APPENDIX 1

KIT NAVIGATION MAP

PROJECT REPORT

Submitted by

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2. **Narayani Ghorpade(C 18)**
3. **Yogesh Patil(C 12)**
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5. **Sad Nadaf(C 27)**

in partial fulfillment for the award of the degree of

SY B.TECH

IN

Computer Science and Engineering

KOLHAPUR INSTITUTE OF TECHNOLOGY'S

COLLEGE OF ENGINEERING KOLHAPUR

(EMPOWERED AUTONOMOUS)

April 2025

APPENDIX 2

KOLHAPUR INSTITUTE OF TECHNOLOGY'S COLLEGE OF ENGINEERING KOLHAPUR (EMPOWERED AUTONOMOUS)

CERTIFICATE

This is to certify that the Project report entitled, **"KIT NAVIGATION MAP"** submitted by **"Dhanashree Koli(C 40), Narayani Ghorpade(C 18), Yogesh Patil(C 12), Neha Kulkarni(C 23), Sad Nadaf(C 27)"** , in partial fulfillment for the award of the degree of **"SY B.TECH"** in **"Computer Science and Engineering"** at Kolhapur Institute of Technology's College of Engineering Kolhapur (Empowered Autonomous), Kolhapur, Maharashtra, INDIA, is a record of his / her own work carried out under my / our supervision and guidance.

SIGNATURE	**SIGNATURE**
Dr. Lingraj Hadimani	Mr. Chaitanya Pednekar
HEAD OF THE DEPARTMENT	**SUPERVISOR**
Computer Science and Engineering	Computer Science and Engineering
KIT's College of Engineering	KIT's College of Engineering

APPENDIX 3

KOLHAPUR INSTITUTE OF TECHNOLOGY'S COLLEGE OF ENGINEERING KOLHAPUR (EMPOWERED AUTONOMOUS)

DECLARATION

We hereby declare that the Project entitled, **"KIT NAVIGATION MAP"** submitted to Kolhapur Institute of Technology's College of Engineering Kolhapur (Empowered Autonomous), Kolhapur, Maharashtra, INDIA in the partial fulfillment of the award of the Degree of **"SY B.TECH"** is a bonafide work carried out by me. The material contained in this Project has not been submitted to any University or Institution for the award of any degree.

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Place: KIT's College of Engineering, Kolhapur
Date:

APPENDIX 4

KOLHAPUR INSTITUTE OF TECHNOLOGY'S
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ACKNOWLEDGEMENT

We would like to express our special thanks of gratitude to our project guide Mr.Chaitanya Pednekar as well as our HOD Dr.Lingraj Hadimani who gave us the golden opportunity to do this wonderful project on the topic “KIT NAVIGATION MAP”, which also helped us in doing a lot of research and we came to know about so many new things we are really thankful to them.

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INTRODUCTION

The "KIT NAVIGATION MAP" is a web-based navigation tool designed to assist users in locating key buildings, departments, and amenities within a college campus. In an era where smart solutions are increasingly integrated into educational institutions, this system bridges the gap between physical infrastructure and digital assistance. It provides interactive map features, location search, live user positioning, and shortest path calculation using geographic coordinates.

The main aim is to simplify orientation for students, staff, and visitors, reducing confusion and improving accessibility. It combines frontend visualization, geolocation APIs, and backend pathfinding logic to deliver a seamless, responsive experience.

In addition to the interactive 2D map, the system includes a dedicated page showcasing a 3D model of the college campus. This feature offers a more immersive visualization experience, allowing users to understand the spatial layout and structure of buildings with greater clarity.

PROBLEM STATEMENT

Navigating a large academic campus can be confusing for newcomers, leading to delays in attending lectures, locating offices, or finding resources like the library or canteens. Physical maps are static and hard to interpret in real-time. This project addresses these issues by introducing a centralized, real-time, and interactive digital map that:

- Enables users to search for campus locations.
- Shows current user location on the map.
- Highlights the shortest route between selected points.
- Supports mobile and desktop devices.

PROJECT SCOPE

The assistant currently includes:

- **Location Markers :** Over 15 campus-specific buildings (departments, hostels, canteens, library, etc.) with precise GPS coordinates.
- **Live User Location :** Uses the browser's geolocation API to detect and mark the user's location.
- **Shortest Path Routing :** Users can select a source and destination to view the shortest path computed using Dijkstra's algorithm.
- **Responsive UI :** Sidebar menu navigation, search functionality, and route preview.
- **Expandable :** The architecture supports adding new features like event pins, accessibility paths, or indoor navigation.

The project now includes a 3D visualization module where users can explore the entire campus from multiple angles. The 3D map is especially useful for new students, event organizers, or individuals with accessibility needs who require a comprehensive view of building layouts and terrain.

LITERATURE REVIEW

1 . Smart Campus Navigation

As educational campuses grow in size and complexity, the need for smart navigation systems becomes increasingly important. Traditional methods like physical maps, printed signs, and word-of-mouth directions often lead to confusion and inefficiency. Several studies have emphasized the role of digital navigation tools in improving user experience within large institutions. These tools not only reduce the time spent locating rooms and departments but also significantly lower the cognitive load on new students and visitors. Moreover, they enhance inclusivity by offering accessible and visually guided experiences for people unfamiliar with the layout.

2 . Leaflet.js Mapping Technology

Leaflet.js is a modern, open-source JavaScript library specifically built for interactive maps. It is highly efficient due to its lightweight footprint and offers rich plugin support and easy customization. The library seamlessly integrates with open data sources like OpenStreetMap, making it a preferred choice for educational and non-profit projects. Its ability to handle dynamic tile loading, zooming, marker clustering, and user interactivity makes it suitable for real-time campus layout visualizations. In this project, Leaflet.js powers the core map interface and provides the foundation for displaying markers and paths.

3 . Dijkstra’s Algorithm in GIS

Geographical Information Systems (GIS) often rely on graph-based algorithms for spatial analysis, and Dijkstra's algorithm is one of the most effective methods for calculating the shortest path between two nodes in a network. It works well in environments where all edge weights (distances) are non-negative, which is ideal for physical distances on a map. In this project, Dijkstra’s algorithm is used on a weighted graph where each node represents a location within the college, and edges are weighted based on real-world distances calculated using the Haversine formula. This ensures optimal route recommendations between campus points.

4 . Haversine Distance Calculation

The Haversine formula is widely used in geospatial computing to calculate the great-circle distance between two points on the Earth's surface, given their latitude and longitude. Unlike Euclidean distance, which assumes a flat surface, the Haversine method accounts for Earth’s curvature, making it more accurate for location-based services. In this project, it is used to compute pairwise distances between all known locations within the college campus. These distances form the weighted edges of the graph that Dijkstra’s algorithm uses for pathfinding, ensuring both precision and practicality in routing.

METHODOLOGY

Frontend

- **HTML & CSS :** Structured layout with responsive design, navigation menu, and theme.
- **JavaScript (app.js):**
  - Interactive map using **Leaflet.js** with tile layer from OpenStreetMap.
  - All 18+ locations are defined with precise coordinates and marked using custom icons.
  - Search feature filters markers based on text input.
  - Click-based department locator and dropdown-based shortest path finder.
  - Real-time user geolocation displayed with a unique marker.

Backend

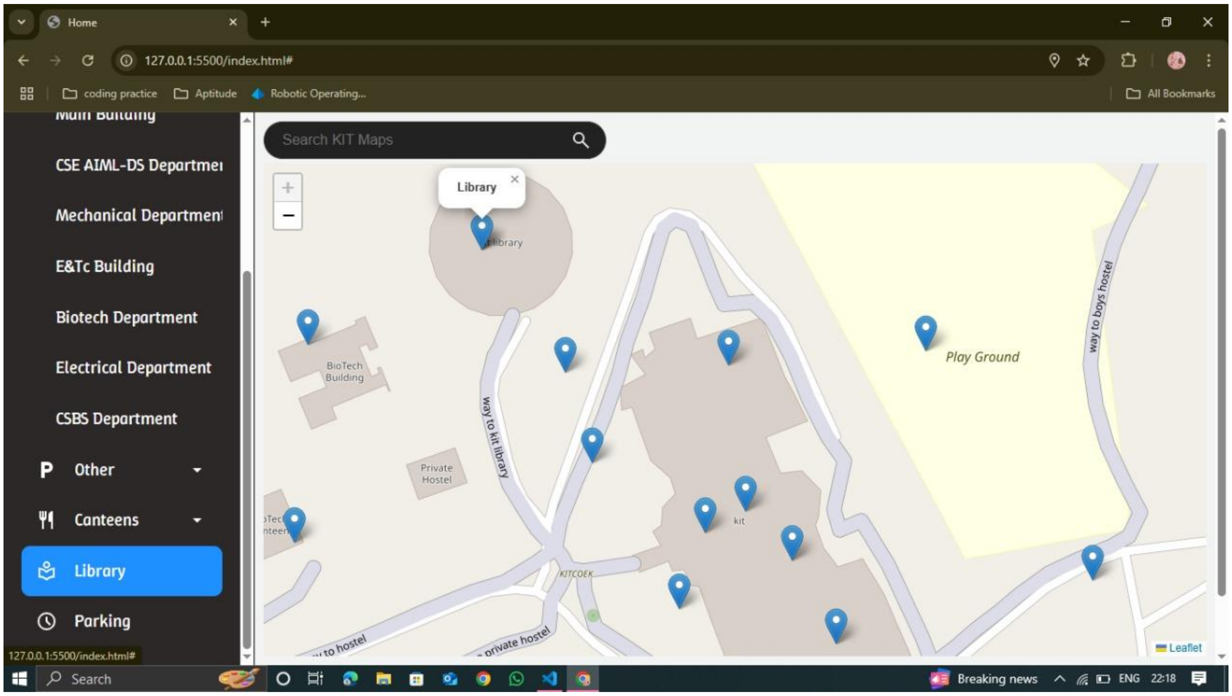
- **Flask**
  - REST API built using Flask with CORS support.
  - POST /shortest-path endpoint accepts source and destination, returns shortest path using **Dijkstra's Algorithm**.
  - Reads data from json file and computes Haversine distances for the graph

Pathfinding Logic

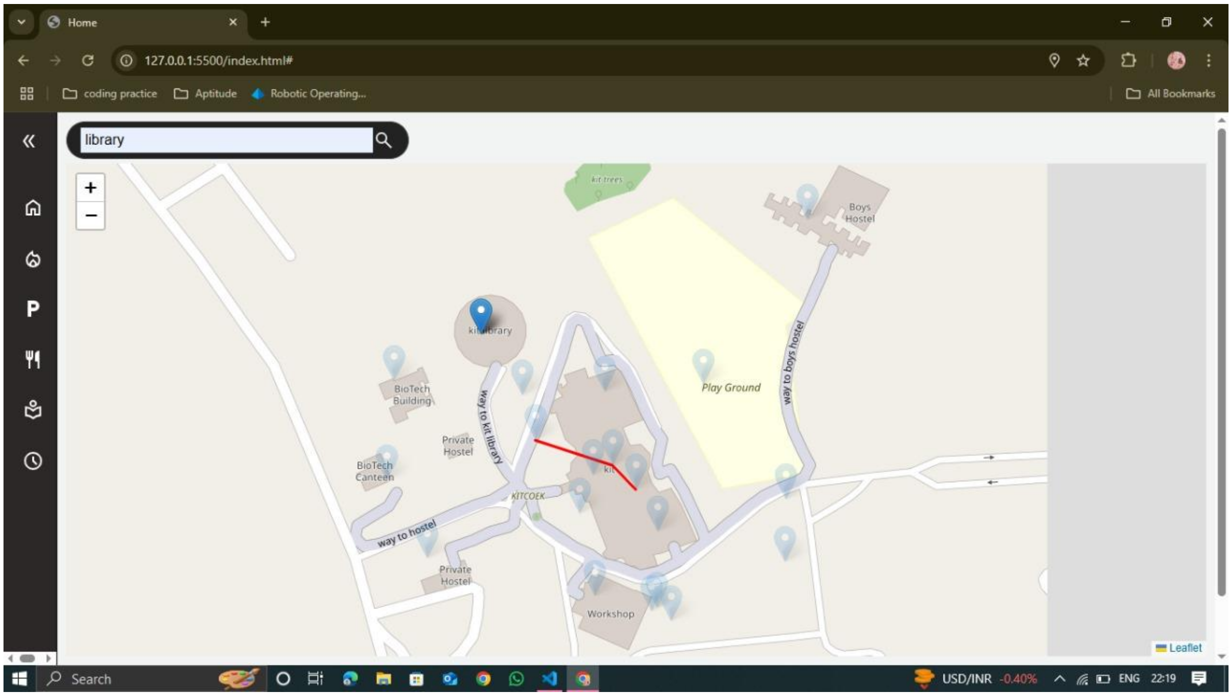
- **Graph Creation:** All locations are nodes; edges are weighted by real-world distance using the Haversine formula.
- **Dijkstra's Algorithm:** Calculates the shortest path from source to target with detailed step trace.
- **API Response:** Returns JSON with the path, total distance, and geographic coordinates to be drawn on the frontend.

KIT NAVIGATION MAP INTERFACE

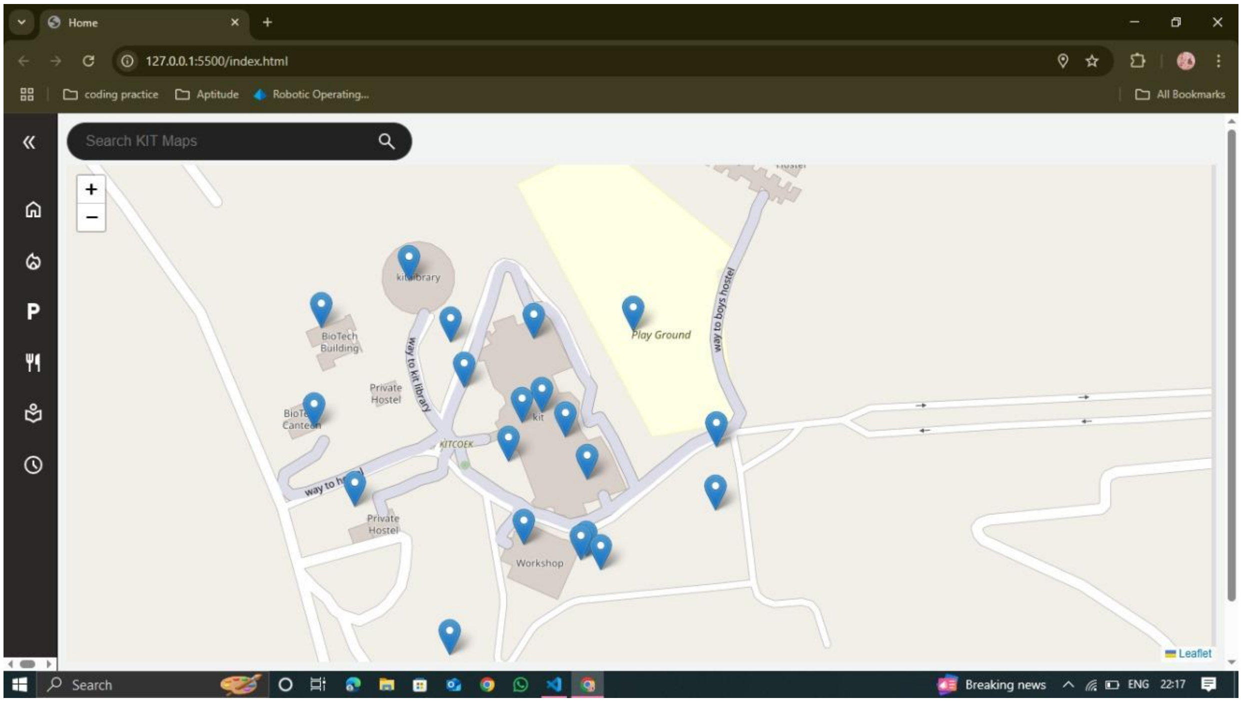
1. SIDEBAR



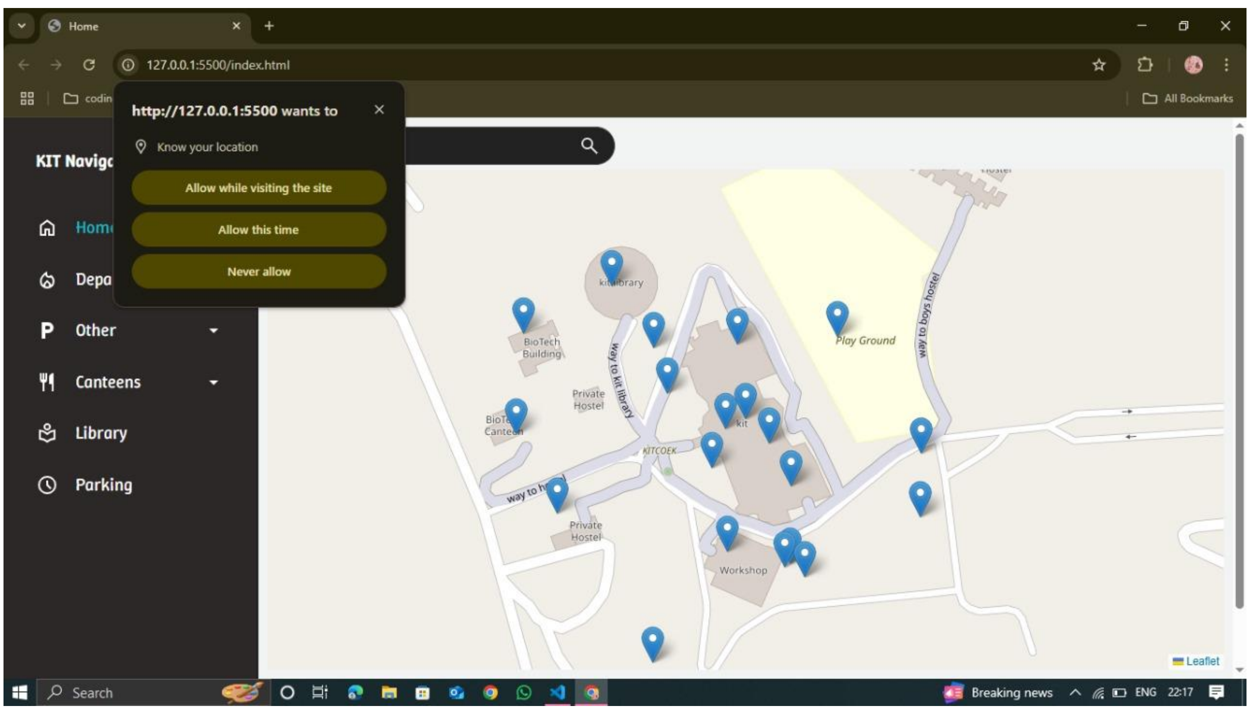
2. SEARCH FUNCTION



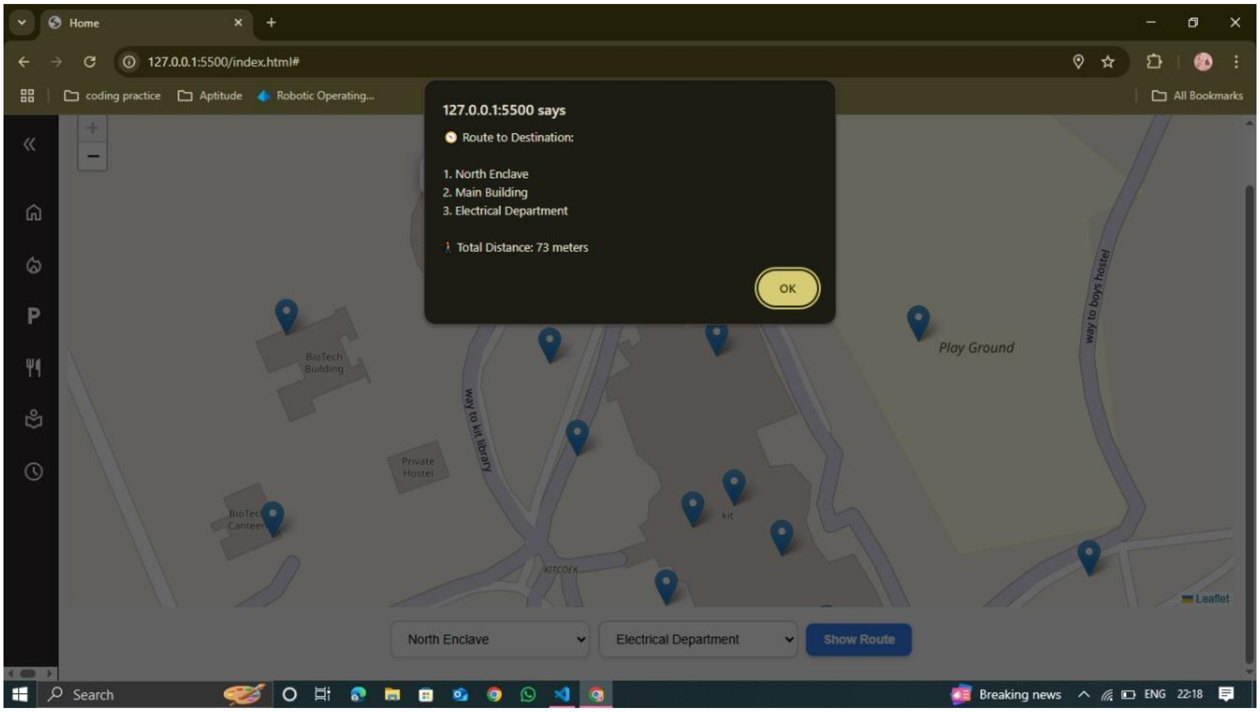
3. CAMPUS MAP



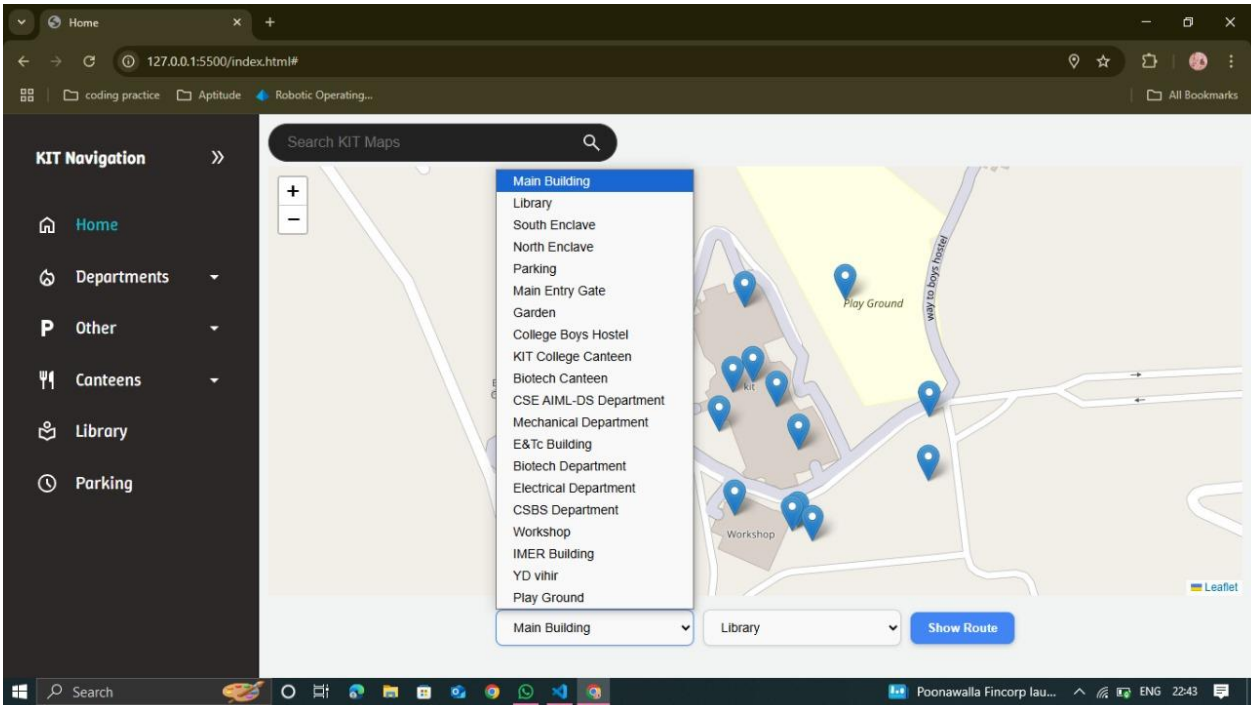
4. USER LOCATION TRACKING



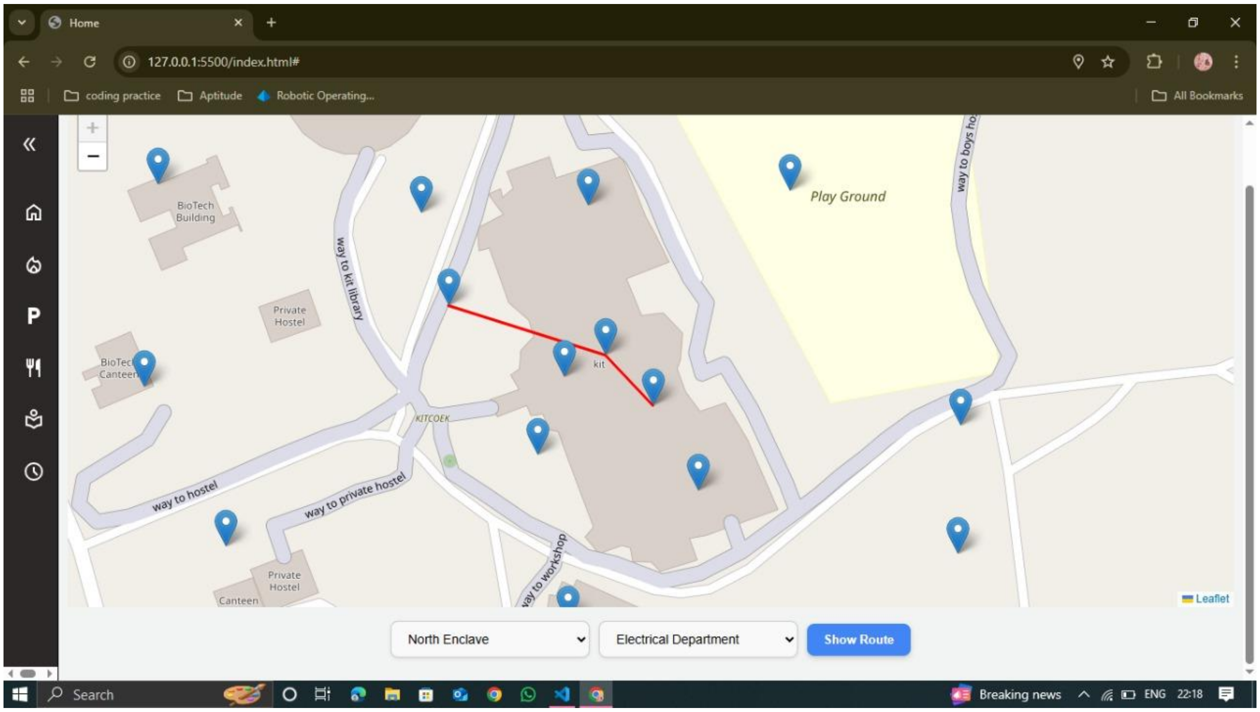
5. ALERT MESSAGE CONTAINING KEY LOCATIONS



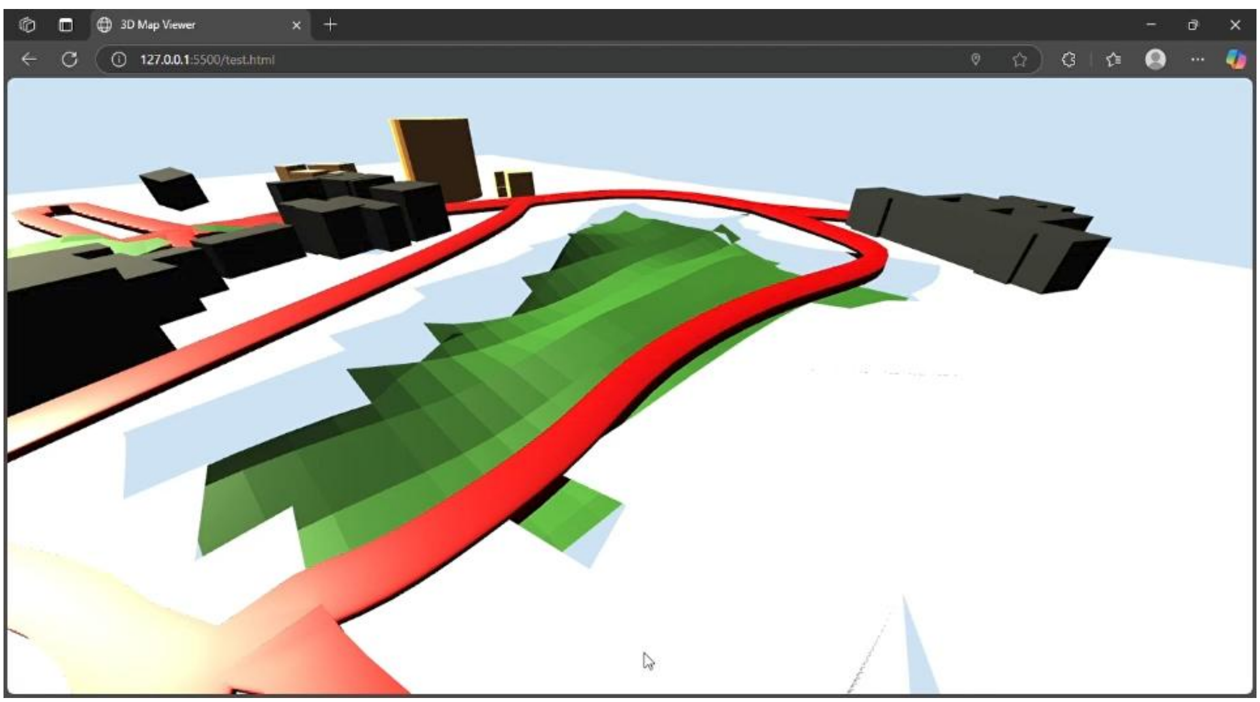
6. SOURCE DESTINATION DROPDOWN



7. PATH NAVIGATION



8. 3D MAP FOR COLLEGE CAMPUS



FEATURE AND FUNCTIONALITIES

Frontend Features

- **Interactive Map:** Scrollable, zoomable map for KIT campus with markers and popups.
- **Live Location Tracking:** Displays real-time user location on the map using the browser's geolocation API.
- **Search Box:** Filters location markers dynamically based on input.
- **Dropdown Navigation:** Allows users to jump to departments or amenities directly.
- **Sidebar Menu:** Collapsible menu with categorized access to various location types (Departments, Canteens, Hostels, etc.).
- **Shortest Path Viewer:** Users select start and end locations and receive both visual path and textual instructions.

Backend Functionality

- **/shortest-path API:** Takes two location names, returns:
    - path → list of location names in order.
    - coordinates → list of latitude/longitude pairs.
    - distance → total path length in meters.

FUTURE SCOPE

- **Admin Panel for Map Editing:** Allow authorized users to add, remove, or update location markers through a dashboard.

- **Indoor Navigation:** Incorporate floor-wise layouts for departments and buildings, integrating room-level maps.

- **Event Pins & Notifications:** Let users pin event venues, display active college events on the map.

- **Accessibility Features:** Add accessible routes for differently-abled students.

- **Voice-Assisted Navigation:** Use text-to-speech APIs for spoken directions.

- **Offline Map Mode:** Use service workers to cache the map and data for offline access.

- **Multilingual UI:** Provide interface in Marathi, Hindi, and English.

- The 3D map can be enhanced further by integrating indoor walkthroughs, animated tours, and accessibility indicators. Potential upgrades include support for virtual reality (VR) headsets, real-time weather/environment simulation, and student orientation modules

CONCLUSION

KIT NAVIGATION MAP

The **KIT NAVIGATION MAP** demonstrates a practical and innovative approach to solving one of the most common yet overlooked challenges in academic institutions—navigation. By combining intuitive user interfaces with robust backend algorithms, the project offers a comprehensive and intelligent solution for guiding users through large and often complex college campuses.

At its core, the project leverages real-time geolocation tracking to provide users with a sense of orientation and spatial awareness. Through integration with the Leaflet.js library and OpenStreetMap, it presents a dynamic and visually engaging map that responds to user input. Additionally, it employs graph-based data structures and Dijkstra's shortest path algorithm to calculate the most efficient routes between any two campus locations. This ensures not only usability but also performance and accuracy in route guidance.

The frontend, built using HTML, CSS, and JavaScript, offers a responsive and mobile-friendly interface, allowing users to interact with the map and access location data with ease. The backend, powered by Flask and Python, handles distance calculations and API logic using real-world geographic coordinates and mathematical models such as the Haversine formula.

This project showcases the seamless integration of full-stack development, combining frontend interactivity with algorithmic backend logic. It reflects the real-world application of concepts such as spatial data processing, pathfinding algorithms, RESTful APIs, and responsive design. More importantly, it lays the groundwork for future expansion into a smart campus ecosystem—one that prioritizes accessibility, user experience, and digital transformation. This assistant is not just a navigational tool but a step forward in making campuses more inclusive, connected, and intelligent.