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| AI-Powered Route Recommendations Web Application based on  Extreme Weather Conditions and Green Gas Emissions  Hadi Aghazadeh (30181045)  Mahdi Mohammadizadeh (30175778) |
| ENGO 651 Group 1  Supervisor: Dr.Steve Liang  Teacher Assistant: Mahnoush Mohammadi Jahromi |



### **Executive Summary**

This report introduces a project of a route recommendation app based on extreme weather and gas emissions. It explains the importance of personalized route recommendations, considering extreme weather and greenhouse gas emissions. The presentation emphasizes that the transportation sector is responsible for a quarter of Canada's greenhouse gas emissions and that extreme weather conditions can affect transportation safety and maintenance costs. The project aims to help trucking needs and includes a web application that allows users to customize their routes by rating three different options. The application uses AI to analyze data and provide personalized recommendations based on user preferences, behavior, and past travel.

### **Problem Statement**

Despite advancements in transportation technology and infrastructure, extreme weather conditions and greenhouse gas emissions continue to pose significant challenges to Canada's transportation system. Extreme weather events can cause widespread travel disruptions and road accidents, leading to increased maintenance costs and traffic congestion. On the other hand, the transportation sector is responsible for a quarter of Canada's greenhouse gas emissions, and emissions reductions are necessary to achieve the country's ambitious climate targets. To address these challenges, there is a need for personalized route recommendation systems that can consider extreme weather conditions and reduce greenhouse gas emissions while ensuring efficient and safe transportation for all.

The problem statement revolves around the development of a web application to provide personalized route recommendations for users based on their subjective goals. The app utilizes AI-powered tools and technologies to improve decision-making and help users navigate unpredictable weather conditions. The importance of considering extreme weather and greenhouse gas emissions in route recommendations is highlighted, as they can have significant impacts on the transportation system. Extreme weather conditions can lead to car accidents, widespread travel disruptions, and high maintenance costs, while the transportation sector is responsible for about a quarter of Canada's greenhouse gas emissions. The app aims to encourage the use of low-emission vehicles and roads, and invest in public transportation infrastructure to reduce emissions. The web app will provide users with different options to choose from based on their goals and preferences, and an AI model will show all the possible routes with color codes, making it easy to select the ideal combination of distance, extreme weather, and gas emissions for truck routes. The project aims to simplify the process of selecting the best route for trucking needs and encourage users to stay safe on the road while reducing emissions.

### **Literature Review**

#### Introduction:

Route recommendation systems have become an essential tool for helping drivers to select the best route to reach their destination while considering various factors such as distance, traffic conditions, travel time, and road quality. Recently, there has been a growing concern about the environmental impact of transportation, especially in terms of gas emissions. Moreover, extreme weather events, such as floods, hurricanes, and heatwaves, have become more frequent due to climate change, making route recommendation systems that consider weather conditions increasingly relevant. In this literature review, we discuss recent studies that have explored route recommendation algorithms based on gas emissions and extreme weather.

#### Gas emissions:

Several studies have proposed route recommendation algorithms that aim to reduce gas emissions by suggesting the most environmentally friendly route. In a study by Gao et al. (2021), a machine learning-based route recommendation system was developed to consider both gas emissions and travel time. The proposed algorithm was evaluated using real-world data, and the results showed that it was effective in reducing gas emissions without significantly increasing travel time.

Another study by Shang et al. (2020) proposed a multi-objective optimization model that aimed to minimize both gas emissions and travel time while considering various constraints, such as road network capacity and vehicle type. The proposed model was evaluated using real-world data, and the results showed that it was effective in reducing gas emissions while maintaining reasonable travel time.

#### Extreme weather:

In recent years, extreme weather events have become more frequent due to climate change, posing challenges for route recommendation systems that do not consider weather conditions. Several studies have proposed route recommendation algorithms that consider weather conditions to help drivers avoid hazardous roads.

In a study by Zhao et al. (2019), a route recommendation algorithm was developed to consider both weather conditions and traffic conditions. The proposed algorithm was evaluated using real-world data, and the results showed that it was effective in reducing the risk of accidents caused by weather conditions.

Another study by Liu et al. (2020) proposed a route recommendation algorithm that considered weather conditions and road elevation to help drivers avoid roads that are more likely to be affected by extreme weather events. The proposed algorithm was evaluated using real-world data, and the results showed that it was effective in reducing the risk of accidents caused by extreme weather events.

#### Conclusion:

Route recommendation systems that consider gas emissions and extreme weather can help drivers make more informed decisions while reducing the environmental impact of transportation and improving road safety. The studies discussed in this literature review demonstrate the effectiveness of route recommendation algorithms that consider gas emissions and extreme weather in reducing the environmental impact of transportation and improving road safety. Future research could explore the integration of these two factors into a single route recommendation algorithm.

### **Solution Summary**

The proposed route recommendations app considers extreme weather and gas emissions and gives the users the flexibility to choose their importance dynamically. It provides the importance of route recommendations based on subjective goals, the impact of extreme weather on the transportation system, and the role of the transportation sector in greenhouse gas emissions. The web application also highlights how AI can help in providing personalized route recommendations by analyzing traffic data, weather data, and user preferences. The project goal is to encourage the use of low-emission vehicles and roads.

**Architecture**

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**Results**

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**Lessons Learned**

* Route recommendation apps are essential, especially when it comes to personalized route recommendations based on subjective goals, as they help in ensuring that the users' goals are taken into account when suggesting a route.
* Extreme weather conditions have a significant impact on Canada's roadways, and they could have serious consequences on the transportation system, including affecting travel safety, infrastructure, and maintenance costs. Therefore, it is essential to keep an eye on the weather and prepare accordingly to stay safe on the road.
* The transportation sector is responsible for about a quarter of Canada's greenhouse gas emissions, and to achieve Canada's ambitious target to reduce greenhouse gas emissions by 30% below 2005 levels by 2030, significant emissions reductions in the transportation sector are required, including the encouragement of the use of low-emission vehicles and roads and investment in public transportation infrastructure.
* AI-powered tools and technologies can improve decision-making and help in navigating unpredictable weather conditions. They can also personalize route recommendations based on user preferences, learn from each user's behavior and preferences, and make real-time adjustments to route recommendations to avoid any problems.
* A web application that simplifies the process of selecting the best route for trucking needs, based on the starting point and destination, and options such as distance, extreme weather, and gas emissions, with customized weights for each option, can be helpful in planning truck routes like a pro.

**Conclusion and Discussions**

In conclusion, the project aims to develop a personalized route recommendation system based on extreme weather conditions and gas emissions using AI-powered tools and technologies. The project highlights the importance of considering subjective goals when suggesting routes and emphasizes the impacts of extreme weather events and greenhouse gas emissions on the transportation sector in Canada. The project's web application modules simplify the process of selecting the best route by allowing users to customize their preferences based on their goals. By using AI, the system can provide real-time and personalized recommendations, making it a convenient and efficient way to navigate unpredictable weather conditions while reducing the negative impact on the environment.

**References**

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