Road Assessment and Hazards (RAAH)

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1. Introduction

Pakistan has a high rate of road hazards that disrupt urban life in the form of potholes, broken traffic lights, littering, and clogged drains. These problems not only undermine road safety, but also lower the overall quality of life for citizens. Despite being chronic, such issues are rarely reported or resolved in a timely manner due to the absence of proper communication channels between the public and municipal authorities.

To address this gap, Road Assessment and Hazards (RAAH) has been developed as a Human-Computer Interaction (HCI) system. Providing a user-friendly and real-time platform, RAAH gives citizens the opportunity to report hazards with ease and authorities to respond more efficiently. With features such as multi-language support, large buttons, voice assistance, and real-time notifications, RAAH ensures inclusivity, making it accessible to elderly and differently-abled individuals as well.

2. Personas Summary

Primary Persona – Ali Hassan (Daily Commuter)
26-year-old student who wants to quickly report road hazards during travel.

Primary Persona – Fatima Malik (Bank Employee)
33-year-old bank employee who wants to avoid commute delays and stay updated on road repairs.

Secondary Persona – Sana Iqbal (Municipal Officer)
38-year-old municipal officer who wants to identify high-risk zones and prioritize repairs efficiently.

Secondary Persona – Kamran Ansari (Civil Engineer)
42-year-old civil engineer who wants to prioritize repairs, track progress, and allocate resources efficiently.

Supplementary Persona – Haider Malik (Delivery Rider)
29-year-old rider who wants to report road problems and get timely updates for safer travel.

Supplementary Persona – Javed Mirza (Traffic police warden)
36-year-old traffic police officer who wants to ensure smooth traffic flow, report hazards, and coordinate safety.

Customer Persona – Ahmad Raza (Senior officer Municipal Corporation)
38-year-old senior municipal officer who wants to improve coordination, ensure accuracy, and monitor staff digitally.

Served Persona – Sara Khan (Marketing Executive)
29-year-old marketing executive who wants a cleaner, safer neighborhood with smooth daily mobility and confidence.

Negative Persona – Bilal Siddiqui (Student)
24-year-old student who wants to express frustrations quickly, gain attention, and test digital systems.

3. Defining the Interaction Framework

3.1. Form Factor, Posture, and Input Methods

Form Factor:
Mobile app accessible on smartphones for reporting and monitoring road conditions.

Posture:
Its posture is sovereign, as it empowers citizens to report hazards directly while enabling municipal officers to take action on those reports.

Input Methods:
Touchscreen inputs (tap, swipe), voice reporting, photo uploads, and automatic or manual location selection.

3.2. Functional and Data Elements

- **Data Elements:**

Elements	Description	Attributes
Hazard Report	Issue submitted by citizen	Image, category, user ID, timestamp, status, location
User Profile	Basic user info	Name, email, submitted reports
Task Assignment	Tasks generated for staff	Assigned area, deadline, priority, completion state
Notifications	Alerts sent to users	Category, status update
Hazard Category	Types of hazards	Pothole, garbage, drain blockage, waterlogging, broken streetlight
Admin Profile	Used by municipal officers	Email, role, assigned areas
Heatmap Data	Aggregated report data	Area name, severity level, report frequency

- **Functional Elements:**

Function	Description
Capture Photo	Allows user to take picture of hazard
Auto-Detect Location	Uses GPS to automatically tag the exact location
Hazard Category Selection	User chooses the issue type
Report Submission	Sends report to system
Track Report Status	Shows progress of user's report
Dashboard View (admin)	Shows heatmaps and analytics
Assign Tasks	Officers can schedule maintenance
Browse Reports	For staff to verify and update
Generate Monthly Reports	Download or review monthly summaries for planning and budgeting.

3.3. Functional Groups and Hierarchy

To ensure a smooth interaction flow across the RAAH system, the interface was organized into clear functional groups. Each group clusters related screens and actions so that citizens, officers, and field staff can move through tasks efficiently with minimal cognitive load.

3.3.1 Mobile App Groups (Citizen Side)

1. Entry & Authentication

- Welcome Screen
- Sign Up
- Login

2. Home & Reporting

- User Dashboard
- Report Hazard
- Camera / Upload Image
- Auto-Location / Manual Pin

- Category Selection
- Submit Report

3. Tracking & History

- Track Report
- Report Status
- History (Past Submissions)
- Notifications

3.3.2 Administrative System Groups (Municipal Side)

1. Authentication & Setup

- Admin Login
- Admin Settings

2. Oversight & Management

- Admin Dashboard
- Reports List
- Report Details
- Task Assignment
- Heatmap/Statistics

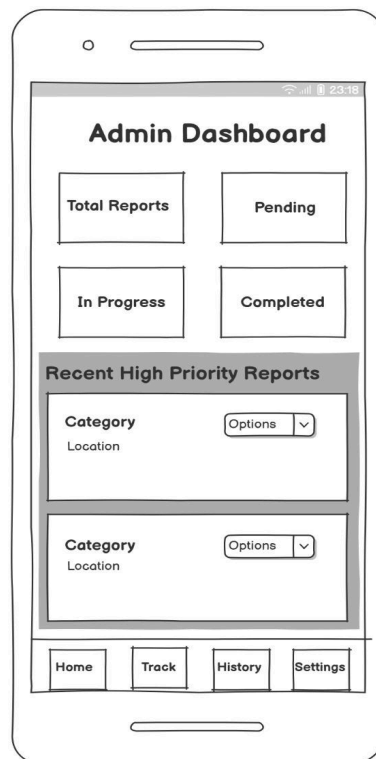## 3. Verification & Control

- Flagged Reports
- Restrict/Unblock User
- System Management Tools

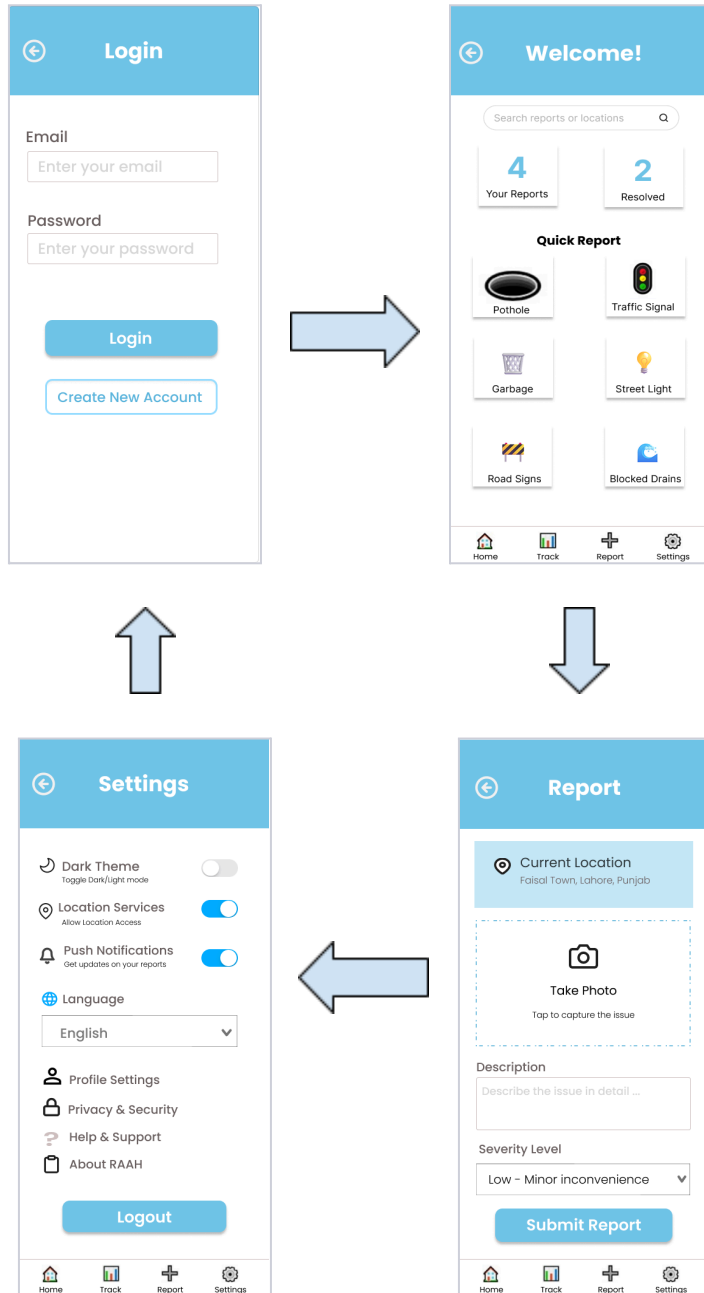## 3.4. Sketch of Interaction Framework

- **User Dashboard**

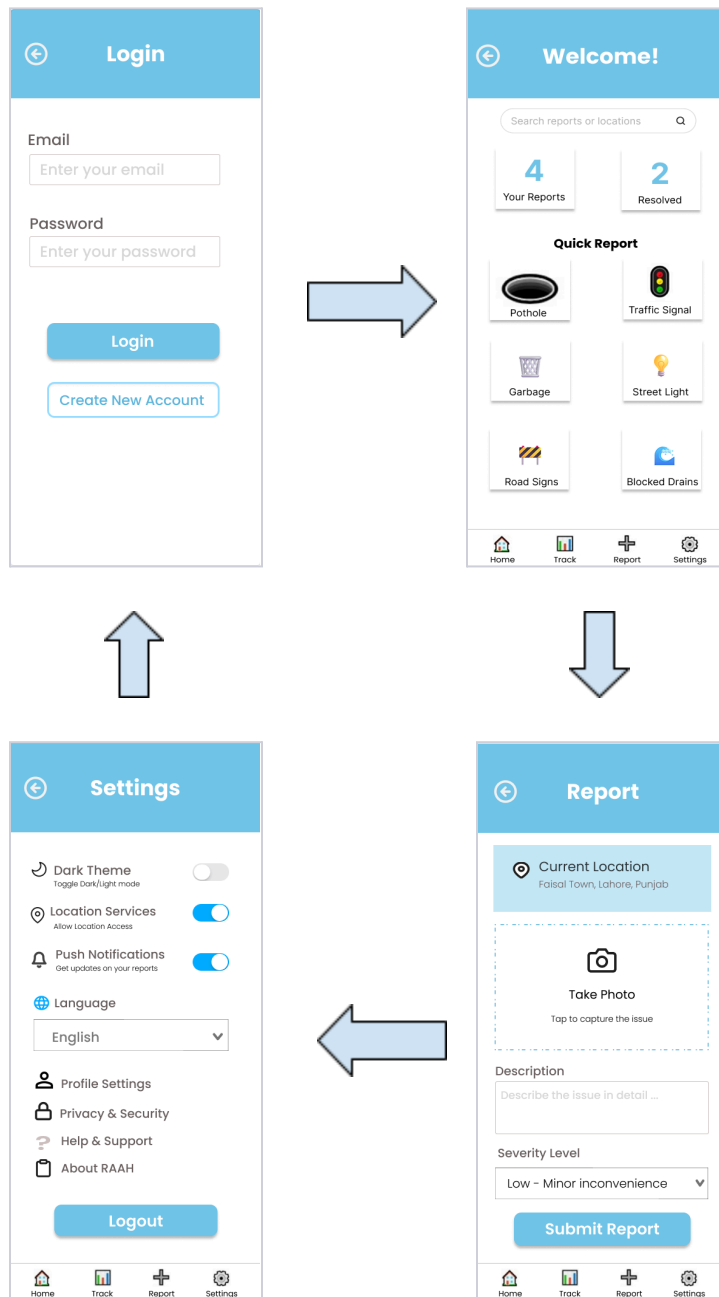- **Admin Dashboard**

3.5. Key Path Scenarios

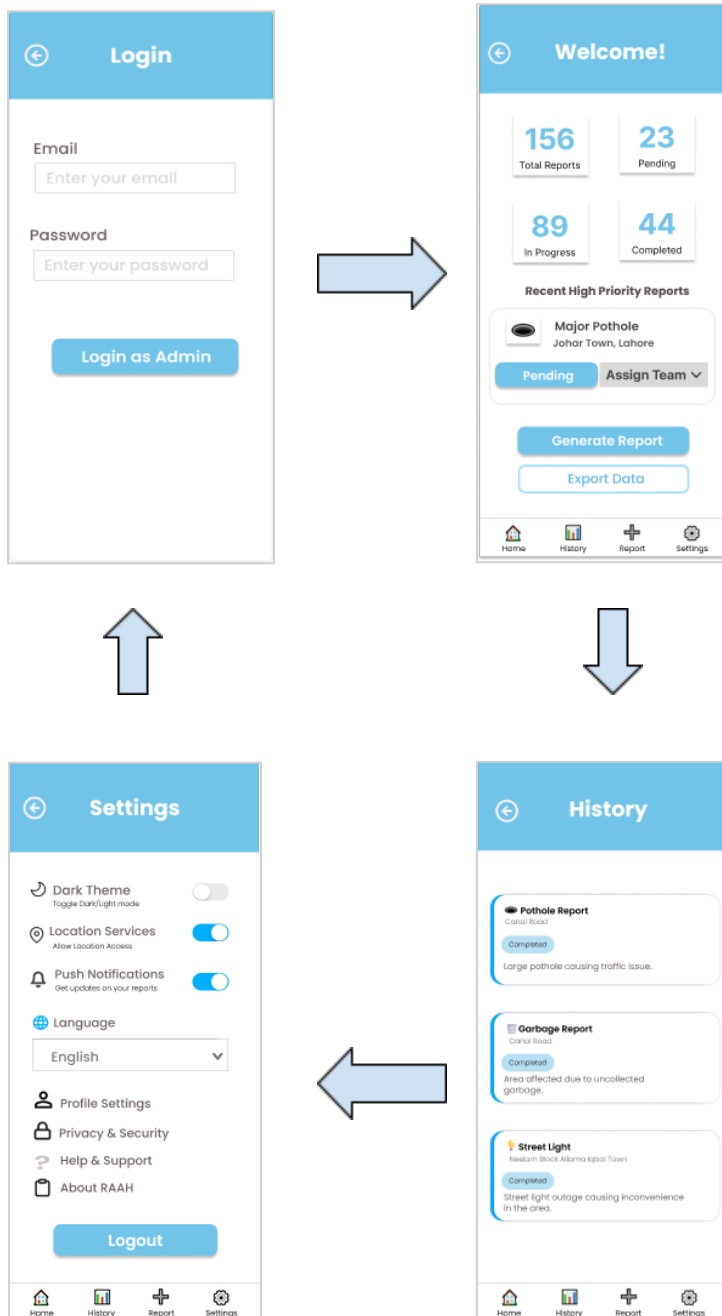● **Scenario (KP-01)**

Title: Citizen Reporting a Pothole

- **Scenario (KP-02)**

Title: Citizen Reporting a Broken Traffic Light

- **Scenario (KP-03)**

  Title: Municipal Monitoring

3.6. Validation Scenarios

- **Alternative Scenario**

1. **Multiple Reports Merged Automatically**

    Fatima notices a large pothole on her way to work. Before she takes out her phone to report it, she sees that another citizen has already submitted the same issue on RAAH. The app displays:

    "Similar Report Already Exists; Do You Want to Support It?"

She taps Support, which increases the report's credibility and priority without creating a duplicate entry.
This scenario highlights an alternate path where the user contributes by strengthening an existing report instead of submitting a new one.

2. **Report Submitted Without Internet**

    On his way home after closing his shop, Javed spots water overflowing from a clogged drain near the market entrance. He takes out his phone to report the issue through RAAH, but the app immediately notifies him that he has no internet connection.
Instead of blocking the action, RAAH switches to Offline Mode, allowing Javed to take a photo, select the hazard type, and pin the location. The report is saved safely on his device. Later that night, once his phone reconnects to Wi-Fi, the app automatically uploads the stored report. Javed receives a confirmation message:

    "Your report has been submitted successfully."

This scenario covers an alternate flow where users can complete their task even without real-time connectivity.

- **Necessary-Use Scenario**

1. **Blocked Drainage on Route**
    While commuting to work, Fatima notices water overflowing from a blocked drainage point along the roadside. She opens the Report screen and selects Blocked Drainage from the categories. The app shows a simple guided form:

    "Add a photo and a short description to help municipal teams locate the issue."

Fatima uploads a picture, adds a brief note, and submits the report. RAAH confirms receipt with a tracking ID. This scenario ensures that even occasional drainage issues can be reported quickly and clearly through a structured reporting flow.

2. **Malfunctioning Street Light at Night**

While walking home after sunset, Ali sees a street light flickering and turning off repeatedly. He opens the Report screen and chooses Street Light as the issue type. The app displays clear instructions asking for a photo and nearby landmark to help identify the exact pole. Ali captures a photo, adds a short message, and submits the report. RAAH instantly acknowledges the submission and notifies him that the maintenance team has been informed. This scenario ensures that infrequent nighttime safety issues can still be reported easily and reliably.

- **Edge Case Scenario**

1. **No GPS Signal at Time of Reporting**

While travelling under a flyover, Ali opens the Report screen but the app cannot get a GPS fix. Instead of failing silently, RAAH displays a clear message:

"We're having trouble detecting your location. Please try again or select
the location manually on the map.."

Ali taps **Select on Map**, drops a pin roughly where he is, and submits the report. This scenario verifies that the design degrades gracefully when device sensors fail.

2. **Fake Reports**

Bilal repeatedly submits fake hazard reports. When municipal staff mark a report as **Invalid/Fake**, RAAH automatically flags the user's account. After a predefined threshold—such as two confirmed fake reports—the system temporarily blocks the user from submitting any new hazard reports for 7 days.

This scenario ensures the framework handles misuse without affecting honest users, balancing community safety with responsible participation.

4. Conclusion

The RAAH interaction framework establishes an efficient communication channel between citizens and municipal authorities for managing urban road hazards. By combining intuitive reporting features for citizens with comprehensive administrative tools like task assignment and heatmap analytics, the system addresses diverse user needs effectively. Validation scenarios confirm the framework reliably handles the complete hazard lifecycle, even under challenging conditions such as GPS failures or fraudulent reports. This structured approach has the potential to significantly improve road safety, accelerate municipal response times, and strengthen civic participation in urban infrastructure maintenance.

References

Cooper et al., (2014). About Face: The Essentials of Interaction Design. (4th ed.). John Wiley & Sons, Inc.

Figma: The Collaborative Interface Design Tool. (n.d.). Figma. https://www.figma.com/design/jYBvWSY9HFK00adiUZmVa2/RAAH?node-id=0-1&p=f&t=eqR4oq02mINEoJVA-0

Balsamiq: Fast, focused wireframing tools. (n.d.). Balsamiq. https://balsamiq.cloud/sl0c259/p1ey9wt/r2278

Appendix

- End User Questionnaire: https://forms.gle/nKYTj3UDvbVgQdms6
- Interview Responses: ResponseSheet.xlsx