IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 6, April 2025
Impact Factor: 7.67

Mid-Way Map Routing

Asst. Prof. Angelin[1], Sakshi Biradar[2], Ankita Chauhan[3], Sahili Muknak[4]
[1]Assistant Professor, Department of Information Technology
[234]Bachelor of Engineering in Information Technology
K. C. College of Engineering and Management Studies and Research, Thane, Maharashtra, INDIA

Abstract: *Optimized route planning is an important factor in contemporary transportation, logistics, and navigation systems. This study introduces a web-based multi-stop route optimization system that computes the shortest and most efficient route from three user-specified locations: a starting point, a midpoint, and a destination point. The system utilizes Dijkstra's Algorithm, one of the most popular graph-based shortest path algorithms, to compute the best route with the shortest travel distance.The planned system incorporates a Flask-based backend for handling location data and calculating the shortest route through a pre-defined graph visualization of routes. The JavaScript-based frontend with Leaflet.js has an interactive map visualization of the calculated route. The system further estimates travel times across various transportation modes such as walking, car, bus, motorbike, and train, and allows users to make informed decisions regarding travel.The study assesses the performance of the algorithm as a function of computed paths compared to other routing strategies and measures efficiency both in terms of computation time and accuracy. The system finds possible applications in urban transit planning, logistics, and delivery organizations and can provide a realistic solution to real-time navigation and route optimization.*

Keywords: Route optimization, Dijkstra's Algorithm, shortest path, Flask, navigation, multi-stop routing

I. INTRODUCTION

As technology continues to advance at a fast pace and more people become dependent on digital means of navigation and transportation, route optimization has emerged as a key research area. Effective pathfinding is necessary in many fields, such as urban transport, logistics, supply chain management, and personal navigation systems. Classic routing algorithms aim to discover the shortest route from one source and one destination, but most scenarios in the real world demand route planning for a multi-stop travel, where individuals have to traverse several waypoints prior to reaching the destination.

Efficient optimization of routes is especially important for delivery routes, ride-sharing services, and multi-destination trip planning since reducing travel distance and time actually affects cost, efficiency, and user satisfaction directly. In this research, we introduce a multi-stop route optimization system that applies Dijkstra's Algorithm, a widely used graph-based method to determine the shortest distances between nodes in a weighted network.The system is supposed to calculate an optimized path among three points: a start point, an intermediary point (midpoint), and an end point, such that the most efficient route is chosen based on traveling distance. By utilizing Dijkstra's Algorithm, the system provides reliable and computation-effective pathfinding, which makes it a viable option for practical applications.

The system backend is implemented with Flask, a minimal web framework that enables user input processing and route computation. The system models the road network as a graph with locations as nodes and the edges as weighted connections according to travel distance.When a request is received, the algorithm calculates the shortest route dynamically and sends an optimised route plan back. The frontend, done in terms of JavaScript and Leaflet.js, presents an interactive and easy-to-use map interface where users can see their calculated route. In addition, the system includes estimation of travel time for various transport modes, such as walking, car, bus, motorbike, and train, allowing users to make well-informed decisions according to their desired transport mode.

The research will look to solve the inefficiencies associated with conventional navigation systems by presenting a real-world solution for multi-stop routing that can be advantageous for multiple stakeholders, such as logistics firms, urban planners, and regular commuters. Through the integration of graph-based algorithms, geospatial data visualization, and real-time user interaction, the proposed system increases the usability and precision of route planning tools. The following sections detail the methodology, system architecture, implementation specifics, and performance evaluation to showcase the efficiency and usefulness of our methodology in resolving actual navigation issues.

II. LITERATURE SURVEY

Course optimization and GPS-based route frameworks have been broadly considered and created over a long time, with nonstop changes in precision, effectiveness, and user-friendliness. The expanding dependence on advanced mapping and route advances has driven to different developments in course arranging, counting the joining of halfway stops to upgrade travel adaptability. The require for halfway steering has picked up critical consideration in later a long time, particularly with the rise of ride-sharing, conveyance administrations, and tourism applications.

The paper[1] presents an improved A* calculation for energetic course optimization utilizing real-time activity information. It diminishes travel time, particularly in congested urban zones, by altering courses on the fly. In any case, the framework is computationally seriously, especially in thick activity situations. Future work points diminish computational requests for broader application.

The paper[2] proposes a cloud-based directing framework utilizing information from shrewd city sensors to alter courses based on real-time conditions. It appears promising comes about in decreasing blockage but is restricted in regions with deficiently sensor systems. The creators prescribe moving forward information collection strategies to extend the system's appropriateness in different districts.

The paper[3] employs machine learning to determine optimized delivery routes using real-time and historical traffic information. It enhances delivery time and fuel consumption but is heavily dependent on big datasets, hence restricting scalability in smaller areas. The system demands ongoing data refreshes for efficient route prediction, which can be resource-consuming.

The paper[4] employs Genetic Algorithms hybridized with Dijkstra's algorithm for route optimization in large networks. The hybrid technique improves scalability and flexibility to complex traffic conditions. But it needs a lot of tuning for varying cases, making it harder to implement. Further enhancements can target automating the process of tuning.

The paper[5] authors proposes an AI-based system with cloud infrastructure for real-time route recalculations. It works efficiently to decrease congestion and travel time where connectivity is good. But its dependency on uninterrupted internet access restricts its utilization in areas with low connectivity. The authors recommend increasing offline functionality to enhance the reliability of the system.

III. PROPOSED METHODOLOGY

1. SystemArchitecture

The Smart Route Planner is a web application that assists users in identifying optimized routes from a start, midway, and end location. The frontend (HTML, CSS, JavaScript,Leaflet.js) accepts user inputs and communicates with the Flask backend, which handles requests and maintains communication with external APIs. If the input locations are provided as text, the Nominatim API translates them into geographic coordinates. These coordinates are then handed over to the OSRM (Open Source Routing Machine) API, which uses Contraction Hierarchies (CH), an algorithm that accelerates Dijkstra's algorithm to calculate the shortest path efficiently. The calculated path with distance and navigation information is sent back to the backend, which then relays it to the frontend. Lastly, Leaflet.js displays the route on an interactive map so that users can see the optimal route to their destination. The system effectively combines geocoding, routing, and visualization to provide a better user experience.

2. Implementation Details

Frontend (User Interface & Input Handling)

The frontend is developed with HTML, CSS, and JavaScript, with Leaflet.js taking care of the map display. Users type in the start, midpoint, and end locations into input fields. As they type, the system auto-suggests locations using the

Nominatim API for geolocation. Upon clicking on "Calculate Route," the input is passed to the Flask backend to process.

Backend (Flask API & Data Processing)

Backend, implemented with Flask, serves as a middle ground between the frontend and external APIs. It captures the user's inputs and turns them into geographic coordinates via the Nominatim API. The coordinates obtained are then routed to the OSRM (Open Source Routing Machine) API in order to calculate the best path between the source and destination points.

Routing Engine (OSRM)

OSRM uses Contraction Hierarchies (CH), an optimization technique that accelerates Dijkstra's algorithm for shortest path calculations. It calculates the shortest route among the three destinations based on the coordinates passed by the backend. The calculated route contains information like total distance, estimated time taken, and step-by-step driving directions.

Displaying Route on Map

Once the backend receives the calculated route from OSRM, it returns the results to the frontend. Leaflet.js library is utilized to visually display the route on an interactive map. The optimized path, travel distance, and turn-by-turn instructions are dynamically visible to users, which makes navigation more convenient.

Extra Features

The project has a search history feature that enables users to view previously searched routes for ease of use. Users can also compare various possible routes prior to making a choice. There is also a reset button that enables the clearing of input fields and resetting of the map interface to provide a seamless user experience.

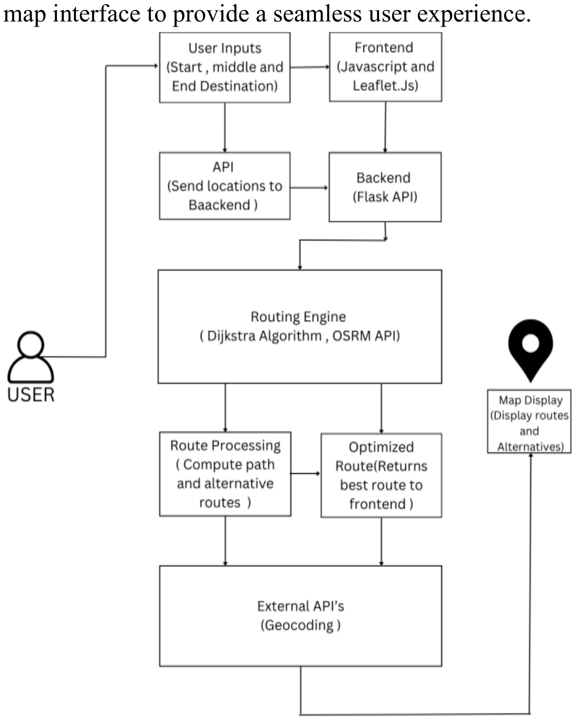

Figure 1: System Flow Chart

IV. IMPLEMENTATION

The Mid Way Map Routing system is implemented as an interactive web application that is light in weight but enables the planning of routes with a specific midway point. Real-time geolocation APIs, intelligent routing algorithms, and a graphical user interface are utilized by the system to provide accurate directions and route visualization.

4.1 User Interface and Interaction

The frontend implemented by HTML, CSS, JavaScript, and Leaflet.js provides facilities for users to:

Input start, midway, and end locations

Use the Nominatim API to parse addresses into geographic coordinates

Select travel modes like car, pedestrian, or train

Display route breakdowns along with travel distance, estimated travel time, and transport mode icon

The UI shows both text and map outputs to enable comparison and better insight into various portions of the route.

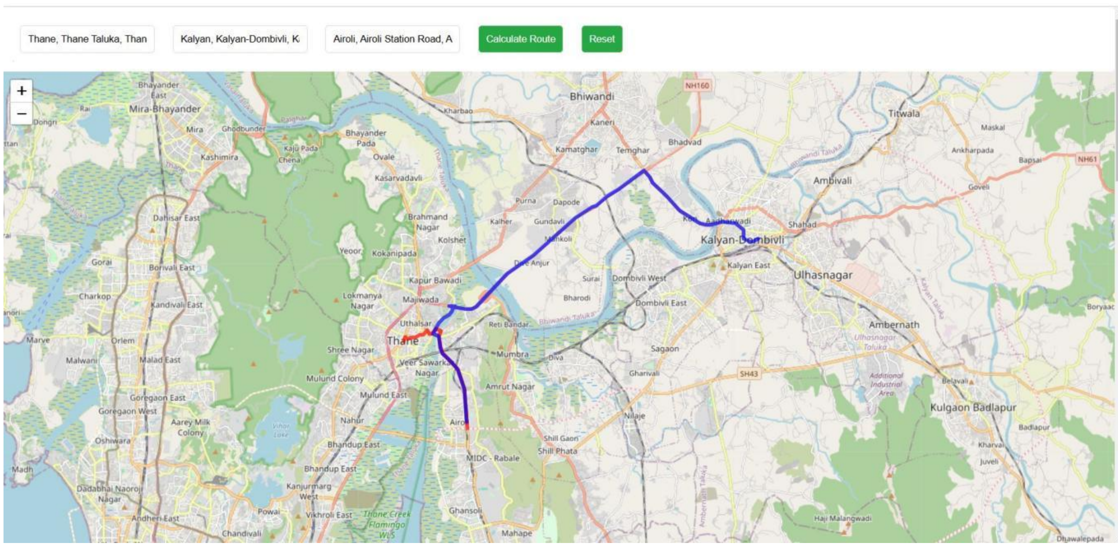

Fig No.2. Displayed routes

4.2 Map Rendering

With the help of Leaflet.js and OpenStreetMap, the calculated route is presented by the app in two main map views

A high-level overview map providing the entire path with beginning, middle, and end locations

A detail map zoomed in for a more detailed view of individual segments

Color-coded lines make travel modes stand out visually:

Blue for automobile routes

Red for pedestrian paths

Purple for train/subway lines

This makes it easier to understand and improves user experience through a visual representation of the trip.

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 6, April 2025
Impact Factor: 7.67

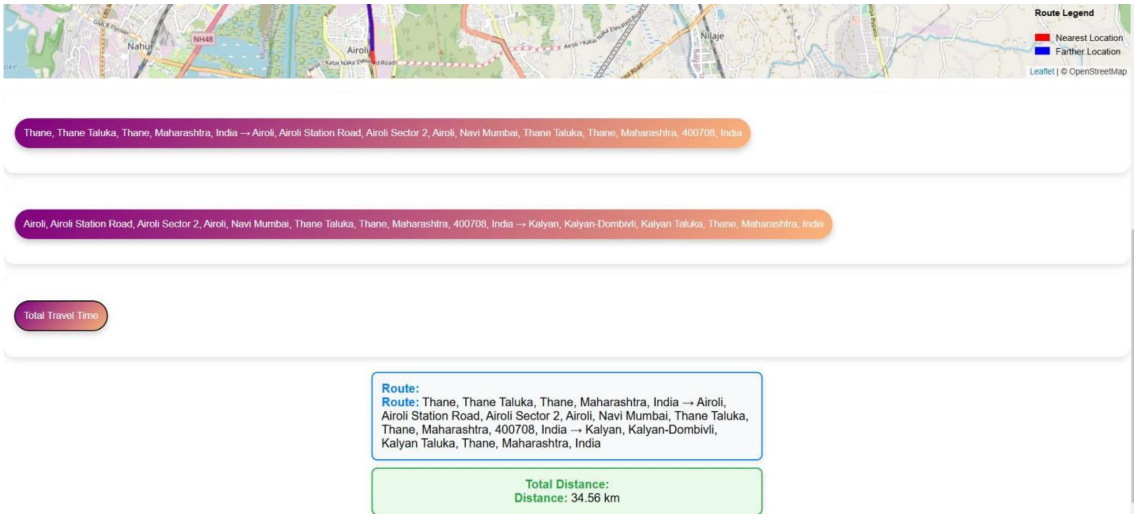

Fig No.3 Routes displayed with total time

4.3 Backend and Routing Logic

The backend is developed using Flask (Python) and handles:

API requests from the frontend

Location geocoding with Nominatim

Route calculation through OSRM API based on Dijkstra's shortest and most efficient route algorithm

Construction and return of route information (distance, travelling time, polyline path) to the frontend

This structure holds the promise of precision, responsiveness, and flexibility in varied route situations.

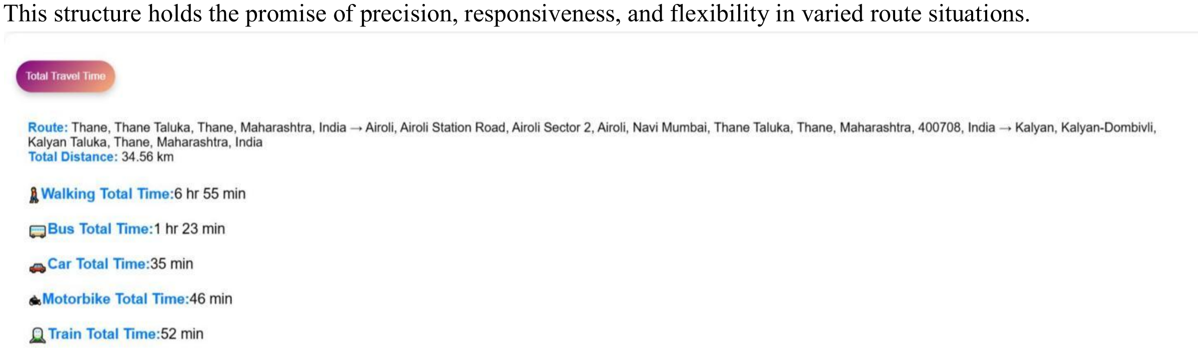

Fig No.4 Modes of Transport

The presented travel overview indicates approximate travel times for different modes of transport—walking, bus, car, motorbike, and train—on a given route. The distance is computed based on geographical coordinates from start, middle, and end points entered by the user. Dijkstra's algorithm through the OSRM (Open Source Routing Machine) API is utilized by the system to determine the shortest and quickest routes. According to this, typical speeds for every transport means are utilized to calculate approximate travel times. This assists users in comparing different routes and selecting the most effective route.

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 6, April 2025
Impact Factor: 7.67

V. RESULT ANALYSIS

Test Cases Names	Input Data	Expected Output	Pass/Fail
Test Dijkstra Algorithm (Shortest Path)	Sources:A Destination:D	Shortest Path: A->B->D	PASS
Test Invaid Start Node	Sources : Z Destination:D	Error :"Start Node not found"	PASS
Test Disconnected Nodes	Sources:A Destination:F	Error : "No path found"	PASS
Test Same Source and Destination	Sources:C Destination:C	Path : C Distance :0km	PASS
Test Path Cost Calculation	>D Distance :5km	Cost: Rs 15 (Rs 3/km)	PASS
Test Transport Modes : Walking	A->D (5km)	ETA : 1hr (assuming 5km/hr)	PASS

VI. FUTURE SCOPE

Real Time Traffic Integration

The system can be upgraded to integrate real-time traffic information through APIs such as Google Maps or TomTom. This will assist in dynamically re-routing based on traffic congestion, accidents, or road closures, providing users with the quickest and most efficient route at any moment.

Mobile App Development

Creation of a native Android and iOS application would enhance accessibility so that users can use the system easily while mobile. Mobile alerts, GPS, and user-specific functionalities can be integrated to provide enhanced user experience.

Offline Navigation Support

For availability even in areas with no or poor internet, offline maps and routing capabilities can be included. This will employ locally cached map tiles and routing data to provide seamless navigation.

AI-Based Travel Predictions

Machine learning models can be used to look at past data, weather trends, and user activity to forecast delays and provide optimal departure time suggestions. This can greatly enhance planning efficiency and user satisfaction

Voice Command Integration

Adding voice control and route requests will enable hands-free operation, increasing accessibility for differently-abled users and enhancing safety for drivers.

Improved POI (Point of Interest) Suggestions-Incorporation of surrounding Points of Interest like petrol pumps, hospitals, restaurants, or tourist attractions on the route will enable users to make intelligent choices during the journey.

VII. CONCLUSION

The "Midway Map Routing Using GPS" project presents a creative solution to a real-world problem common to many—finding the most optimized travel path with an intermediate or midway stop. Through combining frontend map visualization with a backend utilizing Dijkstra's algorithm, the system successfully computes the shortest or most time-effective route that incorporates not only a starting point and a destination but also a defined midway location. This is

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 6, April 2025
Impact Factor: 7.67

especially convenient for tourists, delivery services, or shared trip users who must arrange convenient routes that cater to multiple destinations.

The project not only facilitates conventional routing but also offers travel time estimates over various modes of transport like walking, bus, car, train, and motorbike. This multi-modal view improves cost, speed, or convenience-based decision-making for users. The interactive map interface and easy-to-use design also help in providing an intuitive and interactive user experience.

Essentially, this project establishes a solid foundation for enhanced navigation applications. Not only does it address existing user demands, but it also leaves a lot of room for enhanced additions in the future, such as real-time traffic incorporation, mobile deployment, voice command, and AI-based prediction. Through further development and implementation, this system has the potential to be converted into a fully-fledged smart navigation solution with commercial and social implications.

REFERENCES

[1]. Rajesh Kumar, Anita Mehta, Vikram Chauhan, "Optimized Multi-Stop Routing with Real-Time Traffic Data," International Journal of Transportation Engineering, Vol. 12, June 2023.

[2]. Rohit Singh, Nisha Patel, "AI-Based Route Planning for Delivery Systems," Journal of Logistics and Transportation, Vol. 15, March 2022.

[3]. Xiao Chen, Li Wei, Min Zhang, "Hybrid Routing System Using Genetic Algorithms and Dijkstra's Algorithm," Journal of Advanced Transportation, Vol. 20, December 2022.

[4]. Sofia Martinez, Andre Perez, "Cloud-Based Routing Optimization for Smart Cities," Smart Cities Journal, Vol. 18, February 2023.

[5]. Miguel Rodriguez, John Smith, "Dynamic Route Optimization with AI and Cloud Integration," Journal of Traffic Management, Vol. 11, September 2021.

[6]. Li Wang, Jia Liu, Qiang Zhao, "Machine Learning-Based Route Planning with Predictive Traffic Models," Transportation Research Part C, Vol. 30, August 2021.

[7]. Maria D'Souza, Peter Fernandes, Akash Mehra, "Dijkstra's Algorithm in Modern Route Optimization Systems," Journal of Applied Transportation Research, Vol. 22, January 2020.

[8]. Sunil Sharma, Prakash Gupta, "Ant Colony Optimization for Urban Route Planning," International Journal of Urban Transportation, Vol. 25, April 2019.

[9]. David Chen, Elaine Hsu, "Efficient Pathfinding for Delivery Services Using Predictive Models," Logistics and Transportation Review, Vol. 14, November 2020.

[10]. Jaeho Kim, Minho Lee, "Vehicle Routing Problem with Time Windows (VRPTW) Using Genetic Algorithm," Journal of Transportation Science, Vol. 17, July 2018.

DOI: 10.48175/IJARSCT-25354