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Integrating Haversine And Open Source Routing Machine For Enhanced Geolocation And Routing In Auraassign: A Dynamic Platform For Side Hustles

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Abstract: Side-hustles, or income-generating work performed alongside full-time jobs, have grown significantly in popularity as the gig economy provides opportunities for supplementary work. This increasing demand has created the need for platforms like AuraAssign, designed to connect individuals seeking temporary jobs with organizations requiring a flexible workforce. Events such as weddings, festivals, and corporate gatherings often require temporary staffing, but traditional systems relying on spreadsheets and static databases fail to meet these dynamic needs, leading to inefficiencies and missed opportunities. AuraAssign addresses these challenges by integrating advanced geolocation technologies and algorithms. The platform utilizes the Haversine formula to calculate precise distances between job seekers and employers and employs the OSRM algorithm (Open Source Routing Machine) with a multi-level A* algorithm to optimize routing, ensuring efficient navigation to job locations. Additionally, AuraAssign incorporates Location-Based Services (LBS) to provide real-time recommendations tailored to user preferences, including location, skills, and availability. It overcomes the limitations of traditional recommendation systems, such as collaborative filtering, which are unsuitable for dynamic and event-based social networks. By streamlining job matching and addressing challenges in short-term workforce management, AuraAssign not only improves user experience but also supports societal needs, offering students supplementary income opportunities to bridge financial gaps.

Keywords: Event-based Social Network, Haversine, Location-Based Service, Open Source Routing Machine.

I. INTRODUCTION

The rise of the gig economy has revolutionized the workforce by enabling individuals to pursue side-hustles, offering supplementary income opportunities alongside full-time jobs. This trend has created a demand for platforms that connect job seekers with organizations requiring flexible and temporary human resources. In contexts such as weddings, festivals, and corporate events, the need for a dynamic workforce is critical. However, traditional systems relying on static databases and spreadsheets fail to address the complexities of short-term job management, resulting in inefficiencies and missed opportunities. In India, rising education costs, particularly in private institutions, have further exacerbated financial difficulties for students. With only 7% of Indian students accessing scholarships and limited government support, many are forced to rely on loans or part-time jobs to fund their education. AuraAssign provides an innovative solution by offering part-time job opportunities that are flexible, low-commitment, and easy to manage alongside existing responsibilities. The platform connects students, homemakers, and professionals with short-term assignments, enabling them to earn supplementary income without long-term pressure.

II. RELATED WORK

The concept of a system designed to calculate the shortest path between two locations combines the A* algorithm, which uses heuristic techniques for optimal pathfinding, with the Haversine formula [1], known for calculating the minimum distance between two points on a spherical surface. This is further enhanced by a high-performance multi level routing approach that optimizes query times by preprocessing road network graphs into smaller partial graphs, reducing redundant data. Building on Dijkstra's algorithm [10], this method targets challenges such as irregular town planning and inadequate signage in Indian cities, aiming to improve navigation efficiency. The integration of Open Street Routing

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Machine (OSRM) [11] also helps calculate optimal eco-routes, offering users web and mobile interfaces for inputting coordinates and receiving detailed travel itineraries. Event recommendation systems in Event-Based Social Networks (EBSNs) [2] face challenges due to the lack of prior user ratings for new events and the inapplicability of expired events. Traditional systems often fall short, but modern methods integrate content, social, and geographical information to overcome these limitations. Similarly, event planning systems automate various processes, including managing customer and employee data, event details, services, and e-cards [3], which increases operational efficiency. The effects of side-hustles on full-time work are examined through two pathways: the Affective Pathway, where positive emotions enhance performance, and the Cognitive Pathway, where divided focus leads to increased cognitive load. This study highlights the complex interaction between external activities and work outcomes [4][7]. In visitor tracking, systems utilize the Haversine formula to calculate the distance between user locations and event coordinates, determining if visitors are within a specified radius. Location-Based Services (LBS) [5] send coordinates to a server, which computes distances and adds visitors to the count if they fall within the radius of the event. This method has also been applied to identify the nearest schools for student admission zoning, providing real time location-based assistance [8]. In the context of e-voting, the Haversine formula ensures location-based voting eligibility by calculating the distance between voters and voting stages [9], restricting access for those outside the predefined radius. The Unsyiah Guidance Map demonstrates the effective use of the Haversine formula in an Android application for guiding visitors around a university campus, allowing users to view nearby buildings and navigate routes. A web based administrative interface supports data management [6]. The balance between personal ventures, like side-hustles, and professional work plays a key role in shaping employee performance, offering practical insights into how external activities influence organizational outcomes [7].

III. OBJECTIVE

The primary objective of AuraAssign is to create an efficient platform that bridges the gap between job seekers and employers, focusing on flexible, short-term assignments. By leveraging advanced geolocation algorithms such as the Haversine formula and OSRM, the platform ensures accurate job recommendations and optimized routing. AuraAssign aims to provide tailored job opportunities based on user preferences, including location, skills, and availability, while addressing financial challenges faced by students and other demographics. Additionally, the platform prioritizes user experience through features like real-time notifications, secure transactions, and seamless accessibility across multiple devices.

IV. PURPOSE

AuraAssign aims to revolutionize the gig economy by providing an innovative platform that bridges the gap between job seekers and employers. The purpose is to offer a user-friendly system that ensures efficiency in job matching, supports students and other financially constrained individuals, and addresses the limitations of traditional workforce management systems. By integrating geolocation technologies and dynamic job filtering, AuraAssign empowers users to make informed decisions, improving accessibility and reliability in short-term job markets.

V. PROPOSED SYSTEM

AuraAssign is developed to connect job seekers with employers efficiently and address challenges in short-term workforce management. It is a location-based platform that tailors job recommendations based on user preferences, such as skills, location, and availability. The system leverages advanced algorithms like the Haversine formula for distance calculation and the OSRM algorithm for optimized routing, ensuring precise geolocation and navigation for users. This allows for seamless job matching and enhanced decision-making for both job seekers and employers.

The system is user-centric, providing real-time notifications, secure role-based authentication, and cross-platform accessibility to enhance user experience. By integrating features like interactive analytics dashboards and real-time data processing, the platform ensures that users and organizations can efficiently manage opportunities, tasks, resources. AuraAssign is particularly beneficial for students seeking supplementary income to overcome financial challenges.

The Proposed System Consists of 3 Main Modules:

1. Job Posting and Search Management System: Enables organizations to post jobs and users to search for relevant opportunities based on location and preferences.

2. Mapping and Routing System: Uses the Haversine formula and OSRM to calculate precise distances and provide optimized navigation.

3. Task Assignment and Analytics: Automates task assignments, tracks progress, and provides insights through analytics dashboards.

a) Job Posting and Search Management System

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This module is the backbone of AuraAssign, enabling organizations to post job opportunities and individuals to search for relevant gigs. Employers can define job requirements such as location, required skills, and job type (remote or on-site). The system uses an advanced recommendation engine powered by the Haversine formula to calculate the distance between the job seeker and the job location. This ensures that job seekers are presented with opportunities that are not only relevant to their skills but also convenient in terms of proximity.

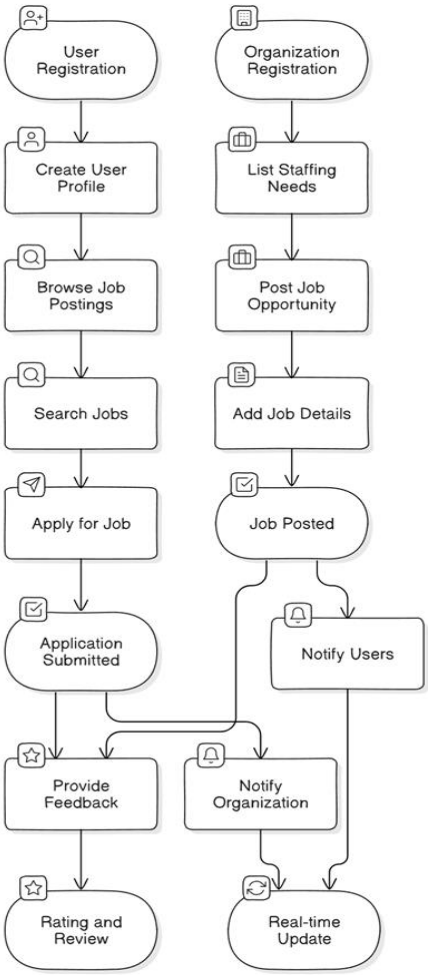

Figure 1 Control Flow Diagram

The job search functionality includes intuitive filters for location, availability, and skill set, allowing users to refine their searches quickly. The module integrates seamlessly with OpenStreetMap to display job locations on an interactive map, enhancing the overall user experience.

b) Mapping and Routing System

AuraAssign uses Leaflet for interactive map integration, providing users with a dynamic interface to explore job locations and event sites. The routing feature, powered by OSRM, enables job seekers to calculate the shortest and most efficient routes to their job locations. This is particularly useful for jobs requiring physical presence, ensuring users can plan their commute effectively. The Haversine formula is used to calculate distances between job seekers and job locations. This logic is implemented in the backend using Javascript / Typescript utility functions and dynamically updates search results in the frontend.

The Haversine formula is an equation important in navigation, giving great-circle distances between two points on a sphere from their longitudes and latitudes, widely used in mapping, GPS systems, location-based services, and geospatial analytics.

$$d = 2r\sin^{-1}\left(\sqrt{\sin^2\left(\frac{\phi_2-\phi_1}{2}\right)+\cos(\phi_1)\cos(\phi_2)\sin^2\left(\frac{\psi_2-\psi_1}{2}\right)}\right)$$

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d is the distance between two points with longitude and latitude (ψ, φ) and r is the radius of the Earth.

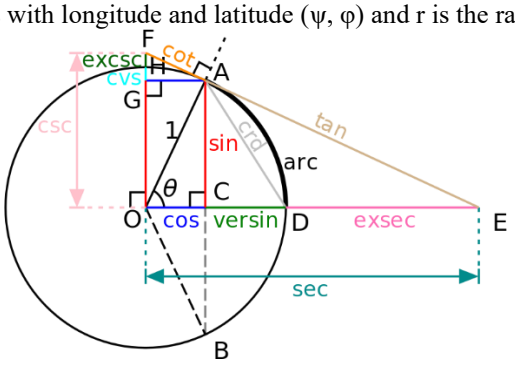

Figure 2 Haversine Function Diagram

The Haversine formula is an equation important in navigation, giving great-circle distances between two points on a sphere from their longitudes and latitudes, widely used in mapping, GPS systems, location-based services, and geospatial analytics.

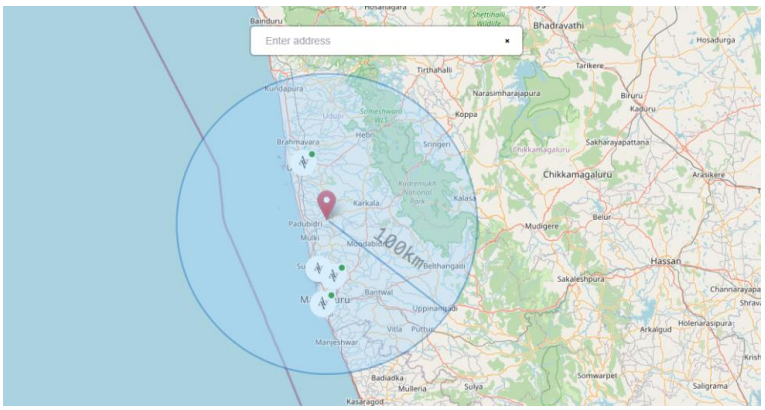

Figure 3 Implementation of Haversine Algorithm using Leaflet

Open Source Routing Machine (OSRM) is a high-performance routing engine designed to compute optimal routes using OpenStreetMap (OSM) data. In the context of AuraAssign, OSRM plays a crucial role in enhancing navigation and location-based recommendations for job seekers. By leveraging OSRM's ability to process vast amounts of geospatial data efficiently, the platform calculates the most optimal routes between job seekers and their desired job locations.

The computed routes are seamlessly integrated into Leaflet, a widely-used open-source mapping library, to provide an intuitive and interactive visual representation for users. This integration allows job seekers to view real-time navigation paths on the map, including step-by-step directions and estimated travel times. The combination of OSRM's precision and Leaflet's user-friendly interface ensures that job seekers can plan their commute effectively, reducing travel time and enhancing overall user experience.

To calculate road gradients, the elevation at a given geographic coordinate (x, y) is interpolated using neighboring data points:

Intermedia Values

$$E(x, b_1) = \frac{a_2 - x}{a_2 - a_1} E(A_{11}) + \frac{x - a_1}{a_2 - a_1} E(A_{21})$$

$$E(x, b_2) = \frac{a_2 - x}{a_2 - a_1} E(A_{12}) + \frac{x - a_1}{a_2 - a_1} E(A_{22})$$

Intermedia Values

$$E(x, y) = \frac{b_2 - y}{b_2 - b_1} E(x, b_1) + \frac{y - b_1}{b_2 - b_1} E(x, b_2)$$

Aij: Known elevation points
a1, a2, b1, b2: Coordinator of known points

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E (x, y): Interpolated elevation

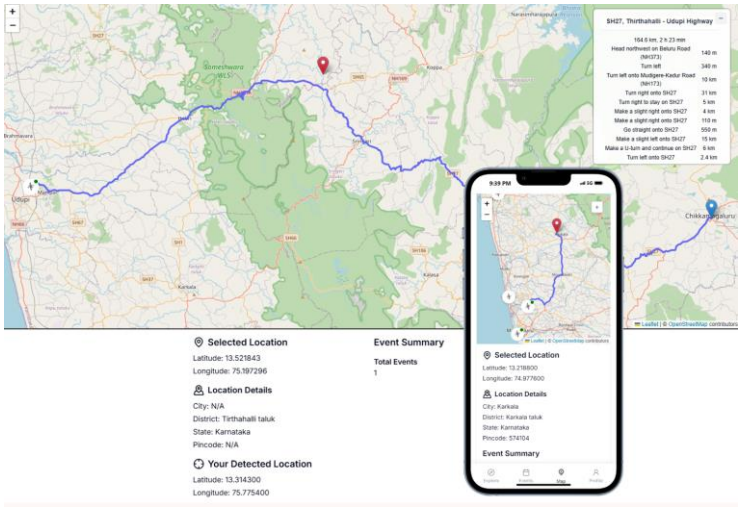

Figure 4 Implementation of OSRM using Leaflet

The system optimizes performance by caching frequently accessed map tiles, reducing load times and enhancing the user experience. By combining Leaflet's intuitive map interface with OSRM's robust routing capabilities, AuraAssign delivers precise and reliable navigation for its users.

c) Task Assignment and Analytics

AuraAssign is designed to streamline workforce management by automating job allocations and offering actionable insights through interactive dashboards. This module plays a pivotal role in ensuring efficient task distribution, real-time tracking, and data-driven decision-making for both job seekers and employers. Employers can monitor task progress through the platform in real-time, gaining visibility into key milestones and deadlines. Job seekers, on the other hand, have access to personalized dashboards where they can view their assigned tasks, completion status, and timelines. This transparency fosters accountability and ensures timely completion of tasks. The analytics component provides comprehensive insights for both users and organizations. Employers can view metrics such as task completion rates, average time to completion, and job seeker performance. The dashboards are designed to visualize data trends, such as the number of jobs posted, user activity, and engagement levels, enabling organizations to identify areas of improvement and optimize their operations

VI. METHODOLOGY

The methodology for developing AuraAssign focuses on integrating advanced geolocation algorithms, dynamic routing technologies, and user-centric features to create a robust platform that connects job seekers with employers efficiently. This research emphasizes the combined use of the Haversine formula and Open Source Routing Machine (OSRM) to enhance geolocation accuracy and optimize navigation.

- Geolocation Data Acquisition
  The platform utilizes OpenStreetMap (OSM) as the primary source for geospatial data. OSM provides detailed, open-access maps that include road networks, landmarks, and other critical geographic information. This data forms the foundation for location-based filtering and routing.
- Distance Calculation Using Haversine Formula
  AuraAssign integrates the Haversine formula to calculate the great-circle distance between two points on the Earth's surface using latitude and longitude. This ensures precise proximity-based job recommendations, prioritizing opportunities close to the job seeker's current location. The formula's computational efficiency makes it ideal for large-scale, real-time applications.
- Route Optimization with OSRM
  The platform employs Open Source Routing Machine (OSRM), a high-performance routing engine, to compute optimized routes for job seekers. OSRM uses a multi-level Dijkstra's shortest path algorithm, enabling efficient route calculations even in large geospatial datasets. Job seekers are provided with step-by-step directions integrated into interactive Leaflet maps for seamless navigation.
- Dynamic Recommendation System

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AuraAssign's recommendation engine combines geolocation data, user preferences, and job requirements to suggest tailored opportunities. This system uses filters such as distance, skills, and availability to personalize job matches, overcoming the limitations of traditional platforms that rely on static databases.

- Cross-Platform Accessibility
  Developed as a Progressive Web Application (PWA) using Next.js, AuraAssign provides a consistent experience across web browsers, desktop applications, and mobile devices. The responsive design ensures accessibility and ease of use for a diverse user base.
- Analytics and Insights
  The platform integrates advanced analytics dashboards to offer actionable insights into user engagement, job performance, and system efficiency. Metrics such as task completion rates, user activity, and distance traveled are visualized through intuitive charts, enabling data-driven decision-making for both users and organizations.
- Security and Privacy
  AuraAssign incorporates robust security measures, including role-based authentication, secure APIs, and data encryption, to ensure user data is protected. These features foster trust among users and organizations, making the platform reliable and secure.

The methodology emphasizes the integration of cutting-edge algorithms, user-focused features, and robust system design to deliver an innovative solution for side hustles. By combining the precision of the Haversine formula with the efficiency of OSRM, AuraAssign ensures accurate job matching and optimized navigation, addressing the challenges of traditional job and event management platforms. This comprehensive approach demonstrates the platform's potential as a dynamic, research-driven solution for short-term workforce management.

VII. IMPLEMENTATION

The platform is built with modern technologies, including Next.js for the frontend, NextAuth v5 for secure authentication, and Prisma ORM with PostgreSQL for robust database management. Geolocation features are implemented using Leaflet and OSRM for mapping and routing.

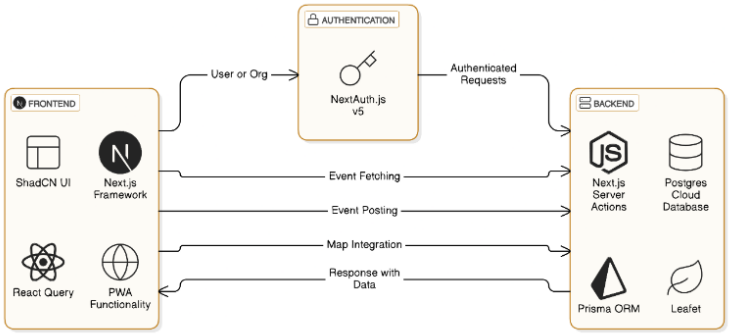

Figure 5 Three Layer Architecture

AuraAssign is built on a robust three-layer architecture comprising the frontend, backend, and database. This architecture ensures scalability, performance, and security. The three-layer architecture of AuraAssign exemplifies a well-structured and efficient system, ensuring seamless integration between the frontend, backend, and database layers

Frontend**:** The frontend of AuraAssign is built using Next.js, ensuring a responsive and mobile-first design. TailwindCSS and ShadCN are used to create an intuitive and aesthetically pleasing interface. The frontend allows users to perform tasks such as job searching, task tracking, and messaging seamlessly across devices.

Backend**:** The backend, also developed in Next.js, handles core functionalities like user authentication, job postings, and notification triggers. OSRM APIs are integrated for routing, while secure communication between the frontend and backend ensures a smooth experience.

Database**:** Prisma ORM manages a PostgreSQL database, providing a scalable and efficient data storage solution. The database stores user profiles, job details, task statuses, and communication logs, enabling quick and reliable data retrieval.

This architecture forms the backbone of AuraAssign, enabling it to deliver a reliable and dynamic user experience.

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VIII. RESULT

The results of implementing AuraAssign highlight its capability to address key challenges in short-term workforce management through advanced geolocation and routing technologies. Unlike traditional job platforms, AuraAssign excels in dynamic location-based matching combined with flexible scheduling, effectively catering to users with varying needs and constraints.

The integration of the Haversine formula ensures precise proximity filtering, while OSRM's multi-level A* algorithm provides optimized routing, enhancing navigation efficiency and user satisfaction. Additionally, the platform's ability to deliver real-time updates, secure role-based authentication, and detailed analytics contributes to its user-centric design.

Table 1 Analysis of OSRM with Google Map

Road Segment	Elevation	Google Maps	OSRM
Mangaluru to Bangalore - 350km	680m gain	6hr30min	5hr20min
Bangalore to Mangaluru - 350km	680m drop	6hr45min	5hr40min
Bangalore to Mysuru Rd - 150km	570m gain	2hr45min	2hr10min
Mysuru to Bangalore Rd - 150km	570m drop	3hr	2hr20min
Mangaluru to Udupi Rd - 60km	520m gain	1hr20min	1hr
Udupi to Mangaluru Rd - 60km	520m drop	1hr25min	1hr05min

This table provides a direct comparison of the performance and estimates between the industry-standard Google Maps and the OSRM algorithms. It offers insights into the accuracy and practical benefits of OSRM's routing models, particularly in areas with complex geospatial features or significant elevation changes. Such analysis enables a better understanding of OSRM's suitability for dynamic applications like AuraAssign, where real-time and efficient navigation is critical.

Comparison Between Existing Platforms and AuraAssign

After analyzing the existing platforms, the key difference of AuraAssign lies in its advanced location-based filtering using Haversine and OSRM, seamless user experience, robust geolocation capabilities, and flexibility in job assignments. This enables AuraAssign to cater to a broader audience while addressing the limitations of other platforms effectively and efficiently.

Table 2: Comparison between Existing Platform and AuraAssign

Features	Existing Platforms	AuraAssign
Location-Based Filtering	Basic location filtering with limited accuracy	Advanced Haversine and OSRM-based filtering for precise geolocation and optimized job matching
User Flexibility	Limited job types, often requiring long-term commitments	Short-term, low-commitment tasks suitable for various demographics (students, homemakers, etc.)
Platform Accessibility	Often web-only platforms	Multi-platform (web and mobile) with a user-friendly interface
Real-Time Updates	Delayed updates for job status and notifications	Instant real-time updates for job statuses and enrollments
Custom Visualizations	Static data visualization	Dynamic and interactive analytics for user activities and enrollment trends

AuraAssign stands out with its precise geolocation features and unique focus on flexibility, making it a superior choice for both users and organizations in the gig economy. The research highlights AuraAssign's success in combining geolocation precision with advanced routing technologies to create a dynamic, user-centric platform for side hustles.

IX. CONCLUSION

AuraAssign leverages cutting-edge technologies like OpenStreetMap for geolocation, the Haversine formula for proximity-based filtering, and OSRM for optimized routing to revolutionize event management. Its responsive architecture, built with Next.js, enables seamless cross-platform accessibility, while features like dual authentication and multi-role access control enhance security and operational efficiency. By combining geospatial algorithms with dynamic

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recommendation systems, AuraAssign stands as a research-driven platform addressing modern challenges in event management with precision and innovation

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