A FRAMEWORK FOR INTEGRATING PROBABILISTIC WEATHER FORECASTS INTO VEHICULAR ROUTING

PROJECT PROPOSAL

September 3rd, 2025

PROBLEM STATEMENT

Driving in hazardous weather conditions can be dangerous for all drivers. The ability to monitor and predict severe weather events is critical.

Identifying when storms, violent winds, or other extreme weather patterns can reduce disruptions in transportation and improve driver safety.

PROBLEM STATEMENT

Current methods have one of these limitations:

1. Rely on the operator to understand weather data and evaluate danger (Airplane Industry)
2. Show weather forecasts every hour during a route without warning about dangers (Existing apps)
3. Show detailed weather information but only at query time (AerisIQ)

PROJECT SCOPE

Primary and secondary goals, setting the scope, research questions and stakeholders

01

Primary goal

ALGORITHM

To develop an algorithm that can be implemented into existing mapping software to detect and avoid extreme weather events

02

Secondary goal

VISUALIZATION

To create a visualization tool that helps users identify the safest route between two points using real-time and simulated weather data

RESEARCH QUESTIONS

Primary and secondary goals, setting the scope, research questions and stakeholders

01

TRAFFIC

To what extent does predictive weather information influence a driver's route selection and therefore, have an impact on traffic?

02

SAFETY

To what extent does predictive weather information influence a driver’s route selection for a route with less weather events and therefore, avoid getting in an accident?

OUT OF SCOPE

Primary and secondary goals, setting the scope, research questions and stakeholders

SYSTEM IMPLEMENTATION

Any implementation with current systems:
While leaving methods for quick implementation into mapping software could be done at a later stage, developing the algorithm is the priority

DRIVER SAFETY

The impact on driver safety:
The ability to asses impact of weather prediction software on drivers would require a separate study examining results over a sizable timeframe

TRAFFIC

Analyzing weather impact on traffic is one of the end goals for this project, this phase of the project will only focus on developing the algorithm that shows weather conditions on a rolling bases

TARGET USERS

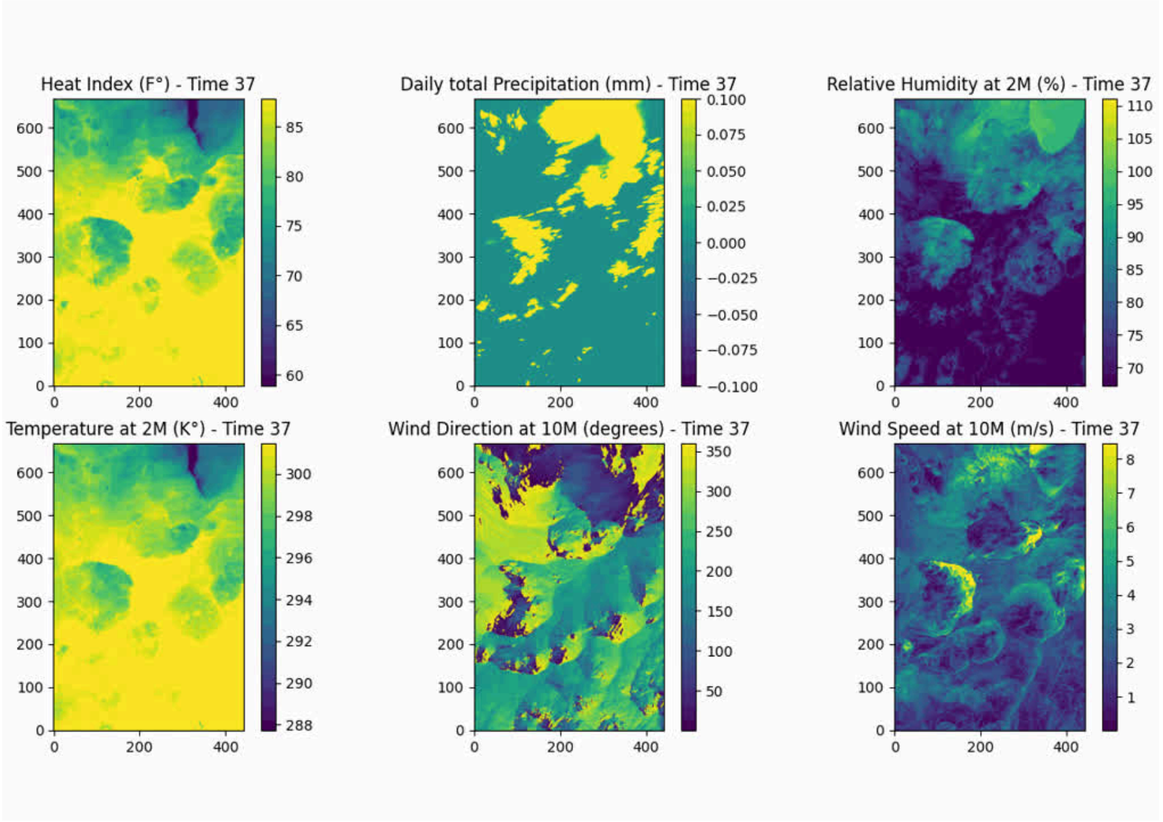
1. Commuters
    a. Small to medium distances
    b. Objective is to avoid traffic
2. Logistic professionals
    a. Medium to long trips
    b. Time and risk adverse
3. Last-mile delivery
    a. Usually in city routes
    b. Very sensitive to time delays
4. Emergency responders
    a. Very time sensitive
    b. May benefit from weather prediction

HOW THE ALGORITHM WILL WORK

PHASE 1

Phase 1 consists of:

1. Identifying a weather dataset that presents distinct weather information over a large enough usable area
2. Implement a backtrack algorithm in a pre-selected area to be able to find a route bounded by roads



PHASE 2

Phase 2 will consist on having the backtracking algorithm find the shortest path between 2 points, taking into account a weather data point from the dataset identified in phase 1

HOW THE ALGORITHM WILL WORK

PHASE 3

Training a model to be able to project the weather to have data points in between observations so the backtracking algorithm is able to use it for shorter trips

PHASE 4

Combine the model with the backtracking algorithm so the program is able to present to the user the weather conditions of every point in the route when they are passing trough that point

TIMELINE

DESIGN STUDY “LITE” METHOD

- Abstract phase
- Design Phase
- Build Phase
- Evaluate Phase
- Post - Study Phase

Stage	Stage duration	Key activities	Expected outcome
Stage 1: Abstract Phase	2 weeks	User interviews, task analysis	Project proposal
Stage 2: Design Phase	2 weeks	Prototyping, designing	Prototypes
Stage 3: Build Phase	2 - 4 weeks	Implementations	Working tool
Stage 4: Evaluate Phase	1 - 2 weeks	User testing, evaluations	Design validations, bug fixing

TIMELINE

DESIGN STUDY “LITE” METHOD

- Abstract phase
- Design Phase
- Build Phase
- Evaluate Phase
- Post - Study Phase

Stage	Stage duration	Start date	Finish Date
Stage 1: Abstract Phase	2 weeks	22/09/2025	03/10/2025
Stage 2: Design Phase	2 weeks	06/10/2025	17/10/2025
Stage 3: Build Phase	2 - 4 weeks	20/10/2025	14/11/2025
Stage 4: Evaluate Phase	1 - 2 weeks	17/11/2025	21/11/2025

THANK YOU

September 3rd, 2025

REVIEWED MATERIAL

- Meteorology. https://www.faa.gov/air_traffic/publications/atpubs/aim_html/chap7_section_1.html
- Pilot’s handbook of aeronautical knowledge (FAA-H-8083-25C). (2023). FEDERAL AVIATION ADMINISTRATION. https://www.faa.gov/regulations_policies/handbooks_manuals/aviation/faa-h-8083-25c.pdf
- Academy, B. 6. F. (2024, April 2). The Role of Weather in Pilot Training and Safety. Bravo 6 Flight Academy. https://bravo6flightacademy.com/mastering-the-skies-the-role-of-weather-in-pilot-training-safety/
- How do weather events affect roads? - FHWA Road Weather Management. https://ops.fhwa.dot.gov/weather/roadimpact.htm
- Weather forecasting system. https://aerisiq.climate-dpi.org/
- Syeda, U. H., Murali, P., Roe, L., Berkey, B., & Borkin, M. A. (2020). Design Study «Lite» Methodology: Expediting Design Studies and Enabling the Synergy of Visualization Pedagogy and Social Good. Conference On Human Factors, 1-13. https://doi.org/10.1145/3313831.3376829