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# Accessibility Mapping for People with Disabilities for Urban Environments

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***Abstract* - Equitable mobility for people with disabilities is a key requirement for inclusive and sustainable urban development; however, despite the presence of accessibility-focused infrastructure such as ramps, elevators, tactile paving, and accessible transportation, many individuals with disabilities continue to experience difficulties while navigating urban environments. These challenges arise not only from physical barriers but also from the absence of reliable, real-time accessibility information. Most existing accessibility mapping systems depend on static datasets that do not reflect temporary or dynamic obstacles such as malfunctioning elevators, blocked walkways, construction zones, or uneven surfaces. To address these limitations, this research presents a web-based participatory accessibility mapping system that enables users to report accessibility issues, verify location-specific information through community participation, and access accessibility details tailored to individual needs. By integrating user-generated data with geospatial mapping technologies, the proposed system offers a continuously updated and realistic view of accessibility conditions in urban spaces. In addition to supporting independent mobility for people with disabilities, the collected data can assist urban planners, policymakers, and accessibility stakeholders in improving infrastructure planning and informed decision-making. The study demonstrates that participatory and real-time accessibility mapping significantly enhances the accuracy, relevance, and usability of digital accessibility tools, thereby contributing to inclusive, people-centred, and sustainable smart city development.**

**Keywords - accessibility map, disability, urban mobility, participatory mapping, smart city**

## INTRODUCTION

Urban mobility is a key factor in enabling people to live independently and participate actively in society. For individuals with disabilities, the availability of accessible urban spaces directly affects their ability to travel safely and confidently. Many cities have made efforts to improve accessibility by introducing facilities such as ramps, elevators, tactile paving, and accessible public transport systems. However, these measures alone have not fully resolved the mobility challenges faced by people with disabilities in everyday urban environments.

In practice, accessibility facilities are often affected by issues such as poor maintenance, temporary breakdowns, or obstructions caused by construction work and environmental conditions. At the same time, commonly used navigation and mapping applications depend on static information that does not represent current accessibility conditions. Because of this limitation, people with disabilities may encounter unexpected barriers, including non-functioning elevators, blocked walkways, or uneven surfaces, which can increase travel uncertainty and reduce independence.

Another important challenge is the lack of reliable and up-to-date accessibility information tailored to different disability needs. Existing digital tools provide limited options for users to report accessibility issues or verify on-ground conditions. As a result, there is a noticeable gap between the actual state of accessibility infrastructure and the information available to users. Addressing this gap requires solutions that combine real-time data with active user involvement.

This research focuses on the development of a web-based participatory accessibility mapping system that enables users to report, access, and validate accessibility information in real time. By using user-generated inputs together with geospatial mapping technologies, the proposed system aims to reflect real urban conditions more accurately. The system supports independent mobility for people with disabilities and also provides useful data that can assist urban planners and decision-makers in improving inclusive and accessible urban infrastructure.

### 1.1 Problem Statement

Inclusive urban mobility is essential for the independence and social participation of people with disabilities. Although cities increasingly provide accessibility-related infrastructure such as ramps, elevators, tactile paving, and accessible public transportation, these facilities often fail to function effectively in real-world conditions. Studies show that accessibility features are frequently poorly maintained or temporarily

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unavailable, limiting their usability [1]. Furthermore, most existing navigation and mapping systems depend on static data and do not capture real-time changes in urban environments. As a result, people with disabilities encounter unexpected barriers such as broken elevators, blocked pathways, construction activities, or uneven surfaces. Current digital platforms also lack user participation and personalised accessibility support, reducing their effectiveness for diverse disability needs [2].

### 1.2 Significance

The absence of real-time, location-based accessibility information directly affects the safety, confidence, and independence of people with disabilities. Research emphasizes that accurate and timely accessibility data is as important as physical infrastructure for enabling inclusive mobility and informed urban planning [3].

### 1.3 Proposed Solution

This study proposes a web-based accessibility mapping system that enables users to report and access real-time accessibility information. By integrating user-generated data with geospatial mapping technologies, the system aims to support accessible navigation and promote inclusive urban environments.

## 2. LITERATURE REVIEW

Urban accessibility has gained increasing attention in inclusive urban planning and smart city research. Studies indicate that people with disabilities depend not only on accessible physical infrastructure but also on accurate and timely information to navigate urban environments safely. Although cities provide facilities such as ramps, elevators, tactile paving, and accessible public transportation, these features often become ineffective due to poor maintenance and the lack of real-time accessibility updates. Several researchers have analyzed accessibility mapping through physical infrastructure audits, identifying common barriers such as non-functional elevators, damaged ramps, and inaccessible pedestrian pathways [1]. While audit-based approaches provide structured assessments, they rely on static data and fail to capture temporary or dynamic accessibility conditions caused by construction activities, maintenance issues, or environmental factors, resulting in a gap between documented accessibility and actual user experience. Other studies focusing on digital accessibility tools report limitations including outdated information, lack of personalized navigation, weak integration with mainstream mapping platforms, and minimal user participation in reporting and validation processes, which reduces data accuracy and system reliability [2]. Research further highlights that inclusive accessibility benefits not only people with disabilities but also older adults, caregivers, and individuals with temporary impairments, making accessibility systems essential for equitable and sustainable urban development [3].

### +Research Gap:

Despite existing research, current accessibility mapping solutions largely rely on static or outdated data, offer limited personalization for diverse disability needs, and lack real-time, participatory mechanisms for reporting and validating accessibility conditions. There is a clear need for a dynamic, user-driven accessibility mapping system that integrates real-time data, supports multiple disability types, and provides actionable insights for inclusive urban planning.

## 3. METHODOLOGY

### 3.1 System Architecture

The proposed accessibility mapping system follows a three-tier web-based architecture, consisting of the following components:

### 3.2 Frontend Methodology

A responsive web application developed using React.js, providing an accessible user interface for people with disabilities. The frontend allows users to view accessibility information on maps, submit reports of accessibility barriers, and filter locations based on individual accessibility needs.

### 3.3 Backend and Scheduling Logic

A server application developed using Node.js and Express.js, responsible for handling API requests, managing user reports, processing accessibility data, and coordinating communication between the frontend and the database.

### 3.4 Database Management

A real-time database is used to store accessibility reports, location data, user inputs, and system-generated updates. This enables efficient storage and retrieval of accessibility-related information.

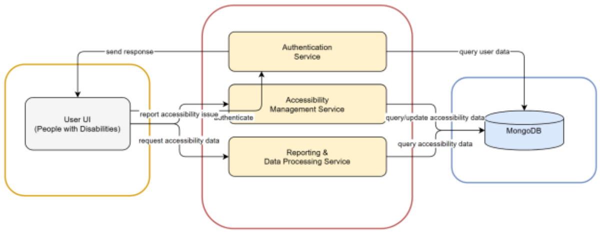


**Figure 1 System Architecture of Accessibility Mapping**

### 4.2 Technologies Used

The proposed accessibility mapping system is developed using a modern web technology stack to ensure scalability, performance, and accessibility. The selected technologies support real-time data processing, interactive mapping, and secure user interactions. Table 1 presents the major technologies used at different levels of the system.

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| **Component** | **Technology Used** |
|---|---|
| Frontend | React.js, HTML, CSS, JavaScript |
| Backend | Node.js, Express.js |
| Database | MongoDB |
| Authentication | JSON Web Token (JWT) |
| API Communication | REST API |
| Mapping Services | Geospatial Mapping APIs |

### 4.3 User Interface (UI) & Screenshots

The accessibility mapping web application is designed with a user-friendly and inclusive interface to support people with diverse disabilities. The interface is responsive and accessible across desktop and mobile devices. Key design principles include simplicity, clarity, and compliance with accessibility guidelines to enhance overall user experience.

#### 4.3.1 User Interface Overview

The system provides multiple role-based and functional interfaces, including:

- **Homepage**: Displays an overview of the platform, key features, and login or registration options.
- **Sign-Up Page:** Allows new users to register and create an account on the platform.
- **Login Page:** A common authentication page for users to securely access the system.
- **Map Interface:** Enables users to view accessibility information, routes, and location-specific details on an interactive map.
- **Reporting Interface:** Allows users to submit accessibility barrier reports with location information.

#### 4.3.2 UI Screenshots

The following figures illustrate the key user interface screens of the Accessibility Mapping System, highlighting the main functional components of the application.

| **Figure No.** | **Description** |
|---|---|
| Figure 2 | Homepage displaying an overview of the platform, key features, and login/register options. |
| Figure 3 | User registration page for creating a new account on the platform. |
| Figure 4 | Interactive map interface displaying accessibility information for locations and routes. |
| Figure 5 | Reviews page for submitting user feedback and reviews with relevant location details. |
| Figure 6 | User data stored in MongoDB was tested to ensure accurate storage, retrieval, and system reliability. |

*Fig. 2 Shows the homepage of the proposed accessibility mapping system.*

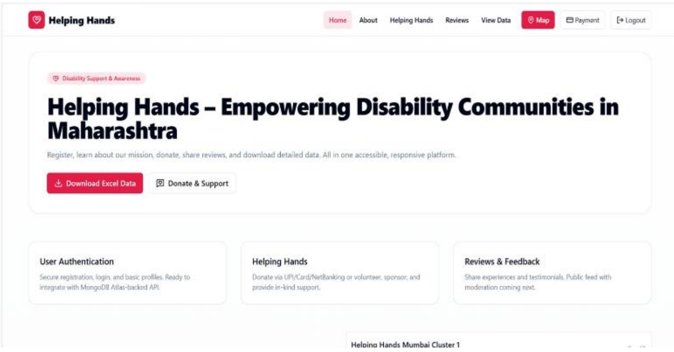



*Fig. 3 Shows the User Registration page of accessibility mapping system*

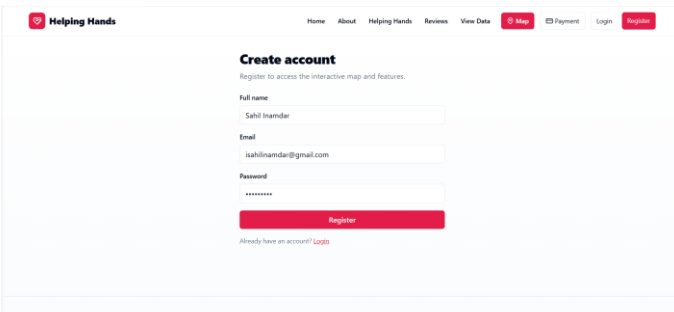


*Fig. 4 Shows the Map Interface page of accessibility mapping system*

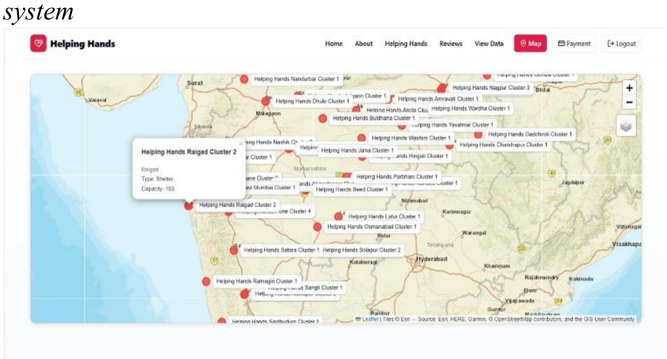



*Fig. 5 Shows the Review & Feedback page of accessibility mapping system*

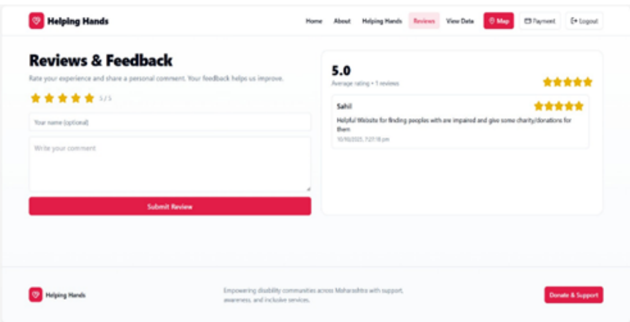
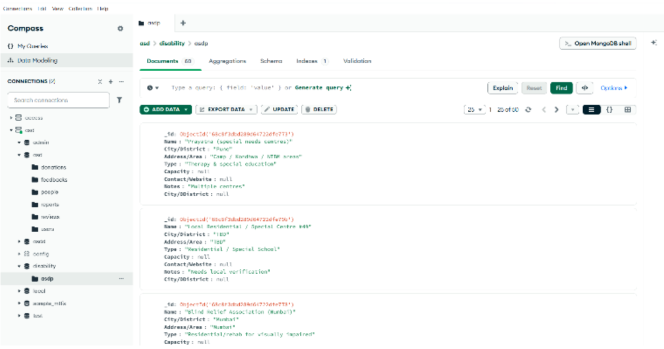



*Fig. 6 Shows the Database page of accessibility mapping system*




## 5. DISCUSSION

### 5.1 Strengths of the System

- **Enhanced Independent Mobility:** The proposed system empowers people with disabilities by providing real-time, location-specific accessibility information, enabling them to navigate urban spaces more independently while reducing reliance on external assistance.
- **Dynamic Awareness of Accessibility Conditions:** Unlike conventional static accessibility maps, the platform continuously reflects real-world changes such as malfunctioning elevators, temporary obstructions, or construction zones, allowing users to anticipate and avoid unexpected barriers.
- **Improved Data Reliability through User Involvement:** By encouraging users to report and validate accessibility issues, the system ensures that the collected information remains accurate, up to date, and representative of actual on-ground conditions.
- **Inclusive Support for Diverse Disability Requirements:** The system accommodates multiple types of disabilities by allowing users to filter accessibility information based on specific needs, making it more inclusive than generic navigation solutions.
- **Valuable Insights for Urban Planning and Policy Making:** The aggregated accessibility data generated by the platform can assist urban planners and policymakers in identifying critical accessibility gaps and prioritizing targeted infrastructure enhancements.

### 5.2 Challenges and Limitations

- **User Awareness and Platform Adoption:** Effective use of the system depends on awareness among people with disabilities and the wider community. Training sessions, outreach programs, and continuous guidance may be required to encourage active participation in both reporting accessibility issues and utilizing the platform's features.
- **Reliance on User-Contributed Information:** The quality and completeness of accessibility data are largely influenced by the frequency and consistency of user contributions. Variations in participation across different locations or time periods may lead to uneven data coverage.
- **Limited Level of Automation:** At present, the system primarily depends on manual reporting of accessibility barriers and does not incorporate automated data collection mechanisms such as IoT-based sensors or direct integration with official infrastructure management systems.

### 5.3 Future Scope

- **Mobile Application Development:** Developing a dedicated mobile application can further enhance accessibility by allowing users to report barriers, access information, and navigate urban spaces conveniently while on the move.
- **Integration with Smart City Infrastructure:** Future system versions can be connected with smart city components such as IoT sensors, public transportation APIs, and municipal databases to enable automatic updates of accessibility conditions in real time.
- **Advanced Analytics and AI-Based Support:** Machine learning and data analytics techniques can be incorporated to anticipate potential accessibility disruptions and recommend optimized routes based on user preferences and historical usage patterns.
- **Multilingual and Voice-Assisted Interaction:** Introducing regional language support and voice-based interfaces can significantly improve usability and inclusivity, especially for users with visual impairments or limited digital literacy.

## 6. CONCLUSION

People with disabilities continue to face significant challenges while navigating urban environments, despite the presence of accessibility-oriented infrastructure such as ramps, elevators, tactile paving, and accessible public transportation. These challenges are further intensified by the lack of reliable, real-time accessibility information and the dependence of existing navigation systems on static and outdated data. As a result, individuals with disabilities often encounter unexpected barriers that limit their independence, safety, and confidence in urban mobility. To address these issues, this research presented the development of a web-based participatory accessibility mapping system designed to provide real-time, location-based accessibility information. By enabling users to report and view accessibility barriers and integrating user-generated data with geospatial mapping technologies, the proposed system bridges the gap between physical infrastructure and digital accessibility information. The platform not only supports independent navigation for people with disabilities but also generates valuable insights that can assist urban planners and policymakers in improving inclusive infrastructure.

Although the system has certain limitations, such as dependence on user participation and the absence of automated data sources, it represents a practical and impactful step toward inclusive urban mobility. With future enhancements including mobile application development, integration with smart city infrastructure, and advanced data analytics, the proposed system has the potential to significantly contribute to the creation of more inclusive, accessible, and people-centred urban environments.

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