

INTELLIGENT ROUTE RECOMMENDATION

¹Mr Siddesh K T, ²Siddesh D H

¹Assistant Professor, Department of MCA, BIET, Davenagere

²Student, Department of MCA, BIET, Davenagere

ABSTRACT

The "Intelligent Route Recommendation" project provides a state-of-the-art, intelligent, and adaptive system that addresses the constantly increasing difficulties in the world of modern transportation and navigation. In today's world, where urbanization is becoming more and more extensive, traffic changes are becoming highly unpredictable, and efficient navigation has become a necessity, this project presents a completely new perspective on traditional routing systems. While traditional routing solutions may be limited to providing a route based either on the shortest or fastest option, this innovative approach goes much further by using various sources of data. These include current traffic updates, incidents (accidents, closed roads), weather condition (both current and expected ones), as well as crowdsourced data from the community of users. This rich variety of information is processed using highly intelligent algorithms in order to give personalized route suggestions to users.

Keywords: *Intelligent Transportation Systems (ITS), Route Optimization, Generative AI-Based Recommendation, OpenRouter API Integration, Real-Time Traffic Data Processing.*

I INTRODUCTION

The "Intelligent Route Recommendation" project may be regarded as a progressive and futuristic initiative aimed at a radical transformation of the approach to making routes for individuals. The concept of such an initiative presupposes development of an advanced routing software that, unlike current navigation services, is distinguished by its ability to function intelligently and dynamically. At its core, this project implies design and operation of a highly sophisticated system able to constantly accumulate, analyze, and interpret an immense amount of data related to different kinds of traffic. including, but not limited to, the current state of traffic gathered through GPS devices, cell phones, and in-road detectors; information about accidents provided by the official traffic control agency and users; meteorological predictions and their possible consequences for the For the sake of reliability and flexibility, the project will utilize multi-tier architecture. There will be a specialized tier dedicated to data collection and normalization. The collected data will then undergo further analysis in the next step of the process – the data analysis tier. At this stage, sophisticated algorithms and models will be applied to identify patterns within the processed information and create predictions of future traffic scenarios. This feature of predicting future events and acting upon it constitutes one of the most important elements of the system, as it enables the system to act proactively and not just reactively when generating routes. To illustrate, the system can anticipate a traffic jam occurring due to an excessively high speed of vehicles and advise the user on taking a different route before it occurs.

II RELATED WORK

The problem of route recommendations and transport optimizations is widely considered within the scope of ITS systems. In early research efforts, the most attention was paid to the shortest path problems in graph theory, which include methods like Dijkstra's and A* search algorithms. Graphs were used as models of the transportation system that would calculate the optimal path depending on distance and duration of travel. Though optimal by mathematical standards, these methods do not take into account the dynamic characteristics of reality.

With the advancement of data-driven technologies, researchers began integrating traffic prediction models and optimization techniques to improve route planning systems. Several machine learning methods have been developed for predicting traffic congestion and journey times based on historical information. They offer increased precision but are demanding in terms of data availability and constant model updates. Moreover, these methods are oriented towards numerical optimization and cannot generate recommendations in natural language. New technologies in the field of artificial intelligence have enabled researchers to create recommendation engines that can personalize the recommendations for the consumer. Recommendation systems that have emerged through the advancements in AI technology emphasize contextual information and understanding of the user's needs. Yet, most of the transportation systems available currently utilize algorithms and not context-based recommendation systems. The development of generative AI has brought new possibilities to decision support systems. Generative AI can understand complex input prompts and provide responses that seem like they were generated by humans. Although generative AI is prevalent in conversational and content-generation applications, there is not much use of generative AI in route recommendation systems. However, the suggested system is unique in that it employs an AI-based reasoning component via the use of APIs. While current transportation systems utilize deterministic shortest-path algorithms or locally trained machine learning models, the proposed system uses prompt-based contextual reasoning to provide flexible and explainable routes. The suggested method adds to the field of AI-based transport systems by integrating web-based infrastructure with generative intelligence.

III METHODOLOGY

The proposed Intelligent Route Recommendation System will employ a well-structured method based on generative AI. The system will combine user interaction, back-end processing, prompt engineering, and visualization techniques to produce intelligent route recommendations. This process will be organized in the following main phases:

3.1 Prompt Acquisition

The prompt input stage marks the beginning of the system flow. During this process, the system receives prompts from the users via a web application developed using React. The user offers critical details about their trip like the origin, destination, and preference for the route taken. Once validated and formatted, the collected data is then sent to the backend server. The backend transforms this information into a natural language prompt that is defined and clear. This prompt acts as the basis for reasoning in generative AI. A properly obtained prompt results in an accurate and relevant AI response.

3.2 Schema Structure

The schema structure defines how user data and system responses are organized internally. The backend uses a structured JSON schema to manage input parameters such as:

- Source
- Destination
- Travel preference
- Additional contextual details (if any)

This structured representation ensures consistency in data handling and smooth communication between frontend, backend, and the OpenRouter API. By maintaining a clear schema, the system reduces ambiguity and enhances the quality of AI-generated recommendations.



Figure 3.2.1 Architecture diagram

3.3 Primitive-Based Generative Decomposition

Primitive-based generative decomposition refers to breaking down the routing request into smaller logical components before sending it to the generative AI model. Instead of submitting raw user input, the backend decomposes the request into fundamental travel primitives such as:

- Distance consideration
- Travel time estimation
- Traffic awareness
- Safety preference
- Route feasibility

These primitives are embedded into the structured prompt, allowing the generative AI to analyze each factor logically. This decomposition improves contextual reasoning and ensures that the generated route recommendation is balanced and preference-aware rather than random or purely descriptive.

3.4. Generative AI Processing

After decomposition, the structured prompt is sent to the OpenRouter API. The generative AI model interprets the contextual information and produces an optimized route recommendation. Unlike traditional deterministic algorithms, the AI model applies reasoning to generate human-readable guidance along with explanatory insights.

This stage enables adaptive decision-making without requiring local machine learning model training.

3.5 Real-Time Rendering and Visualization

Once the backend receives the AI-generated response, it processes and formats the output for presentation. The React frontend dynamically renders the recommended route and its explanation in real time.

The visualization layer ensures:

- Immediate response display
- Clear route explanation
- User-friendly interface updates

- Interactive and responsive design

Real-time rendering enhances user experience by minimizing latency and providing instant intelligent feedback.

Overall Workflow

The complete methodological flow can be summarized as:

User Input → Prompt Acquisition → Schema Structuring → Primitive Decomposition → Generative AI Processing → Response Formatting → Real-Time Visualization

3.6 Flowchart



Figure 3.6.1 : Flowchart IV RESULTS

4.1 Input Panel

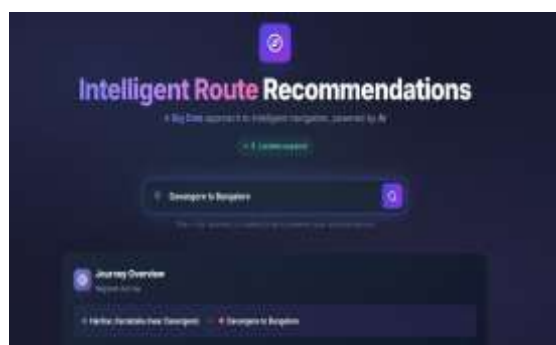


Figure 4.1.1 : Prompt Input

4.2 Output Panel



Figure 4.1.1 : Alternative Route



Figure 4.1.2 : Data Visualisation

V CONCLUSION

The "Intelligent Route Recommendation" project represents a significant and transformative leap forward in the field of navigation and transportation technology. By moving beyond the reactive and one-size-fits-all approach of existing systems, this project has the profound potential to deliver a truly intelligent, personalized, and proactive travel experience. The core innovations of the project, including its predictive routing capabilities, its deep and meaningful personalization options, and its seamless multi-modal integration, will effectively address many of the key limitations of current navigation systems and will provide users with a powerful and indispensable tool to navigate the ever-increasing complexities of modern transportation.

The development of this system is not merely about creating a more convenient navigation app. It is about building a platform that can have a real, tangible, and positive impact on people's lives and on the environment. By helping users to avoid traffic congestion, the system can save them valuable time and significantly reduce their stress levels. By providing fuel-efficient and eco-friendly routing options, it can help to reduce our collective carbon footprint. And by actively promoting the use of public transportation and other sustainable modes of travel, it can contribute to the creation of smarter, more livable, and more sustainable cities.

The successful implementation of this ambitious project will require a harmonious combination of deep technical expertise, innovative thinking, and a profound and empathetic understanding of the needs of the end-users. The proposed Agile methodology and the unwavering focus on continuous testing and user feedback will be absolutely crucial for ensuring that the final product is of the highest quality and that it truly and effectively meets the needs of its target audience.

While there will undoubtedly be challenges along the way, the potential benefits of the "Smart Route Recommendation" system are immense and far-reaching. It has the potential to not only transform the way we travel but also to make our transportation systems more efficient, sustainable, and enjoyable for everyone. This project is not just about getting from point A to point B; it is about creating a smarter and better way to move.

VI REFERENCES

- Delling, D., & Wagner, D. (2009). Time-Dependent Route Planning. In: Robust and Online Large-Scale Optimization. Springer, Berlin, Heidelberg.
- Dijkstra, E. W. (1959). A Note on Two Problems in Connexion with Graphs. *Numerische Mathematik*, 1(1), 269–271.
- Hart, P. E., Nilsson, N. J., & Raphael, B. (1968). A Formal Basis for the Heuristic Determination of Minimum Cost Paths.
- Koot, S., et al. (2021). A Reference Architecture for IoT-enabled dynamic planning in Smart Logistics. *IEEE International Conference on Smart Logistics (SL)*.
- Lujak, M., Giordani, S., & Ossowski, S. (2016). An Architecture for Safe Evacuation Route Recommendation in Smart Spaces.
- Lv, Y., et al. (2015). Traffic Flow Prediction with Big Data: A Deep Learning Approach.
- Oladimeji, D., et al. (2023). Smart Transportation: An Overview of Technologies and Applications. *Sensors (Basel, Switzerland)*, 23(8), 3880.
- Shaheen, S. A., & Finson, R. (2013). *Intelligent Transportation Systems*
- Veluru, C. S. (2023). A comprehensive study on optimizing Delivery Routes through Generative AI using Real-Time Traffic and Environmental Data.
- Zhou, H., et al. (2020). Short-Term Traffic Flow Prediction with Deep Learning: A Survey. *IEEE Transactions on Intelligent*

Copyright & License:



© Authors retain the copyright of this article. This work is published under the Creative Commons Attribution 4.0 International License (CC BY 4.0), permitting unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.