A FRAMEWORK FOR INTEGRATING PROBABILISTIC WEATHER FORECASTS INTO VEHICULAR ROUTING

PROJECT PROPOSAL

September 8th, 2025

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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 current and future forecasted weather data

RESEARCH QUESTIONS

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

01

TRAFFIC

To what extent does access to predictive weather information influence drivers' route selection and overall traffic distribution?

02

SAFETY

To what extent does access to predictive weather information influence a driver's route choice in ways that reduce exposure to hazardous weather conditions and the likelihood of accidents?

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

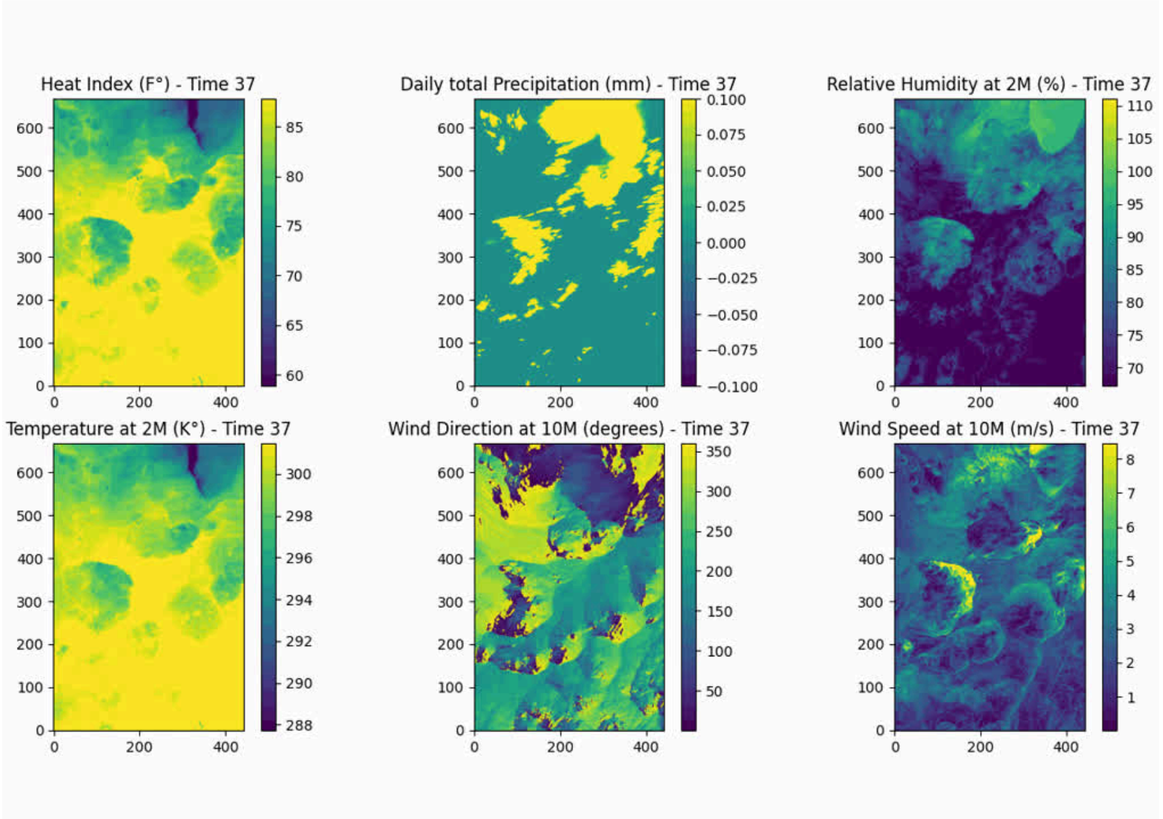
HOW THE ALGORITHM WILL WORK

PHASE 1: DATASET & INITIAL BACKTRACKING

- Step 1: Identify a weather dataset with sufficient spatial coverage and intensity
- Step 2: Implement a backtracking algorithm in a pre-selected area
  - Output: Route bounded by roads

PHASE 2: SHORTEST PATH WITH WEATHER

- Input: Route from Phase 1, weather dataset
- Step 1: Use backtracking to find shortest path between two points
- Step 2: Incorporate weather data point to influence route selection



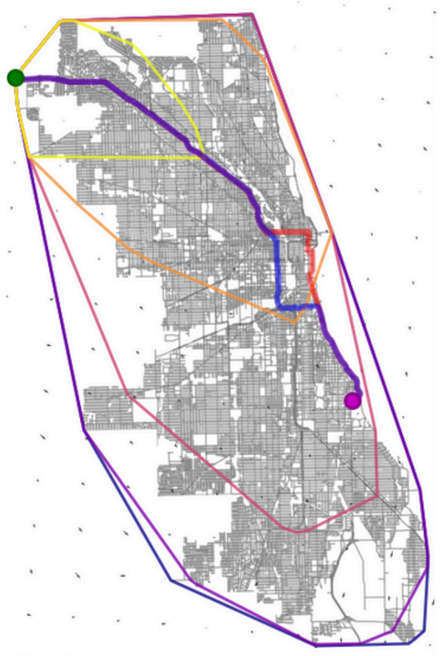
HOW THE ALGORITHM WILL WORK

PHASE 3: MULTI-TIME SAFE & QUICK PATHS

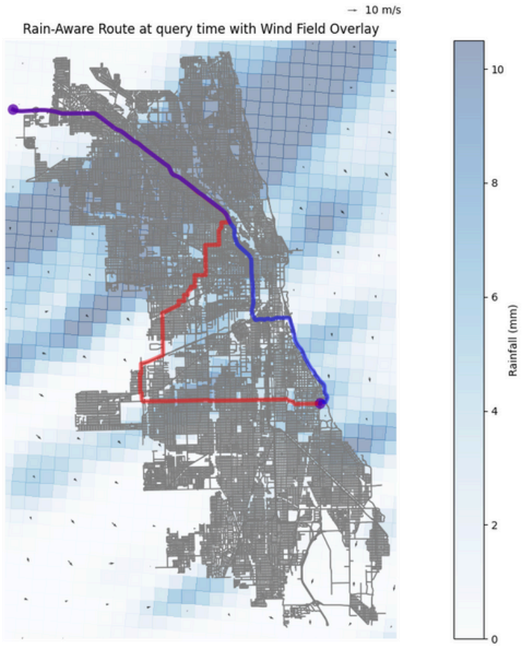
- Input: Weather dataset over time
- Step 1: Develop algorithm to evaluate paths using multiple timestamps and multiple thresholds
- Step 2: Calculate paths optimizing for:
  - Safety (within thresholds)
  - Travel time

PHASE 4: WEATHER PREDICTION

- Step 1: Train a basic model to predict/project weather
- Step 2: Fill gaps between x-minute readings
- Output: Smoothed weather dataset for routing



Fastest route vs a very high penalization rain evading route over time



Fastest route vs a very high penalization rain evading route, single rain zone

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	Phase 1-2
Stage 3: Build Phase	2 - 4 weeks	Implementations	Working tool	Phase 3-4
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	Phase 1-2
Stage 3: Build Phase	2 - 4 weeks	20/10/2025	14/11/2025	Phase 3-4
Stage 4: Evaluate Phase	1 - 2 weeks	17/11/2025	21/11/2025	

THANK YOU

September 8th, 2025

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