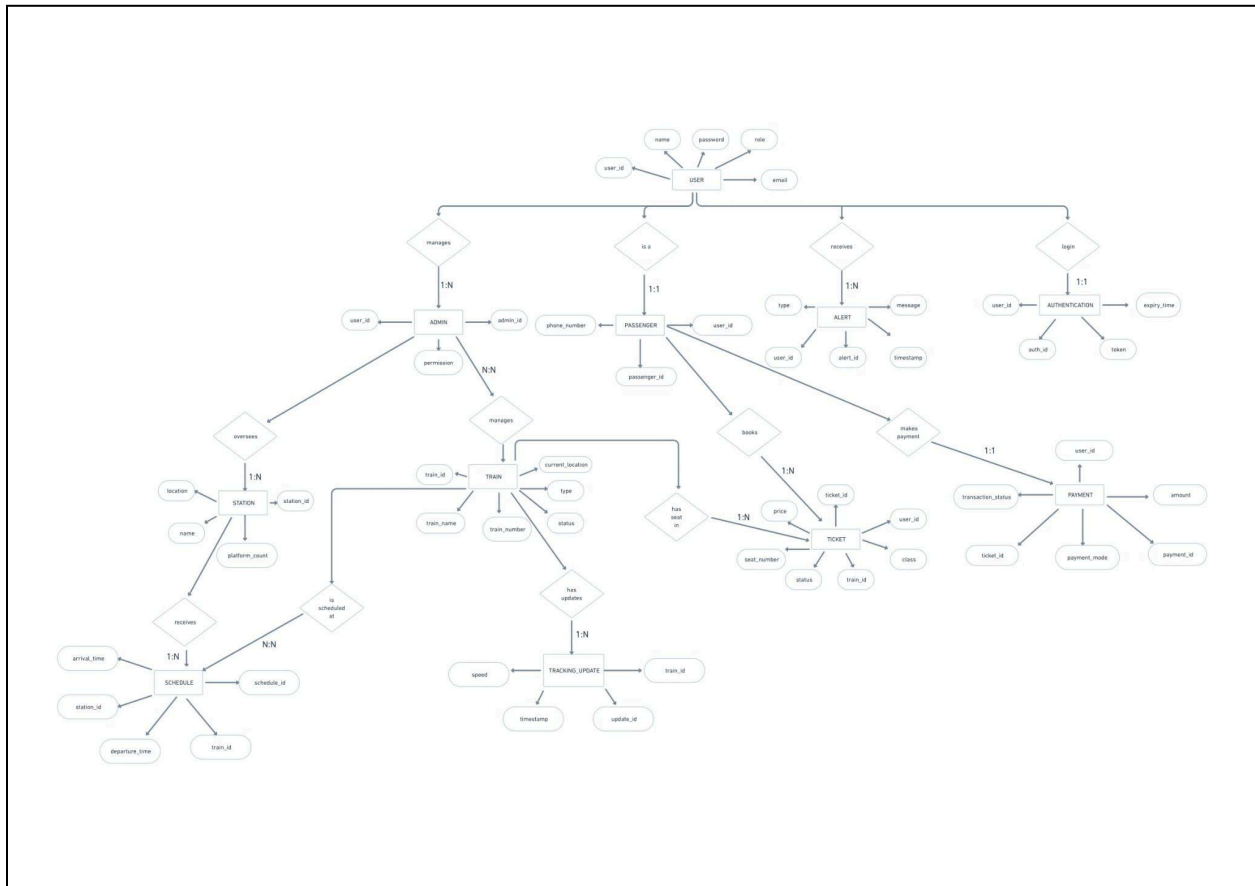


Entity Relationship Diagram (ER Diagram)



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.

