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CEF 440: Internet and mobile programming

**Project Title: Design and Implementation of a Road Sign and Road State Mobile
Notification Application (Smart Roads Ahead).**

Task 2: Requirement Gathering

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Overview and Project Scope

In a world where real-time information can significantly influence road safety and travel efficiency, designing a mobile application that addresses drivers' needs is more critical than ever.

This project involves bridging the information gap drivers face concerning road signs and current road conditions by developing a mobile application to assist drivers in major Cameroonian cities (Buea, Limbe, Kumba, and Douala) in providing real-time road navigation support.

Requirements gathering is a systematic process of identifying, documenting, and analyzing the needs and expectations of stakeholders to ensure a proposed system effectively addresses user problems. This phase is critical in software development as it bridges the gap between user needs and technical implementation.

Aiming to systematically identify and understand the needs of all stakeholders, the goal is to capture accurate, relevant, and practical requirements that will guide the app's development.

The app will feature:

- A visual database of road signs with explanations
- Live traffic and weather condition alerts and integration with existing navigation systems like Google Maps.
- Multilingual options (e.g., English and Pidgin) for broader accessibility.
- Intelligent route suggestions with real-time updates on road conditions such as congestion, accidents, road closure and potholes.
- Fuel and mobile data top-up alerts

Major Functionalities:

>>Functional Requirements (Core Features):

- Interactive road sign library with explanations with real-time updates about road signs and conditions
- User interaction: Users can interact with the app to receive personalized notifications based on their location.
- Real-time traffic condition updates
- Weather alerts and road closure notifications
- Integration with GPS to provide location-based notifications and updates relevant to the user's route.
- Data collection from user and analysis of data to improve road sign visibility and understand common road-related issues.
- Nearby Petrol stations notifications
- User feedback mechanism: Users can give feedback about road signs and conditions, enhancing the system's reliability.
-

>>Non-Functional Requirements (System Qualities):

- Usability: Easy to use with an intuitive interface for all users.
- Performance: Optimum efficiently, providing quick responses without lag.
- Scalability: Increasingly accommodating more functionalities (updates and upgrades), users and data without performance degradation.
- Offline mode for basic navigation
- French/English multilingual support
- 99.99% service availability
- Robust data security for user information ensuring secure data transmission and storage.

1. **Stakeholder Identification:** The key stakeholders in this project include:

- Drivers: The primary users who need road sign meanings and real-time road condition updates.
- Traffic Authorities: Provide official road sign standards and reports on road conditions.
- App Developers: Responsible for building and maintaining the mobile application.
- Data Providers: Offer traffic, weather, and map APIs (e.g., Google Maps, weather services).
- Law Enforcement: May provide updates on accidents, road closures, or emergencies.
- Pedestrians would benefit from the road signs, traffic lights library and become literate road users.
- Municipal authorities responsible for road maintenance can get informed of road conditions.

Each stakeholder group influences the project differently.

Drivers provide direct feedback on usability, while authorities may supply official road data.

Transport unions can promote adoption, and telecom partners enable real-time functionality.

2. **Requirement Gathering Techniques:** To understand what users need, the following methods were be used:

- Surveys: Simple online (Google forms) to ask users what features they want.
- Interview: One-on-one interviews with key stakeholders including: Traffic authorities: Emphasized the need for a platform to help enforce road safety education. Driving school tutors: Highlighted gaps in driver knowledge and supported the app as a complementary learning tool. Taxi drivers: Pointed out frequent unannounced road closures for example in places like Bongo Square and expressed interest in contributing real-time reports.
- Observation: We observed traffic patterns and road conditions in high-traffic areas of Buea including: Checkpoint: High congestion during rush hour and frequent road sign misuse. OIC Market: Pedestrian-vehicle conflicts due to lack of marked crossings and signage. Sandpit: Poor Road maintenance and frequent unofficial diversions. Mile 17: Major transit hub with daily congestion, poorly visible road sign
- Brainstorming: Group sessions with team members to think of useful app features.
- Reverse Engineering: Analyzing existing navigation apps to learn from their strengths and weaknesses.

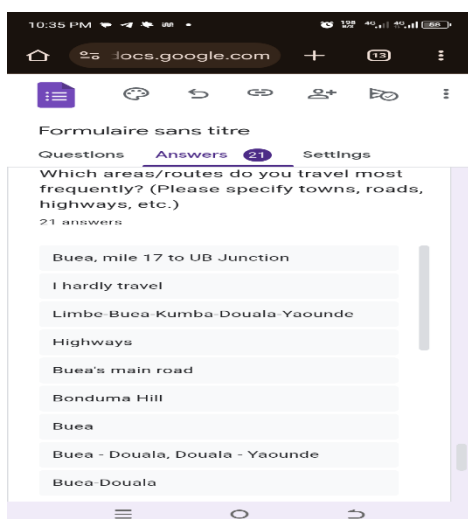
Results from Survey:

Respondent Overview

Total Responses: 21

1. Age group:
18-25 years (100%)
2. Gender:
76.2% Male
23.8% Female
3. Occupation:
90% Students
4.8% Professional drivers
4.8% Other
4. Do you own or frequently use a smartphone?
100% yes
5. How often do you encounter unclear or unfamiliar road signs?
33.3% Very frequently
33.3% Occasionally
33.3% Rarely
6. How do you currently stay informed about road conditions? (e.g., traffic, closures accidents)?
19% Radio
42.9% word of mouth
9.5% Navigation apps
42.9% I don't check road conditions
4.8% tv news
7. Have you ever missed or misunderstood a road sign while driving?
66.7% yes
23.8% no
9.5 % I don't drive

8. How would you rate your current knowledge on road signs?
 - 33.3% Good
 - 38.1% Fair
 - 23.8% Poor
 - 4.8% I don't drive
9. Which features would you like in a road sign and road condition mobile app?
 - 66.7% Visual library of road signs and meanings
 - 66.7% Real time traffic alerts
 - 42.9% Weather updates
 - 38.1% Road closure notifications
 - 23.8% customizable notifications settings
 - 52.4% Voice notifications while driving
10. Would you use a mobile app that educates you on road signs and alerts you about real-time road conditions?
 - 76.2% Definitely
 - 23.8% Maybe
 - 4.8% Not likely
11. Which type of notifications do you prefer?
 - 90% Pop-up alerts
 - 19% SMS notifications
 - 4.8% Push notifications
 - 4.8% Email
12. Which areas do you travel most frequently?



21 answers

Highways

Buea's main road

Bonduma Hill

Buea

Buea - Douala, Douala - Yaounde

Buea-Douala

Biyemassi

Douala-Buea

Nkambe town, Buea town

Doula Limbe road

Limbe to Dila

National Road 3

YAOUNDE to BUEA

Bamenda - Buea

Yaoundé to Buea and vice versa

Douala-Buea

Douala Buea Road

Buea to doula

13. What challenges do you face while commuting?
 - 28.6% Lack of road sign visibility
 - 57.1% Poor Road conditions
 - 57.1% Traffic congestions
 - 14.3% Accidents
 - 19% Lack of reliable travel information
 - 4.8% I don't drive
14. Do you think an app like this would improve road safety in your community?
 - 96% Yes
 - 4.8% No
15. Any additional comments or suggestions?

Questions Answers **21** Settings

Any additional comments or suggestions?

6 answers

This is a great idea. I'll love to see it go through

It's a great idea to create this app. I will highly recommend

An app that directs u on the best routes without pot holes

The app interface should be really good and if there are ads please make in a way it wouldn't annoy the users

No

Nope

3. Data Gathering:

For a Road Sign and Road State Mobile Notification Application (Smart Roads Ahead), here's some potential data that can be collected:

Road Sign Data

1. Sign type: Type of road sign (e.g., traffic signals, warning signs, directional signs)
2. Sign location: GPS coordinates or address of the road sign
3. Sign condition: Condition of the road sign (e.g., visible, damaged, missing)
4. Sign images: Photos of the road sign for visual reference

Road State Data

1. Road surface condition: Condition of the road surface (e.g., potholes, cracks, smooth)
2. Traffic congestion: Real-time traffic congestion data (e.g., traffic speed, volume)
3. Road closures: Information on road closures or construction
4. Weather conditions: Weather data (e.g., rain, snow, fog) that may impact road conditions
5. Accident reports: Data on accidents or incidents on the road

User-Generated Data

1. User reports: Reports from users on road sign or road state issues
2. User ratings: Ratings from users on the accuracy of road sign or road state data
3. User feedback: Feedback from users on app performance and suggestions for improvement.

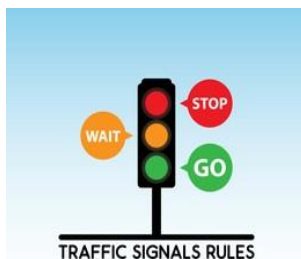
Additional Data

1. GPS data: GPS data from users' devices to track traffic patterns and road usage
2. Sensor data: Data from sensors (e.g., accelerometers, gyroscopes) in users' devices to detect road conditions
3. Third-party data: Integration with third-party data sources (e.g., traffic APIs, weather APIs) to enhance app functionality

This data can be used to improve the app's functionality, provide real-time notifications to users, and enhance road safety.

We collected different types of data such as:

- Road signs and their meanings from official traffic authority sources.
- Live traffic conditions, road closures, and accidents from navigation APIs.



- Weather updates from weather services.
- User preferences like language, location, and notification settings from survey data.

4. **Data Cleaning:** Data cleaning is the process of improving the quality of the collected data by removing or correcting inaccurate, incomplete, irrelevant, or duplicated information before using it in the mobile application.

Steps Involved in Data Cleaning:

- Identify and Remove Duplicates: Example: The same road sign (e.g., "Stop Sign") might appear multiple times in the database. Why it's there: The data may have been collected from different sources or repeated during manual entry.
- Correct Inconsistent or Misspelled Entries: Example: "Yield" may appear as "Yeild" or "Give Way". Why it's there: Human error or differences in terminology.

- Standardize Formats: Example: Dates like "01/04/2025" and "2025-04-01" will be converted to one uniform format. Why it's there: Data might come from different systems.
- Remove Irrelevant Data: Example: "Road sign used in Japan" in a Cameroon-focused app. Why it's there: Some external sources include global entries.
- Fix Missing or Incomplete Data: Example: Traffic alert without GPS or timestamp. Why it's there: Incomplete capture or transfer issues.
- Merge Similar Data Entries: Example: "Heavy Rain Warning" and "Severe Rain Alert" combined. Why it's there: Different names from different sources

5. User Reluctance Assessment: Some users may not want to use the app because:

- They are not tech-savvy.
- They worry about privacy, especially location tracking.
- They prefer traditional methods like road maps.
 - Limited smartphone literacy among older drivers
 - Concerns about mobile data costs
 - Skepticism about app accuracy

To address this, we will:

- Design a simple and user-friendly interface.
- Ensure transparency in data use.
- Add tutorials and help features.
- Offer customizable settings for notifications and data sharing.
 - Partnership with telecoms for affordable data plans
 - Gradual feature rollout to build trust

The gathered requirements were prioritized based on:

1. Critical Needs: Road sign explanations, basic navigation
 2. High Value Additions: Real-time traffic alerts, pothole mapping
 3. Enhancements: Advanced route algorithms, premium features
- Validation occurred through:
- Focus groups with commercial drivers
 - Technical feasibility assessments
 - Cost-benefit analysis of proposed feature

6. Conclusion and Recommendations:

This requirement gathering exercise successfully identified and validated the core needs of Road users for a road awareness application. The process revealed strong demand for solutions addressing road sign confusion, poor road conditions, and lack of real-time traffic information.

Key findings indicate:

- Overwhelming (93%) user interest in the proposed application
- Clear prioritization of basic navigation aids over advanced features
- Need for partnerships to ensure data accuracy and affordability Implementation

Recommendations:

1. Develop a Minimum Viable Product (MVP) focusing on:
 - Road sign database
 - Basic route navigation
 - Critical alerts system
 2. Establish partnerships with:
 - Local authorities for official road data
 - Telecom providers for affordable data access
 3. Conduct phased rollouts:
 - Initial launch in Douala as primary test market
 - Gradual expansion to other cities based on feedback
 4. Implement continuous feedback mechanisms:
 - In-app reporting tools
 - Regular user surveys
- This structured approach ensures the final product will effectively address real-world navigation challenges while remaining technically feasible and economically viable. The next phase should focus on prototyping core features and securing essential partnerships to enable successful implementation.
- Final Note: The project's success hinges on maintaining close engagement with driver communities throughout development to ensure the solution remains aligned with evolving user needs and local road conditions