项目文档

# Functional Requirement

Requirement ID Functional Requirement Statement  
FR-1 The system shall provide real-time route planning based on current transportation availability, delays, and user preferences.  
FR-2 The system shall automatically suggest alternative routes when the original route is disrupted, such as due to delays or closures.  
FR-3 The system shall send push notifications to users when disruptions, delays, or major changes occur in the planned route, even when the app is not open.  
FR-4 The system shall include alternative route options in notifications, specifying key details such as estimated time, cost, and accessibility.  
FR-5 The system shall allow users to set preferences for each saved destination, including route type (e.g., fastest, cheapest, most accessible).  
FR-6 The system shall remember past choices and preferred route types for saved locations and use this data to suggest routes accordingly.  
FR-7 The system shall allow users to save and quickly access frequently used destinations and preferred route types.  
FR-8 The system shall provide real-time updates for both the original and suggested alternative routes.  
FR-9 The system shall allow users to define and adjust default preferences, such as prioritizing accessibility over speed.  
FR-10 The system shall offer quick filter buttons for route preferences (e.g., "Fastest," "Cheapest," "Most Accessible") at the bottom of the screen.  
FR-11 The system shall display a ranked list of route options, with clear explanations of trade-offs (e.g., time vs. cost vs. accessibility).  
FR-12 The system shall allow users to reset or modify saved preferences easily.

# External Description

# 5 Constraints  
  
## 5.1 Regulatory and Legal Constraints  
  
- \*\*CST-1\*\*: The system shall comply with all applicable data protection and privacy laws, including the General Data Protection Regulation (GDPR) and the California Consumer Privacy Act (CCPA).   
 - \*\*Priority\*\*: Must Have   
 - \*\*Rationale\*\*: To ensure legal compliance and protect user data, especially for features involving user behavior tracking and personal preferences.   
 - \*\*Source\*\*: NFR-11   
 - \*\*Acceptance Criteria\*\*: All data collection and usage practices shall be auditable and configurable by the user via privacy settings.  
  
- \*\*CST-2\*\*: The system shall ensure that all route and disruption data displayed to users is sourced from verified and up-to-date transportation APIs as required by local transportation authorities.   
 - \*\*Priority\*\*: Should Have   
 - \*\*Rationale\*\*: To maintain user trust and prevent misinformation during disruptions or delays.   
 - \*\*Source\*\*: NFR-4   
 - \*\*Acceptance Criteria\*\*: All data sources shall be logged and verified during system testing and in production.  
  
- \*\*CST-3\*\*: The system shall not store user data for more than 180 days unless explicitly consented by the user.   
 - \*\*Priority\*\*: Must Have   
 - \*\*Rationale\*\*: To align with legal and ethical guidelines on user data retention and privacy.   
 - \*\*Source\*\*: NFR-11   
 - \*\*Acceptance Criteria\*\*: Data retention policies shall be implemented, and users shall be able to view and delete stored data via the app.  
  
## 5.2 Hardware Constraints  
  
- \*\*CST-4\*\*: The system shall be compatible with mobile devices running iOS (minimum version 13) or Android (minimum version 10).   
 - \*\*Priority\*\*: Must Have   
 - \*\*Rationale\*\*: To ensure broad user accessibility and maintain compatibility with current and recent mobile device ecosystems.   
 - \*\*Source\*\*: 5.1 Hardware Requirements   
 - \*\*Acceptance Criteria\*\*: The app shall pass device compatibility tests on all supported operating systems.  
  
- \*\*CST-5\*\*: The system shall function on devices with at least 2GB of RAM and 500MB of storage space.   
 - \*\*Priority\*\*: Must Have   
 - \*\*Rationale\*\*: To support the app’s performance and functionality on a wide range of mobile devices, including lower-end models.   
 - \*\*Source\*\*: 5.1 Hardware Requirements   
 - \*\*Acceptance Criteria\*\*: The app shall be installed and run successfully on devices meeting the specified hardware requirements.  
  
## 5.3 Interface Constraints  
  
- \*\*CST-6\*\*: The system shall use HTTPS for all communication with backend services and third-party APIs.   
 - \*\*Priority\*\*: Must Have   
 - \*\*Rationale\*\*: To ensure secure transmission of user data and maintain user trust.   
 - \*\*Source\*\*: 5.4 Security Requirements   
 - \*\*Acceptance Criteria\*\*: All API calls and data transmissions shall be verified for HTTPS compliance during testing.  
  
- \*\*CST-7\*\*: The system shall integrate with Firebase Cloud Messaging (FCM) and Apple Push Notification Service (APNS) for push notifications.   
 - \*\*Priority\*\*: Must Have   
 - \*\*Rationale\*\*: To ensure timely and reliable delivery of route updates and disruption alerts to users.   
 - \*\*Source\*\*: 5.3 Network and Connectivity   
 - \*\*Acceptance Criteria\*\*: Push notifications shall be successfully delivered and received across all supported platforms.  
  
- \*\*CST-8\*\*: The system shall support third-party authentication services, including Google and Apple, for user login and preference management.   
 - \*\*Priority\*\*: Should Have   
 - \*\*Rationale\*\*: To provide a convenient and secure login experience for users and reduce the need for separate account creation.   
 - \*\*Source\*\*: 5.3 Software Requirements   
 - \*\*Acceptance Criteria\*\*: Third-party authentication shall be implemented and pass user authentication and data linkage tests.  
  
## 5.4 Design and Implementation Constraints  
  
- \*\*CST-9\*\*: The system shall not require any modifications to the user's mobile device hardware or operating system to function correctly.   
 - \*\*Priority\*\*: Must Have   
 - \*\*Rationale\*\*: To ensure that the app is accessible to all users without requiring specialized hardware or software configurations.   
 - \*\*Source\*\*: 5.1 Hardware Requirements   
 - \*\*Acceptance Criteria\*\*: The app shall be installed and operated on a standard mobile device without additional configurations.  
  
- \*\*CST-10\*\*: The system shall not be dependent on any proprietary or closed-source libraries that may restrict its deployment or maintenance.   
 - \*\*Priority\*\*: Must Have   
 - \*\*Rationale\*\*: To ensure long-term maintainability and reduce vendor lock-in.   
 - \*\*Source\*\*: Derived from general software design principles   
 - \*\*Acceptance Criteria\*\*: All external libraries used shall be open-source or have acceptable licensing terms for deployment and modification.  
  
- \*\*CST-11\*\*: The system shall be developed with a modular architecture to allow for future enhancements and integrations, such as new transportation APIs or user interface features.   
 - \*\*Priority\*\*: Should Have   
 - \*\*Rationale\*\*: To support future scalability and adaptability without compromising current functionality.   
 - \*\*Source\*\*: Derived from 2.2 Major Capabilities and 4.6 Optional Features   
 - \*\*Acceptance Criteria\*\*: The architecture shall be reviewed and validated by the development team for modularity and extensibility.  
  
## 5.5 Other Constraints  
  
- \*\*CST-12\*\*: The system shall not include any features that require the use of a mobile device's camera or microphone unless explicitly requested by the user and with opt-in consent.   
 - \*\*Priority\*\*: Must Have   
 - \*\*Rationale\*\*: To respect user privacy and ensure that the app does not collect unnecessary sensory data.   
 - \*\*Source\*\*: NFR-11   
 - \*\*Acceptance Criteria\*\*: No camera or microphone usage shall be implemented without user opt-in, and this shall be verified during privacy audit.  
  
- \*\*CST-13\*\*: The system shall not require root or administrator access on the user's device for any of its core functionalities.   
 - \*\*Priority\*\*: Must Have   
 - \*\*Rationale\*\*: To ensure the app is user-friendly and compatible with standard mobile device security models.   
 - \*\*Source\*\*: Derived from 5.1 Hardware Requirements   
 - \*\*Acceptance Criteria\*\*: The app shall operate fully on non-rooted or non-administrator devices.  
  
- \*\*CST-14\*\*: The system shall not be dependent on any single third-party service (e.g., a specific ride-hailing API) to the extent that its failure would render the app unusable.   
 - \*\*Priority\*\*: Should Have   
 - \*\*Rationale\*\*: To ensure system robustness and avoid single points of failure in optional integrations.   
 - \*\*Source\*\*: NFR-12   
 - \*\*Acceptance Criteria\*\*: The app shall have fallback mechanisms or graceful degradation in the event of third-party API failures.  
  
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## Traceability Table  
  
| Requirement ID | Source | Test Case ID (TBD) |  
|----------------|--------|--------------------|  
| CST-1 | NFR-11 | TC-CST-1 |  
| CST-2 | NFR-4 | TC-CST-2 |  
| CST-3 | NFR-11 | TC-CST-3 |  
| CST-4 | 5.1 Hardware Requirements | TC-CST-4 |  
| CST-5 | 5.1 Hardware Requirements | TC-CST-5 |  
| CST-6 | 5.3 Network and Connectivity | TC-CST-6 |  
| CST-7 | 5.3 Network and Connectivity | TC-CST-7 |  
| CST-8 | 5.3 Software Requirements | TC-CST-8 |  
| CST-9 | 5.1 Hardware Requirements | TC-CST-9 |  
| CST-10 | Derived from general software design principles | TC-CST-10 |  
| CST-11 | Derived from 2.2 Major Capabilities and 4.6 Optional Features | TC-CST-11 |  
| CST-12 | NFR-11 | TC-CST-12 |  
| CST-13 | Derived from 5.1 Hardware Requirements | TC-CST-13 |  
| CST-14 | NFR-12 | TC-CST-14 |  
  
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## Revision Summary  
  
- Added \*\*5.1 Regulatory and Legal Constraints\*\* to address data privacy and retention requirements.  
- Added \*\*5.2 Hardware Constraints\*\* to define minimum compatibility and performance standards.  
- Added \*\*5.3 Interface Constraints\*\* to ensure secure and reliable integration with external services.  
- Added \*\*5.4 Design and Implementation Constraints\*\* to support modularity and future scalability.  
- Added \*\*5.5 Other Constraints\*\* to address privacy, device access, and third-party dependencies.  
  
\*\*Lint Warnings:\*\*  
- No duplicate or conflicting constraints identified.  
- All constraints are atomic, verifiable, and design-independent.  
- Some constraints (e.g., CST-14) are based on assumptions and may require stakeholder confirmation.