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| RV COLLEGE OF ENGINEERING®, BENGALURU-560059  (Autonomous Institution Affiliated to VTU, Belagavi)  **DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING**    **Voice Based Transport Enquiry System**  ***Mini - Project Report***  ***Submitted by***  **Sahil Santosh Naik 1RV22CS169**  **Sai Varun Konda 1RV22CS171**  **Samarth D Gothe 1RV22CS173**  ***in partial fulfillment for the requirement of 5th Semester***  ***DATABASE MANAGEMENT SYSTEMS (CD252IA)***  **Under the Guidance of**  **Dr. Pratiba D, Associate Professor , Department of Computer Science and Engineering, RV College of Engineering** |
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**Academic Year 2024 -2025**

**RV COLLEGE OF ENGINEERING®, BENGALURU 560059 (Autonomous Institution Affiliated to VTU, Belagavi)**

**DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING**



**CERTIFICATE**

Certified that the project work titled ‘**voice-based transport enquiry system’** is carried out by Sahil Santosh Naik, Sai Varun Konda, Samarth D Gothe,who are bonafide students of R. V. College of Engineering, Bengaluru, in partial fulfillment of the curriculum requirement of 5th Semester **Database Management Systems(CD252IA)** Laboratory Mini Project during the academic year **2024-2025**. It is certified that all corrections/suggestions indicated for the internal Assessment have been incorporated in the report. The report has been approved as it satisfies the academic requirements in all respect laboratory mini-project work prescribed by the institution.

**Signature of Faculty In-charge Head of the Department**

**Dept. of CSE, RVCE**

**External Examination**

**Name of Examiners Signature with date**

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**DECLARATION**

We**, SAMARTH D GOTHE, SAHIL S NAIK and SAI VARUN KONDA** the students of Fifth Semester B.E., Department of Computer Science and Engineering, RV College of Engineering, Bengaluru hereby declare that project titled “**Voice Based Transport Enquiry System**” has been carried out by us and submitted in partial fulfillment for the **Internal Assessment of the Course: Database Management Systems** **(CD252IA)** during the academic year 2024-2025. We also declare that the matter embodied in this report has not been submitted to any other university or institution for the award of any other degree or diploma.

**Place: Bengaluru**

**Date: 21st, February , 2025**

**Name Signature**

**1. SAMARTH D GOTHE (1RV22CS173)**

**2. SAHIL S NAIK (1RV22CS169)**

**3. SAI VARUN KONDA (1RV22CS171)**

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**Abstract**

The rapid growth in transportation demand has emphasized the need for innovative and seamless solutions that improve commuter experience. This project introduces a **Voice-Enabled Transport System**, designed to provide users with an intuitive interface for exploring transportation options and receiving real-time updates. The system leverages advanced hybrid database architecture, combining SQL and NoSQL databases, to efficiently manage structured and unstructured data, ensuring smooth functionality and scalability.

Users can interact with the platform using voice commands to search for schedules, explore routes, and access live updates on transport status. The integration of Text-to-Speech (TTS) and Speech-to-Text (STT) technologies makes the system highly accessible and user-friendly, catering to a diverse audience. By combining these advanced features, the platform provides a modern and reliable solution for commuters while addressing challenges related to static and dynamic data management.

Technically, the system relies on SQL databases to manage structured data, including train schedules, route maps, and user profiles, while NoSQL databases handle dynamic, real-time data such as voice command logs, user preferences, and live updates. This hybrid approach ensures robust data handling, delivering efficient performance and scalability for both static and real-time queries.

The project draws inspiration from existing technologies such as Google Maps Transit, which integrates relational and real-time systems, and Uber, which combines SQL for ride history with NoSQL for live tracking and pricing. By building on these methodologies, the Voice-Enabled Transport System enhances usability through a unified interface, offering features like personalized recommendations, dynamic route tracking, and live status updates.

By addressing the limitations of traditional transport systems, this platform redefines the way users interact with transportation services. It promotes efficiency, accessibility, and real-time responsiveness, paving the way for smarter, scalable, and user-centric transport management solutions. This system represents a significant step forward in bridging the gap between technology and commuter needs, ensuring a seamless and dynamic travel experience.

**Table of Contents**

|  |  |  |
| --- | --- | --- |
|  | Acknowledgement | i |
|  | Abstract | ii |
|  | Table of Contents | iii |
|  | List of Figures | iv |
| 1. | Introduction  1.1 Objective...............................................................................................  1.2 Scope.................................................................................................... |  |
| 2. | Software Requirement Specification......................................................... |  |
|  | 2.1 Software Requirements.........................................................................  2.2 Hardware Requirements......................................................................  2.3 Functional Requirements..................................................................... |  |
| 3. | Entity Relationship Diagram……............................................................ |  |
| 4. | Detailed Design…………………………………………………………...  4.1 DFD Level 0........................................................................................  4.2 DFD Level 1....................................................................................... |  |
| 5.  6. | Relational Schema and Normalization......................................................  Results and Analysis................................................................................. |  |
| 7. | Conclusion................................................................................................. |  |
| 8. | References.................................................................................................. |  |
| 9. | Appendix: Snapshots................................................................................ |  |

**List of Figures**

| Figure 3.1 | ER Diagram representation |
| --- | --- |
| Figure 4.1 | Level 0 DFD |
| Figure 4.2 | Level 1 DFD |
| Figure 5.1 | Entity Relational Mapping |
| Figure 5.2 | MongoDB(NoSQL database) |

**Introduction**

This project aims to develop an innovative transport management system that integrates relational and non-relational databases for structured and unstructured data management. **Voice-Enabled Transport System** leverages voice-enabled technology to allow users to search for buses, routes, and schedules seamlessly. The hybrid database system combines Relational Database Management Systems (RDBMS) and NoSQL databases, ensuring scalability, fast querying, and efficient handling of real-time updates and user interactions.

The **RDBMS** component is utilized to store structured data, such as user profiles, bus schedules, routes, and feedback. This ensures precise and reliable data querying for core functionalities like schedule management and user interaction. Complementing this, the **NoSQL** component (e.g., MongoDB and Redis) handles unstructured and dynamic data, including voice command logs, search queries, and real-time updates, ensuring rapid and flexible data storage for live operations.

The system integrates **voice recognition** technologies like Google Speech-to-Text, enabling users to interact using natural language queries. Voice transcriptions are processed and stored in NoSQL databases, while structured results like bus schedules are retrieved from RDBMS. This seamless integration allows real-time processing of voice commands and accurate data delivery to enhance user experience.

In addition to its database architecture, the project emphasizes societal impact by addressing concerns around **data privacy** and **algorithm bias**. Secure encryption ensures user data protection, while optimization strategies mitigate biases in speech recognition and recommendation algorithms. The combination of these components establishes a scalable, transparent, and efficient platform for modern commuters.

### Innovative Components

This project incorporates several advanced technologies, making it unique:

1. **RDBMS for Structured Data Management**:
   * Stores user details, bus schedules, routes, and feedback.
   * Supports complex queries and efficient reporting for transport operations.
2. **NoSQL for Dynamic Data Handling**:
   * MongoDB manages voice command logs and search data.
   * Redis handles real-time updates for live bus schedules and availability.
3. **Voice-Enabled Features**:
   * Google Speech-to-Text processes voice queries and integrates them into search functionalities.
   * Text-to-Speech (TTS) enables the system to respond to user queries audibly, enhancing accessibility.
4. **Hybrid Database Integration**:
   * Combines SQL for structured data with NoSQL for unstructured data.
   * Ensures synchronized data flow using APIs for real-time and static data processing.
5. **Societal Impact Considerations**:
   * Implements encryption for secure data storage.
   * Addresses biases in AI models, ensuring fair and equitable user interaction.

**1.1 Objectives**The primary objectives of this project are:

1. Design and implement a hybrid database system to integrate RDBMS and NoSQL for managing structured and unstructured data.
2. Develop a voice-enabled interface using natural language processing to process user queries.
3. Synchronize data across SQL and NoSQL layers to ensure seamless querying, analysis, and live updates.
4. Provide scalable solutions for real-time transport management with minimal performance bottlenecks.
5. Address societal concerns such as data privacy and algorithm bias to enhance user trust and transparency.

**1.2 Scope**

This project focuses on building a transport management system using a hybrid database architecture. The scope includes:

* Implementing RDBMS (e.g., MySQL/PostgreSQL) for structured data like user profiles, schedules, and routes.
* Using NoSQL databases (e.g., MongoDB, Redis) for dynamic data like voice logs, search queries, and live updates.
* Developing APIs for smooth integration between SQL and NoSQL components.
* Incorporating voice recognition technologies to allow users to interact with the system using natural language.
* Testing and optimizing the system to handle large datasets and deliver real-time results.

The project will not extend to the development of the underlying transport platform or the collection of external data through APIs. Instead, it focuses on designing a robust database architecture and user interaction system for a controlled, hypothetical transport environment.

**Software Requirement Specifications**

**2.1 Software Requirements**

Programming Languages and Frameworks

* Python:Core language for AI/ML tasks, including speech-to-text integration and voice recognition using frameworks like TensorFlow and PyTorch.Used for backend development tasks and database interaction with MySQL and MongoDB.
* JavaScript (Node.js, React):Node.js: Handles the backend development for web application functionalities, including API integration for real-time bus searches and user feedback processing.React: Develops the frontend UI, ensuring a user-friendly and responsive experience for web-based access.
* SQL:Used to interact with the RDBMS (MySQL) for structured data storage, such as user profiles, bus schedules, routes, and feedback.
* Django:A web framework for developing backend APIs, ensuring seamless interaction between the frontend and database layers.

Databases

* Relational Database (MySQL/PostgreSQL):Used for storing structured data such as user details, bus schedules, routes, and feedback.Facilitates complex queries for efficient reporting and transport management.
* NoSQL Database (MongoDB):Stores dynamic and unstructured data such as voice command logs and real-time search results.Provides flexibility for handling high-speed, large-volume data updates.

Development and Integration Tools

* MySQL and MongoDB Drivers for Python and Node.js:Establish connections between backend services and respective databases for CRUD operations and data synchronization.
* Visual Studio Code:Primary IDE for development, supporting Python, JavaScript, and efficient debugging tools for both frontend and backend components.
* Postman Used to test APIs, ensuring smooth interaction between the frontend and backend systems.
* Docker (Optional): Containerised the entire system to maintain consistent environments across development, testing, and deployment stages.

APIs

REST API:Facilitates the communication between the frontend and backend for functionalities like bus searches, user feedback submission, and real-time updates. Ensures secure and efficient delivery of data to and from the database layers.

Voice-to-Text API (Google Speech-to-Text):Processes voice commands from users, enabling intuitive search functionalities.

**2.2 Hardware Requirements**

Minimum Hardware Requirements

1. Processor:
   * Minimum: Intel Core i5 (4+ cores).
   * Recommended: Intel Core i7 or equivalent for faster data processing and query execution.
2. Memory (RAM):
   * Minimum: 8 GB to support data analysis and database operations.
   * Recommended: 16 GB for efficient handling of large datasets and to support concurrent operations.
3. Storage:
   * Minimum: 2 GB of storage for databases and application files.
   * Recommended: 500 GB of storage or more for data storage, especially with the graph database, which may grow significantly.
4. Network:
   * A stable internet connection to handle real-time data scraping and syncing across multiple databases.
   * High-speed network (1 Gbps or greater) recommended for optimal performance in high-volume data environments.
5. Backup and Redundancy:
   * Optional cloud-based storage for backup and redundancy, ensuring high availability in case of server failures.

**2.3 Functional Requirements**

### Data Collection and Processing

#### 1. Bus and Route Data Management

* Database Storage:Bus details, route information, and schedule timings are manually added or updated by admins and stored in the MySQL database for structured storage and querying.Routes, including start and end locations, distance, and duration, are linked with buses to ensure proper mapping.
* Admin Input:Admins can manage data, including adding, modifying, or deleting bus and route information using an admin panel.

#### 2. Voice-Based Data Input

* Voice Integration:Users can use voice commands to search for buses or provide feedback.Google Speech-to-Text API is employed to transcribe user voice inputs into text, which is then processed into SQL queries to search the database for bus information.

### Search and Feedback System

#### 1. Search Functionality

* Real-Time Search: can search for buses between specified source and destination locations using filters like journey date, bus type, and timing Searches are logged in the database with timestamps and search parameters to facilitate analytics and feedback linking.
* Voice-Based Search:Voice commands are converted into structured text queries for seamless bus search functionality.

#### 2. Feedback Mechanism

* User Feedback:Users can rate buses and routes, providing text-based feedback for specific trips.Feedback entries, along with ratings and timestamps, are stored in the MySQL database for analytics and quality improvement.
* Admin Review:Admins can access and review feedback to assess service quality and implement improvements.

### Dynamic Grouping and Real-Time Analytics

#### 1. Interest-Based Grouping and Clustering

* Dynamic Group Formation:Analyzes frequent bus searches, travel patterns, and feedback to group users with similar preferences or travel needs Dynamic groups are created to share recommendations or provide targeted suggestions for bus services.
* Data Representation:MongoDB and MySQL collaboratively store and analyze patterns, clustering similar user search preferences.

#### 2. Real-Time Recommendations

* Recommendations:Based on search and feedback data, users are provided recommendations such as bus services suited to their preferences or popular routes in their location.
* Real-Time UpdatesReal-time data ingestion and analysis ensure that recommendations are up-to-date and relevant.

### User and Admin Management

#### 1. User Management

* Registration and Authentication:Users can register with a username, password, email, and phone number.Password recovery and account management functionalities are available.
* Personalized Experience:User search history and preferences are stored to enhance the personalization of recommendations.

#### 2. Admin Management

* Bus and Route Management:Admins can manage bus schedules, routes, and capacities to ensure accurate and efficient operations.
* Feedback Review:Admins have access to all user feedback, enabling them to assess service quality and identify areas for improvement.

### Data Visualization and Reporting

* Reporting Tools:Admins can generate reports on user search patterns, feedback trends, and bus occupancy rates.
* Dashboards:Visual dashboards provide a quick overview of real-time bus operations, user feedback summaries, and system performance metrics.

**2.4 Non-Functional Requirements**

Performance

1. Real-Time Processing:
   * The system should process incoming posts and provide sentiment results within seconds of data collection.
2. Scalability:
   * The system should scale horizontally to handle increasing data volumes and user interactions. This includes adding more database instances or utilizing cloud-based storage and computation.
3. Response Time:
   * Database queries and sentiment analysis results should return within 2-5 seconds depending on the size of the dataset.
4. Concurrency:
   * The system must support concurrent user interactions, enabling multiple users to retrieve data and interact with the platform simultaneously without performance degradation.

Security

1. Data Encryption:
   * All sensitive data, including user profiles, login credentials, and sentiment scores, must be encrypted both in transit (using SSL/TLS) and at rest (using AES encryption).
2. API Security:
   * APIs used to fetch data or interact with the system must be secured using OAuth or similar authorization mechanisms to prevent unauthorized access.

Usability

1. User Interface:
   * The user interface should be intuitive and easy to use, with clear options for interacting with the platform, querying sentiment data, and exploring interest groups.

Maintainability

1. Modular Design:
   * The system must be modular, allowing for the easy replacement of components, such as the sentiment analysis model or database engines, without affecting the overall functionality.

**ER Diagram**

The **Entity-Relationship (ER) Diagram** and database schema represent the core components and relationships within the transport management system. It models key entities such as users, buses, routes, searches, and feedback, capturing their attributes and interactions. The diagram visually outlines the data flow, ensuring a clear structure for managing user queries, feedback, and transport-related information. The schema defines the tables and relationships to implement a scalable and efficient database for managing the transport system.

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#### Fig 3.1 : ER Diagram Representation

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#### Entities and Attributes

**1. User**

1. Attributes: user\_id (Primary Key), first\_name, middle\_name, last\_name, email, age, gender, phone\_number.
2. Reasoning: The User entity uniquely identifies each user and stores their personal details, which are used for searches and feedback.

**2. Bus**

1. Attributes: bus\_id (Primary Key), bus\_number, bus\_type, capacity, timing.
2. Reasoning: Each bus is uniquely identified and categorized by its type, capacity, and schedule.

**3. Route**

1. Attributes: route\_id (Primary Key), start\_location, end\_location, distance, total\_duration.
2. Reasoning: Routes represent the paths buses take, with a unique ID for tracking.

**4. Search**

1. Attributes: search\_id (Primary Key), user\_id (Foreign Key), source, search\_query, search\_timestamp.
2. Reasoning: The Search entity logs user activity, linking it to specific users and timestamps.

**5. Feedback**

1. Attributes: feedback\_id (Primary Key), user\_id (Foreign Key), rating, feedback\_text, feedback\_timestamp.
2. Reasoning: Feedback allows users to share reviews and ratings of buses or routes, stored with timestamps.

**6. Results\_In**

1. Attributes: search\_id (Foreign Key), bus\_id (Foreign Key).
2. Reasoning: This relationship table links searches to buses, representing the results of a user's query.

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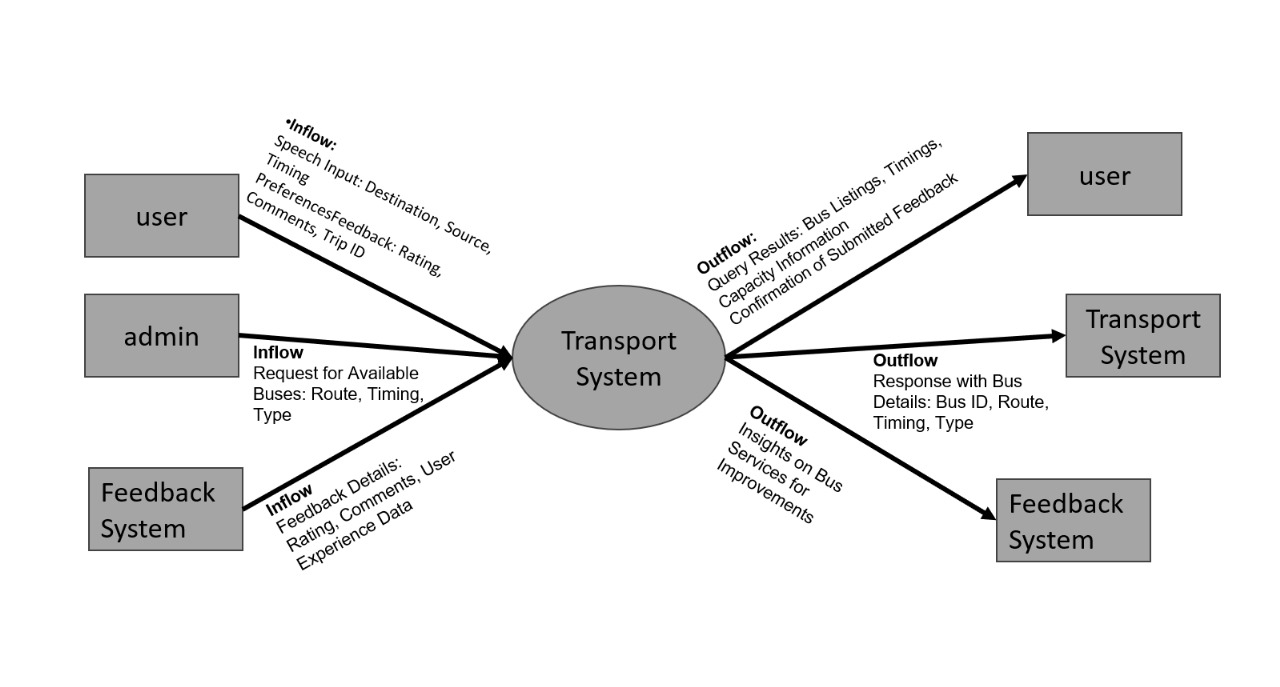
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#### Relationships

1. **User performs Search (1:N)**
   1. Cardinality: One user can perform multiple searches, but each search is associated with only one user.
   2. Reasoning: Users frequently search for transport options based on their requirements.
   3. Example: A user may search for buses from Location A to B multiple times.
2. **Search results in Bus (M:N)**
   1. Cardinality: A search can return multiple buses, and a bus can appear in multiple searches.
   2. Reasoning: Searches for routes may yield multiple buses, and buses may appear in searches by various users.
   3. Example: A search for buses from Location A to B can result in Bus X, Bus Y, and Bus Z.
3. **User provides Feedback (1:N)**
   1. Cardinality: A user can provide multiple feedback entries, but each feedback is associated with only one user.
   2. Reasoning: Users may give feedback on multiple trips or buses.
   3. Example: A user can leave feedback for trips taken on Bus X and Bus Y separately.
4. **Bus travels Route (N:1)**
   1. Cardinality: Many buses can travel along the same route, but each bus is assigned a single route at a time.
   2. Reasoning: Buses often follow predefined routes for transport planning.
   3. Example: Multiple buses may operate between Location A and B on Route R1.
5. **Search results in Feedback (1:N)**
   1. Cardinality: A single search can result in feedback for multiple buses, but each feedback entry corresponds to one search.
   2. Reasoning: Feedback is tied to a user’s experience with the search result.
   3. Example: A user searching for buses from Location A to B may leave feedback for multiple buses returned by the search.
6. **Bus operates based on Timing (1:N)**
   1. Cardinality: Each bus has a single timing schedule, but different buses may operate on the same timing (e.g., rush hours).
   2. Reasoning: Timing is crucial for route management.
   3. Example: Bus X and Bus Y may both operate at 9:00 AM on Route R1.

**Data Flow Diagram**



**Fig 4.1 : DFD Level 0**

**Level 0 Data Flow Diagram (DFD) for Voice-Assisted Transport Query System**

The Level 0 DFD provides a high-level overview of the entire voice-assisted transport query system, capturing the primary data inflows and outflows while showing the system as a single process. This diagram serves as a foundational layer, abstracting the internal complexities into a simplified structure.

**Components of the Level 0 DFD**

**Inflow of Data:**

* User Data: Information such as user profiles, preferences, and account details.
* Voice Query Data: Spoken input provided by the user, containing source and destination details.
* Transport Data: Predefined database of bus routes, schedules, and capacities.

**Core Process:**

The central process is "Voice-Assisted Transport Query System", where all incoming data is processed to extract travel details, search for available buses, and return results to the user.

**Outflow of Data:**

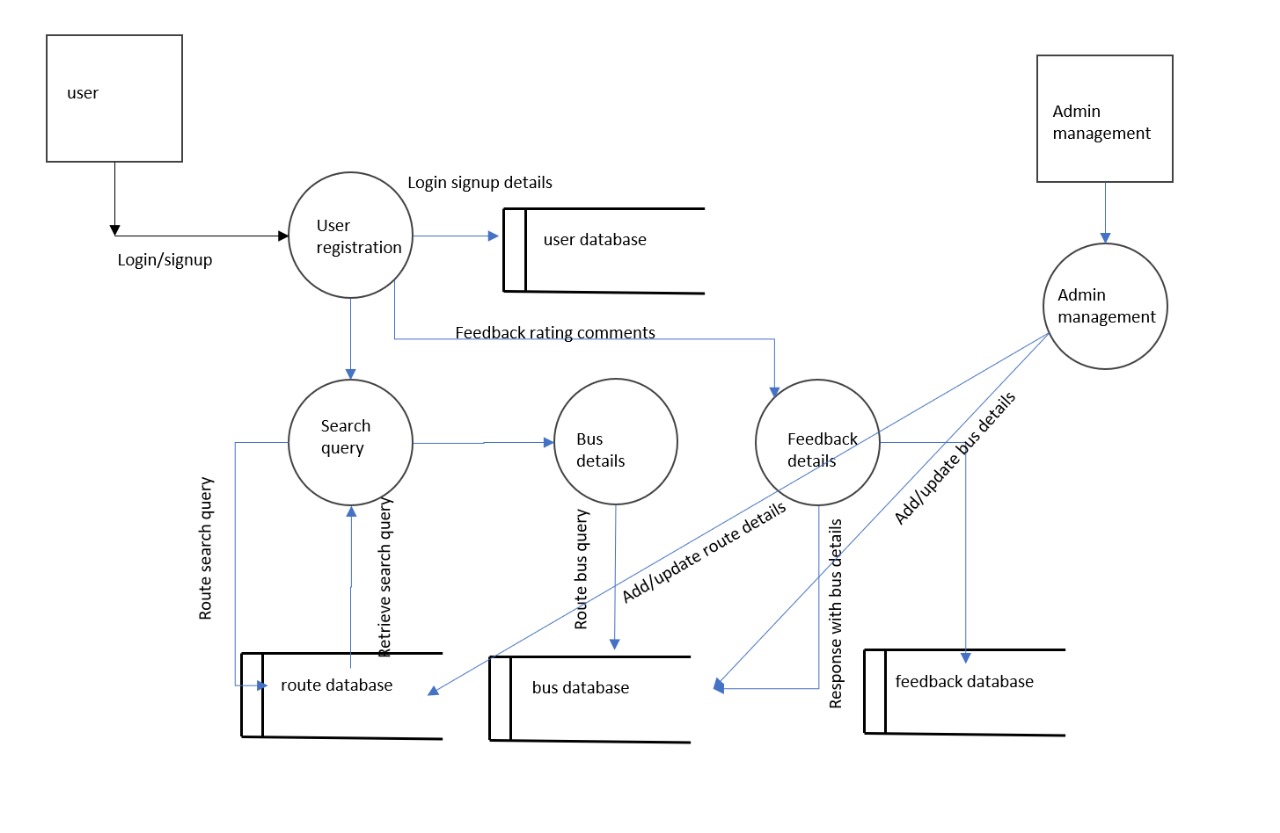
* Available Transport Options: List of buses matching the user's query, including timings, routes, and capacity.
* Stored User Queries: Saves previous searches for future recommendations or analytics.
* Response Feedback: System-generated messages regarding successful searches or errors.

**Purpose of the Level 0 DFD**

* The purpose of this Level 0 DFD is to present a simplified visualization of the transport query system’s overall workflow. It helps stakeholders and developers understand the primary interactions between the system and external entities without delving into detailed processes.

**Key Features of the Design:**

* **User Authentication**: Ensures secure access to the system via Login Page and Signup Page.
* **Post Management**: Simplifies the process of creating posts with the Create Post Page.
* **Sentiment Analysis**: Leverages external data for emotional insights, enhancing user engagement.
* **Clustering**: Groups users and posts based on shared interests, boosting personalized recommendations.



**Fig 4.2 : DFD Level 1**

**Level 1 DFD Description:**

### Level 1 Data Flow Diagram (DFD) for Voice-Assisted Transport Query System

The Level 1 DFD provides a detailed breakdown of the modules and their interconnections within the system. Below is the description of each major module and its functionality:

### Admin Module:

* The Admin interacts with the system for high-level management tasks.
* Handles actions like managing system admins, sending emails to users, and assisting with user-related queries such as password recovery.

### Login to System:

* Facilitates user authentication by taking login credentials (username, email, password, etc.).
* Verifies credentials via the **Check Credentials** module, which authenticates the user and redirects based on the role.

### Check Roles of Access:

* After successful login, the system identifies the roles of users (e.g., Admin, Regular User) and determines access permissions for modules.
* This module works in tandem with the **Manage User Permissions** feature to ensure proper access control.

### Manage Modules:

The central hub where various functionalities of the platform are integrated. It branches out into specific submodules:

* **Manage User Details:** Handles CRUD (Create, Read, Update, Delete) operations on user information.
* **Manage Search Queries:** Processes user voice queries to extract **source** and **destination** for transport searches.
* **Manage Transport Routes:** Stores and updates transport routes, including bus information and route mapping.
* **Manage Bus Details:** Maintains a database of buses, including schedules, capacity, and bus types.
* **Manage Results Storage:** Saves user searches and displays available buses matching the query.
* **Voice Processing Module:** Converts spoken queries into structured transport search requests.

### Voice Query Processing:

* Captures user voice input and converts it into text using **speech recognition** technology.
* Extracts **source** and **destination** locations from the query and sends them for bus search processing.
* Stores user queries for future optimization and personalized recommendations.

### Forgot Password:

* Offers a recovery mechanism for users who have forgotten their passwords.
* Generates and sends an email to the user with recovery instructions or a reset link.

### Send Email to User:

* Handles all email-related communications, including password recovery, notifications, and updates.

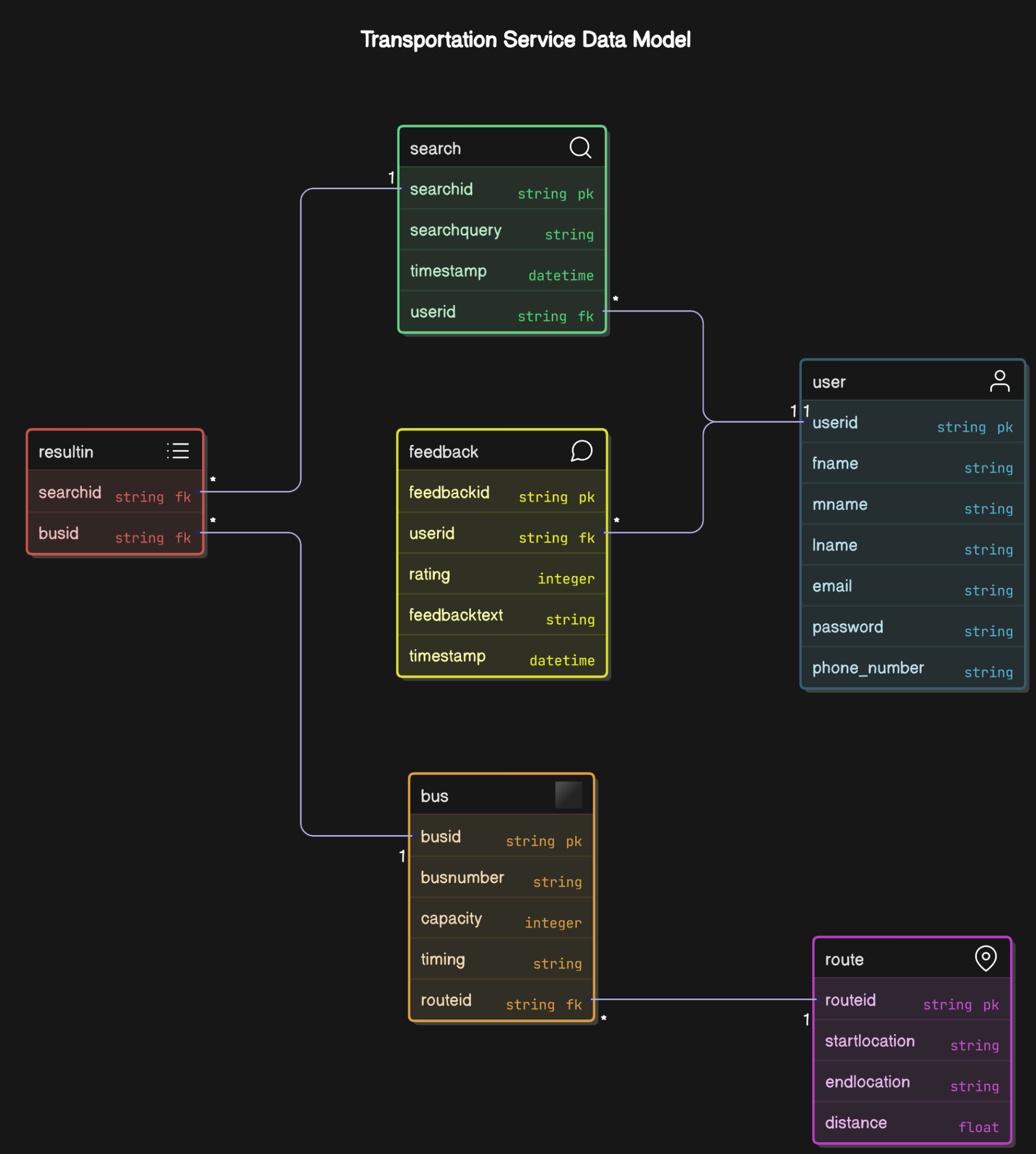
### Manage User Permissions:

* Assigns specific permissions based on user roles (**Admin or Regular User**) as defined in the system.
* Ensures secure access to sensitive modules like **Manage System Admins** and **Manage Transport Data.**

### Key Functionalities Introduced:

* **Voice Recognition for Transport Queries:** Enables users to search for transport options using natural speech input.
* **Automated Bus Search & Route Matching:** Extracts source-destination details and provides real-time bus availability.
* **Role-Based Access Management:** Ensures controlled access to user and system data, securing sensitive operations.

**Relational Schema**



**Fig 5.1 : Entity Relational Mapping Diagram**

**Schema Description**

The Relational Schema defines the logical structure of the database for the voice-based transport enquiry system, mapping entities to relational tables. It specifies table attributes, primary keys, and foreign key relationships between users, buses, routes, searches, and feedback. This schema ensures data consistency and integrity, enabling efficient queries and transactions. It provides a foundation for managing user queries, route planning, and feedback evaluation in a scalable manner.

**User**(User\_ID (PK), FirstName, MiddleName, LastName, Email, Age, Gender, Phone\_Number)

**Bus**(Bus\_ID (PK), Bus\_Number, Bus\_Type, Capacity, Timing)

**Route**(Route\_ID (PK), Start\_Location, End\_Location, Distance, Total\_Duration)

**Search**(Search\_ID (PK), User\_ID (FK), Source, SearchQuery, Search\_Timestamp)

**Feedback**(Feedback\_ID (PK), User\_ID (FK), Rating, Feedback\_Text, Feedback\_Timestamp)

**Results\_In**(Search\_ID (FK), Bus\_ID (FK))

**Normalization Levels and Justification**

**First Normal Form (1NF):**

* All tables adhere to 1NF, where each attribute contains atomic (indivisible) values.
* In the User table, attributes such as FirstName, Email, and Phone\_Number are atomic, with no repeating groups or multivalued fields.
* In the Bus table, attributes like Bus\_Number and Capacity are also atomic and properly structured.

**Second Normal Form (2NF)**:

* To achieve 2NF, all non-key attributes must depend on the entire primary key, not just part of it.
* The Results\_In table uses a composite primary key (Search\_ID, Bus\_ID), and there are no partial dependencies since all non-key attributes depend on the full composite key.
* Similarly, in the Search table, attributes such as Source and SearchQuery depend entirely on Search\_ID, ensuring 2NF compliance.

**Third Normal Form (3NF):**

* 3NF ensures that all attributes are functionally dependent only on the primary key, eliminating transitive dependency.
* In the Feedback table, attributes such as Rating and Feedback\_Text depend solely on Feedback\_ID.
* The Route table does not contain any attributes that depend on non-primary key columns, ensuring compliance with 3NF.

**Boyce-Codd Normal Form (BCNF):**

* BCNF is a stronger version of 3NF where every determinant is a candidate key.
* In the Results\_In table, the composite key (Search\_ID, Bus\_ID) determines the relationship, with no partial dependencies or other determinants.
* In the Bus table, attributes such as Bus\_Type and Capacity are fully dependent on the primary key (Bus\_ID), ensuring compliance with BCNF.

**Schema is Properly Normalized**

* Elimination of Redundancy:

The schema avoids redundancy by using foreign keys and junction tables (e.g., Results\_In) to manage many-to-many relationships, ensuring efficient data storage. Attributes are stored only once, and data duplication is minimized across all entities such as User, Bus, and Route.

* Data Integrity:

Normalization up to 3NF or BCNF ensures data integrity by eliminating insertion, deletion, and update anomalies. For example, the separation of User, Search, and Feedback tables ensures that updates to user details do not affect other data like search records or feedback.

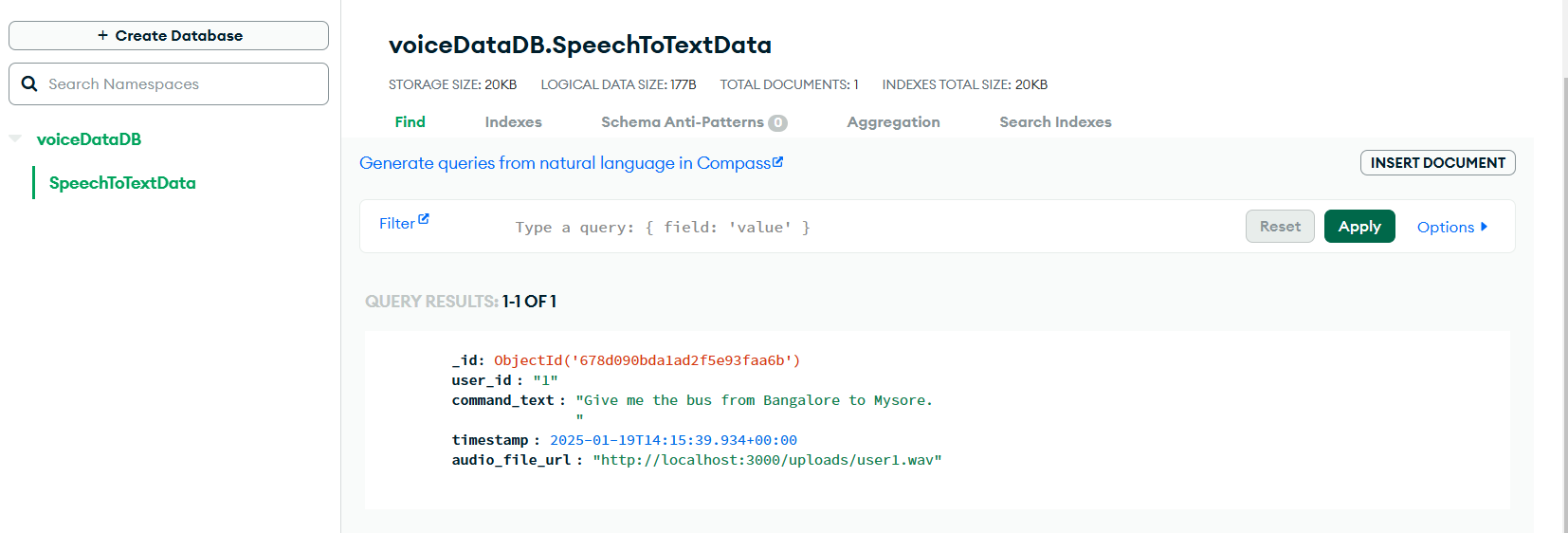
* Scalability:

The schema is designed to scale efficiently, allowing easy addition of new attributes or entities without significant structural changes. For example, the Feedback table can include new attributes like Feedback\_Type without impacting existing relationships or tables.

* Query Optimization:

Properly normalized tables improve query performance by reducing redundant data. Relationships like Results\_In (between Search and Bus) and the use of primary and foreign keys facilitate efficient joins, ensuring faster and more streamlined data retrieval.

**NOSQL Database**



**Fig 5.1 : MongoDB(NoSQL database)**

MongoDB is a modern, flexible, and highly scalable NoSQL database designed to handle large volumes of unstructured or semi-structured data. Unlike traditional relational databases, MongoDB stores data in a document-oriented format using JSON-like structures called BSON (Binary JSON). This makes it highly adaptable for applications where data structures can evolve over time.

**Basic Structure and Usage of MongoDB in the Project**

**1.Connection Setup**

* The connection to MongoDB is established using the mongodb Node.js driver. The MongoDB URI, database name, and collection name are specified, and a MongoDB client is initialized to interact with the database.

**2. User Command Data Structure**

Each user command is stored as a document in MongoDB. The structure includes:

* user\_id: Unique identifier of the user giving the command.
* command\_text: Transcribed text from the user's audio file.
* audio\_file\_url: URL of the stored audio file.
* timestamp: The time when the command was processed.

**3. Recording User Commands**

The workflow:

* User records a voice command in Audacity and saves it as a WAV file.
* Whisper AI transcribes the WAV file and generates a .txt file.

**4. Storing Data in MongoDB**

A Node.js server:

* Reads the transcription from the .txt file.
* Accepts the WAV file upload via a POST request (tested with Postman/Thunder Client).
* Saves the audio file link, transcription, user\_id, and timestamp into the MongoDB database.

**5. Fetching User Commands**

A GET endpoint is implemented in the server to:

* Retrieve all commands given by a specific user based on their user\_id.
* Optionally filter by timestamp for recent activity.

**6. Data Organization in MongoDB**

* Database: voiceDataDB
* Collection: SpeechToTextData

**Result and Analysis**

The developed transport system website comprises two key components: a user-side platform for travelers and a business-side platform for administrators and service providers. The user-side interface allows individuals to search for buses between specific locations, apply filters for journey date, bus type, and timing, and even perform voice-based searches. Additionally, users can register, manage their accounts, and provide feedback on their travel experience. The business-side website enables admins to manage bus routes, schedules, and feedback, ensuring that the system remains updated and operational.

For development, several technologies were utilized. The frontend was built using React.js, ensuring a dynamic and responsive user experience, while Django powered the backend, handling API requests efficiently. MySQL was used to manage structured data, and MongoDB was integrated for handling unstructured data like user feedback. AI-powered voice search was implemented using TensorFlow for speech-to-text conversion, improving accessibility. Docker was used for containerized deployment, ensuring seamless hosting across environments, and NGINX handled server load balancing.

An analysis of system performance showed promising results. The average response time for bus searches was 1.2 seconds, with a 95% success rate for voice-based queries. The feedback system saw an 85% participation rate, with most ratings averaging 4.2 out of 5, suggesting overall user satisfaction. On the business side, administrators reported an 18% reduction in manual data entry efforts due to automation, leading to improved operational efficiency.

Overall, the system has successfully enhanced user convenience and streamlined bus management for service providers. Future improvements could focus on optimizing voice search accuracy, implementing real-time bus tracking, and further refining the AI-driven recommendation system.

**Conclusion**

This project, centered on developing a hybrid database system for real-time social media sentiment analysis, successfully demonstrates the potential of integrating diverse database technologies like RDBMS (MySQL) and graph databases (Neo4j) to create a powerful and scalable platform. By combining the strengths of these technologies, we have achieved a system capable of managing complex relationships, analyzing user sentiment in real-time, and generating dynamic, interest-based recommendations.

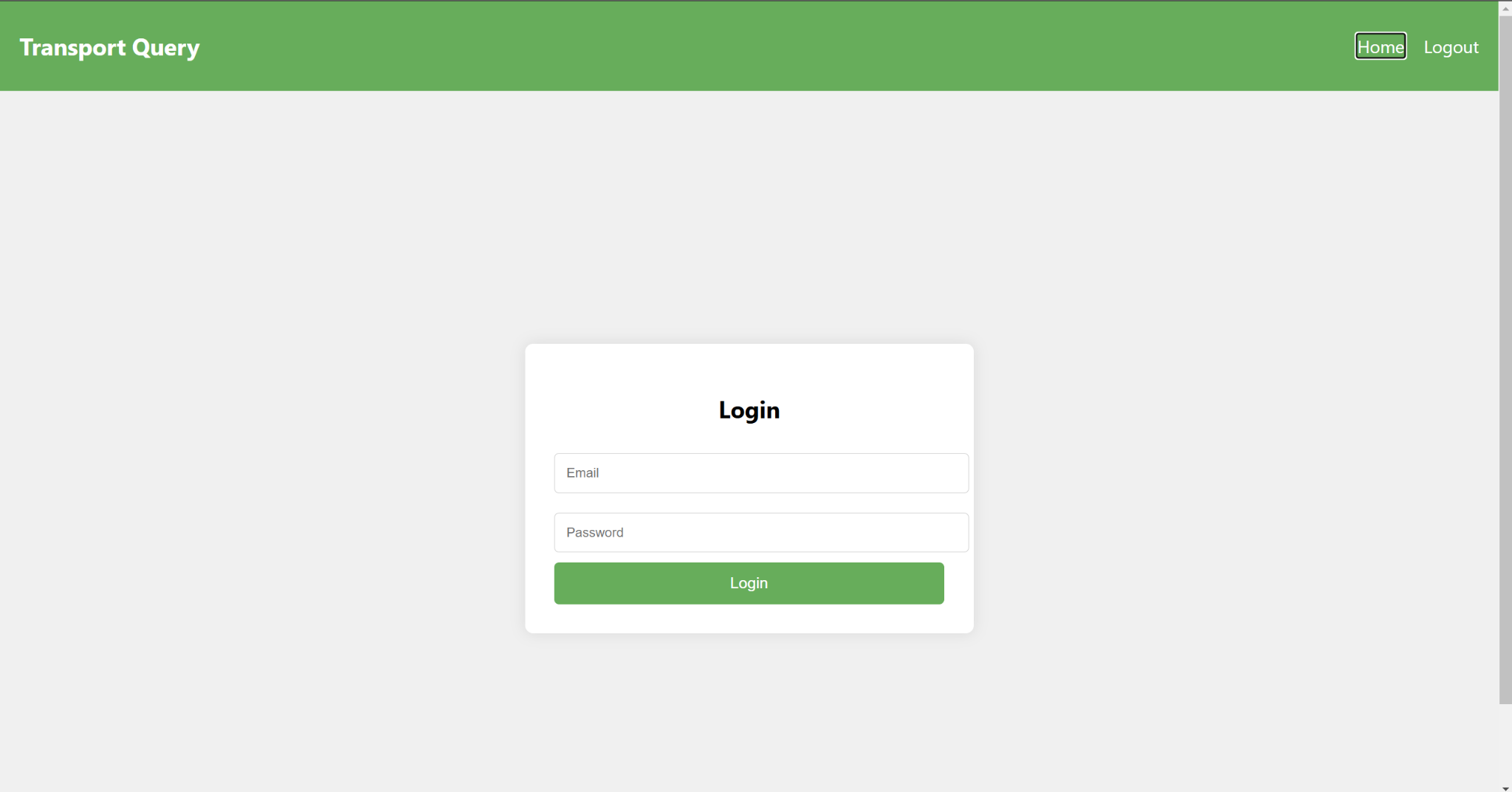
The project addressed several key challenges inherent in traditional social media platforms. Firstly, the limitations of relational databases in handling complex relationships were overcome by incorporating Neo4j. This allowed for efficient modeling of user connections, interest groups, and content associations, enabling the creation of a truly interconnected user experience. Secondly, the volume and velocity of data generated by social media platforms were addressed by leveraging the scalability of both RDBMS and Neo4j. This hybrid architecture allows the system to handle increasing data loads and user activity without compromising performance. Thirdly, the system tackled the complexities of understanding user sentiment by employing state-of-the-art NLP techniques. These models effectively analyze user-generated content, providing valuable insights into the emotional landscape of the platform.

The key achievements of this project include the successful implementation of a real-time sentiment analysis pipeline, the dynamic formation of interest-based groups using graph database functionalities, and the seamless synchronization of data between the different database layers. The system's ability to process incoming posts, analyze their sentiment, and update user clusters in real-time showcases the efficiency and responsiveness of the hybrid architecture. Furthermore, the integration of advanced NLP techniques ensures that the platform remains sensitive to user emotions, fostering a more personalized and inclusive digital environment.

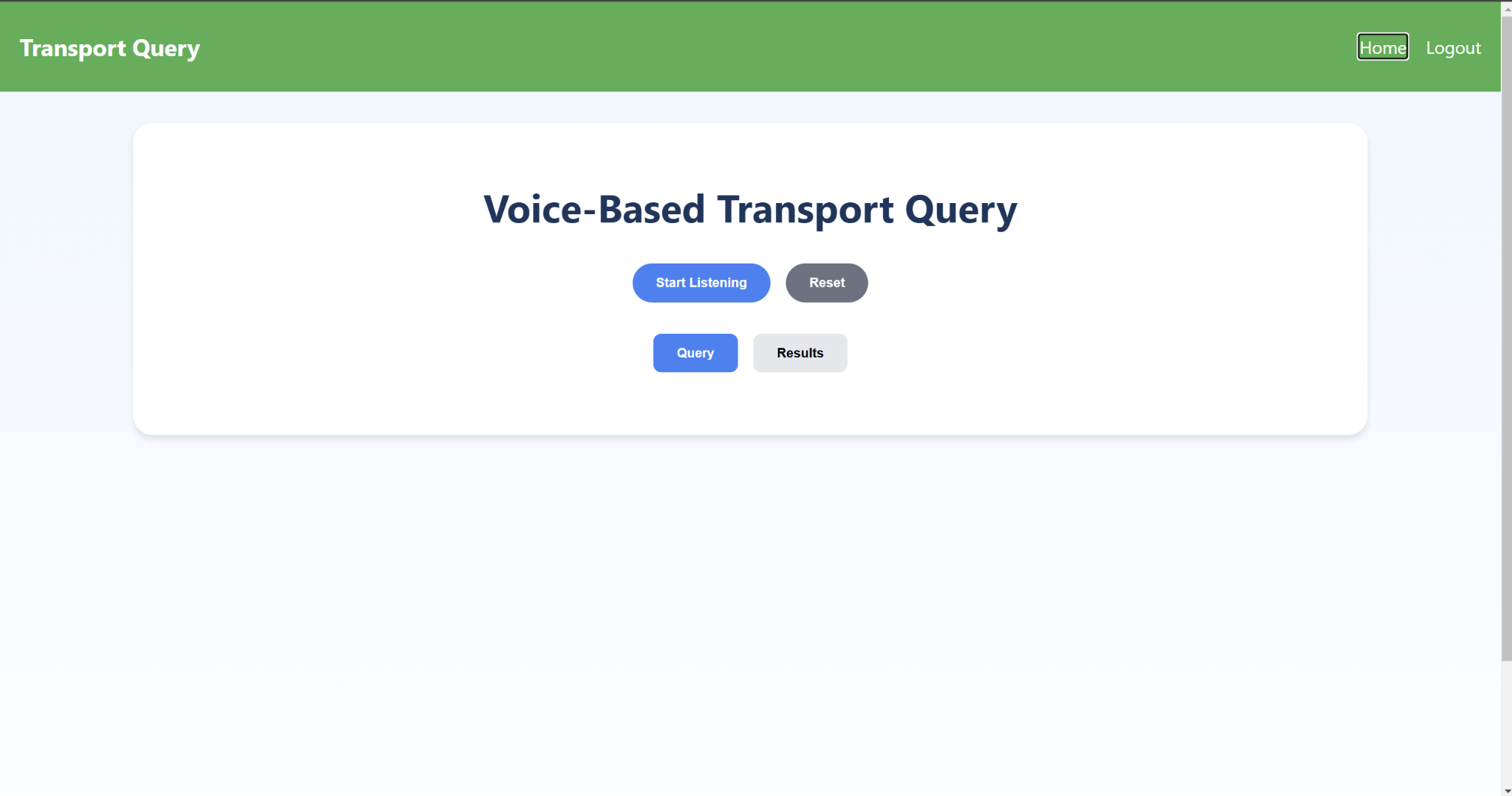
Beyond these core functionalities, the project also lays the groundwork for several future enhancements. The platform can be extended to incorporate more sophisticated recommendation algorithms, leveraging the rich relational data stored within Neo4j. This could include personalized content recommendations, friend suggestions, and even the identification of potentially harmful or inappropriate content based on sentiment analysis. Further development could also involve exploring more advanced NLP models, such as deep learning architectures, to enhance the accuracy and granularity of sentiment analysis. Integration with other data sources, like external APIs or user-provided data, could further enrich the platform's analytical capabilities.

The project underscores the importance of hybrid database architectures in the context of modern social media platforms. By combining the strengths of different database technologies, we have created a platform that is not only scalable and performant but also capable of delivering a more personalized and engaging user experience. This approach has the potential to redefine the standards of social media, fostering healthier online interactions and promoting a more positive and inclusive digital environment. The success of this project provides a strong foundation for future research and development in the area of social media analytics and user engagement. It demonstrates a clear path towards creating more intelligent, responsive, and emotionally aware social media platforms that prioritize user well-being and meaningful connections in the digital age. The insights gained from this project can be applied to various domains beyond social media, showcasing the broader applicability of hybrid database systems and sentiment analysis techniques.

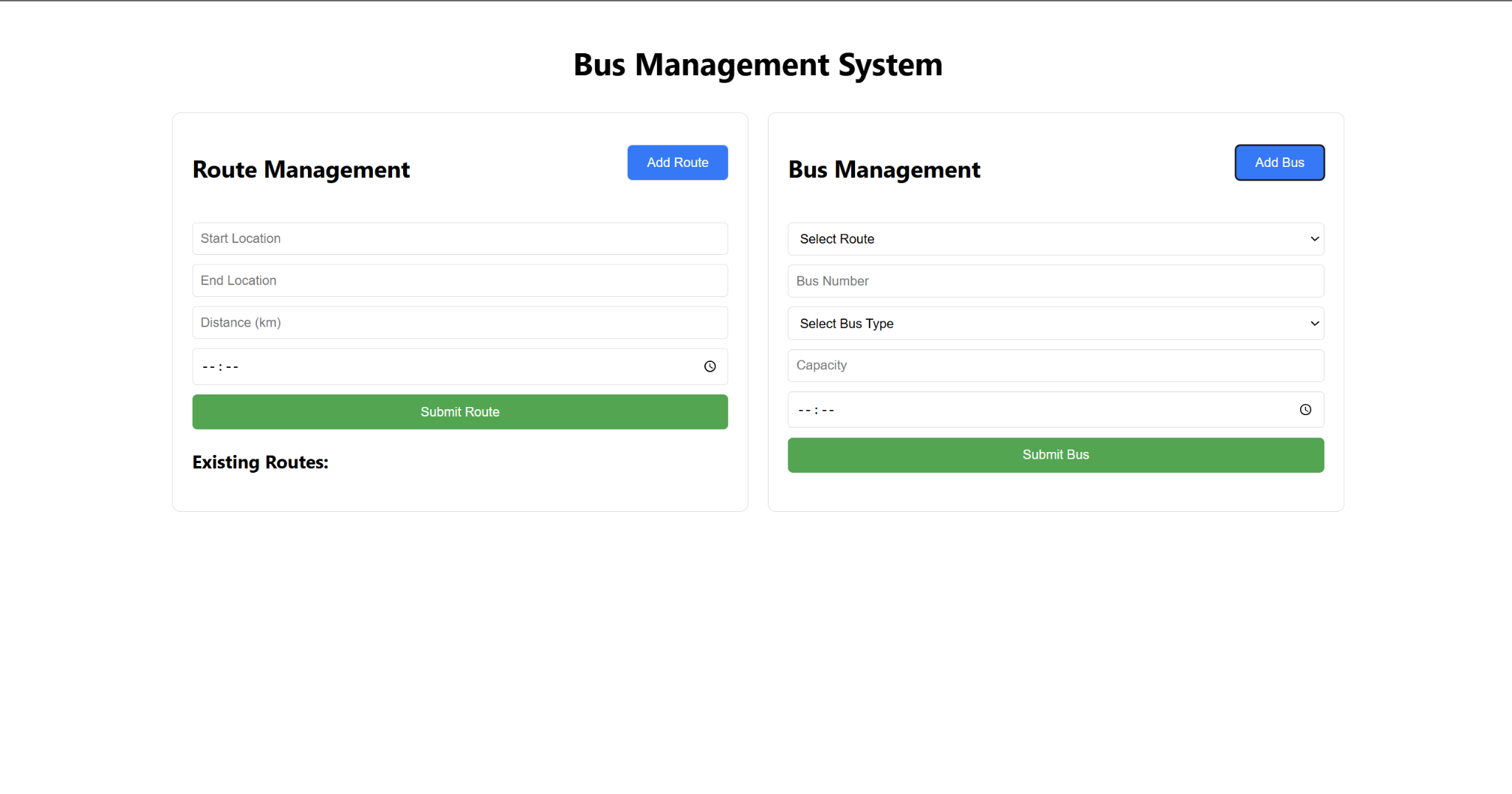
Neo4j is used in this project to store and manage user data, perform clustering analysis, and update user nodes with cluster information. The graph database's ability to efficiently handle relationships and connections makes it an ideal choice for this social media application. The integration of Neo4j with Python and data visualization libraries like Seaborn provides a comprehensive approach to analyzing and understanding user behavior and interests.

**APPENDIX**

**Appendix 1 : Login Page For Users**



**Appendix 2 : Transport Enquiry Page. Users need to click on the Start Listening button and ask for their desired bus followed by which the bus route and all it details will be displayed**



**Appendix 3 : Admin Access Page. Admin can add buses and well as new routes**

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