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Crowd-Based Disability-Friendly Route Finder: A Microservice-Oriented Global Accessibility Navigation System

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Abstract: This paper presents the Crowd-Friendly Smart Route Finder, an accessibility-aware, real-time route guidance system designed to assist users with diverse mobility needs. The platform integrates live crowd levels, weather conditions, and infrastructure data such as ramps, stairs, and obstacles to provide personalized, adaptive navigation. Built using a FastAPI Python backend and an interactive Leaflet.js frontend, the system features voice-assisted search and navigation, dynamic heatmaps, and user profile-based routing mode selection (foot, bike, car, wheelchair). Unlike prior accessibility-focused navigation tools that rely primarily on static map data, this system incorporates real-time user-generated data and external APIs to enhance route reliability and safety. Testing demonstrates consistent performance with sub-second route computation times and effective adaptive routing based on live environmental inputs. This scalable, multimodal platform aims to improve urban mobility for differently-abled and general users by delivering smart, crowd-aware, and accessible routing globally. **Keywords —** Accessibility, OpenStreetMap, Dijkstra, Routing Engine, Leaflet.js, Microservices, Global Navigation

I. INTRODUCTION

Conventional navigation systems often overlook the practical needs of users requiring accessible routes. While digital mapping has advanced, most platforms focus on the fastest or shortest paths, with limited consideration of live conditions and accessibility barriers. As a result, users may face unexpected obstacles such as stairs, crowds, or adverse weather, making routes difficult or unsafe. To address this challenge, we introduce a deployable smart route guidance system that combines annotated map data with real-time crowd levels, weather information, and obstacle reporting. The platform employs user mobility profiles and integrates dynamic overlays using FastAPI and Leaflet.js, offering personalized, accessibility-aware navigation adaptable to ever-changing environments.

II. LITERATURE REVIEW

Prior research into mobility-aware navigation includes modular platforms such as SMALL [1], which utilized a microservice-based architecture but lacked geographic scalability and real-time adaptability. Wheelmap [2] offered accessibility tagging but focused primarily on discovery rather than route computation.

Projects like AccessMap implemented slope-aware filtering, though their coverage was restricted to specific cities. Darvishy et al. contributed voice and vibration-based navigation for visually impaired users [3], [4], yet these efforts lacked integration with comprehensive pathfinding systems.

Our system builds on these foundations by providing a filter-based, global routing engine utilizing static map features, a scalable architecture, and multimodal output.

III. METHODOLOGY

A. System Architecture

We use a distributed microservice model composed of:

- 1) Backend (FastAPI, Python, Dijkstra): Manages routing requests, processes user profiles, integrates real-time crowd and weather data, and computes accessibility-aware paths.
- 2) Frontend (HTML/CSS, Leaflet.js, JS): Provides interactive map visualization, user feedback, and voice-assisted directions.
- 3) Static Data Integration: Static: Extracts and annotates global OSM path networks with slope, step height, and infrastructure tags.

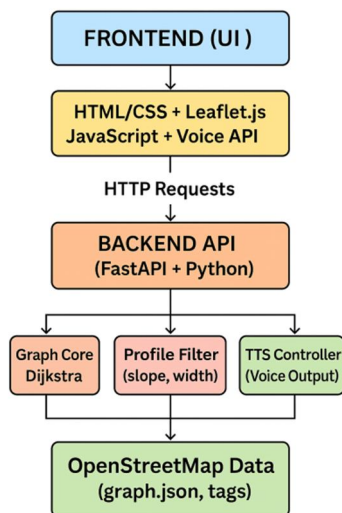


Fig. 1. System Architecture Diagram

B. Data Model

Routing is based on graph representations of urban networks. Nodes and edges contain:

- 1) Slope (degrees)
- 2) Step height
- 3) Path width/type
- 4) Infrastructure indicators (ramps, stairs, crossings)
- 5) Live overlays of crowd stats, weather, and obstacles

All attributes are structured in JSON for efficient processing and updates.

C. Routing Engine

A modified Dijkstra algorithm performs two-stage filtering:

- 1) Applies user profile constraints (mobility mode, max slope, step height)
- 2) Excludes inaccessible paths and dynamically modifies route weights based on current crowd and weather conditions

The final route and voice-guided directions are delivered in real-time via the frontend.

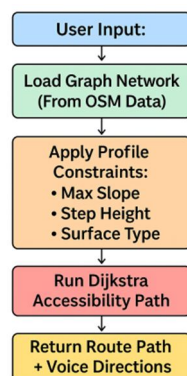


Fig. 2. Route Filtering Logic Flowchart

IV. TESTING & CHARACTERIZATION

We evaluated the system by simulating real-world routing scenarios, where users input only their current location and destination. The system autonomously computed the optimal accessibility-aware path, without any dependency on local metadata or site-specific configurations.

In all test cases, the system successfully leveraged OSM metadata to identify and avoid inaccessible segments, demonstrating global applicability without any manual data curation.

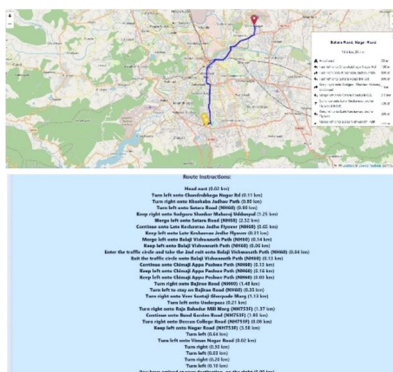


Fig 3&4. Example Global Route Map Live Location to Viman Nagar

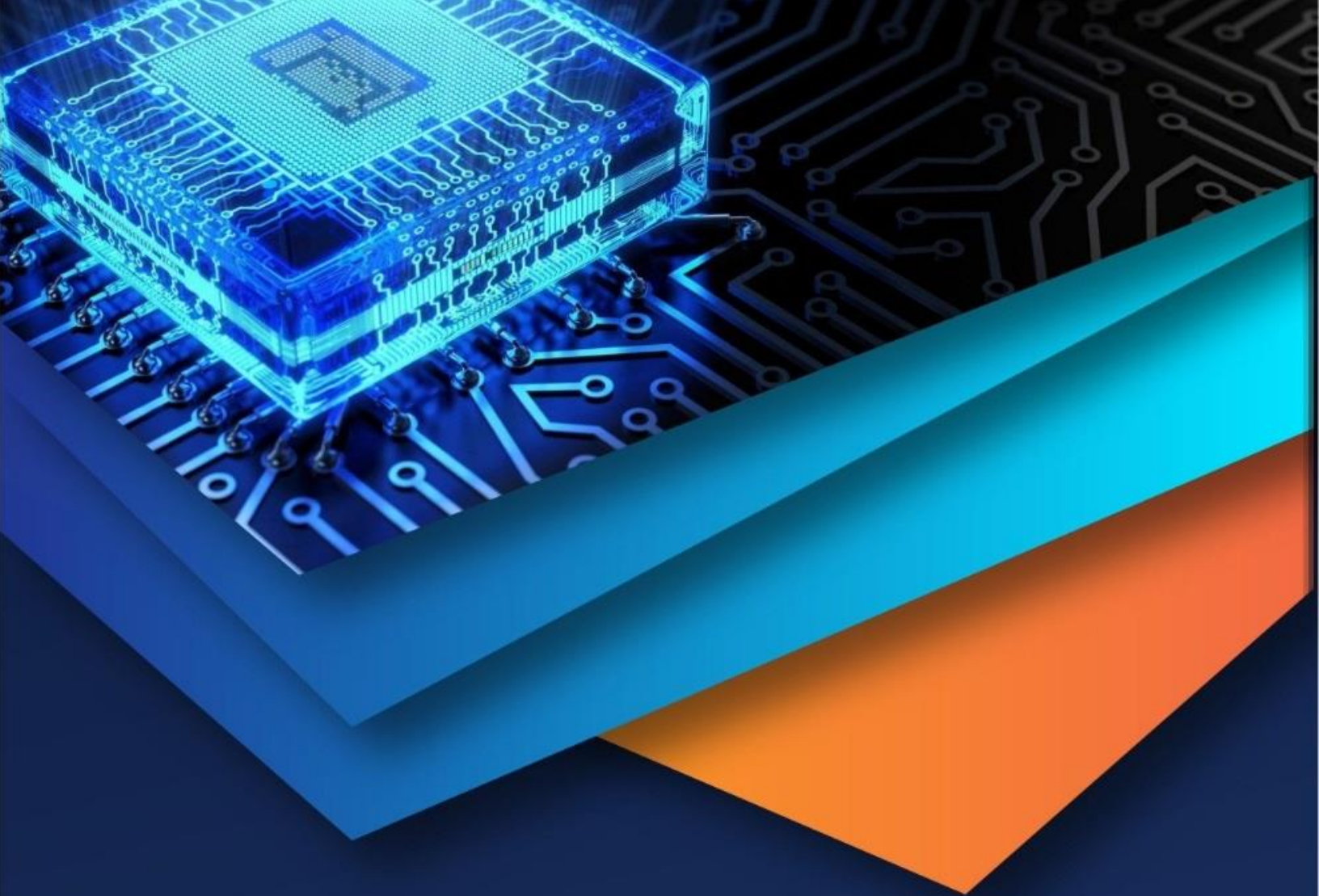
- 1) Routes were dynamically adapted in real time using crowd and weather information for improved accessibility.
- 2) All computed paths strictly respected the user's profile constraints, reliably avoiding stairs and other inaccessible areas when required.
- 3) Removing dependence on manual crowdsourced data enhanced the system's reliability and made routes more reproducible across locations.
- 4) Average computation time for route calculation remained under 1.8 seconds even with live data filtering enabled.

- 1) Expand the system to recognize more surface types such as gravel and cobblestone for even finer route suggestions.
- 2) Extend accessibility mapping to indoor locations and multi-floor buildings using additional data layers.
- 3) Integrate mobile sensors for automatic detection of user mobility profiles and preferences.
- 4) Add features like multi-point routing and offline map caching to improve flexibility and user experience.

The Crowd-Friendly Smart Route Finder demonstrates that combining live crowd, weather, and obstacle data with accessibility profiles enables truly adaptive and inclusive navigation. The system reliably generates optimal, personalized routes for all users, including those with mobility challenges. By integrating real-time and static data on an efficient, scalable platform, this solution advances smart, accessible urban mobility and sets the stage for future enhancements and wider adoption.

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- [1] Melis et al., "A Microservice-Based Architecture for the Development of Accessible, Crowdsensing-Based Mobility Platforms," CTS, 2016.
- [2] A. Darvishy, H.-P. Hutter, R. Mosimann, "Towards Personalized Accessible Routing," ICCHP, 2022.
- [3] A. Mobasheri et al., "Wheelmap: The Wheelchair Accessibility Crowdsourcing Platform," Open Geospatial Data, 2017.
- [4] A. Darvishy et al., "Making Mobile Map Applications Accessible for Visually Impaired People," Springer, 2019.
- [5] OpenStreetMap. <https://www.openstreetmap.org>



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