Increasing Situational Awareness in Pathfinding

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ELECTRICAL & COMPUTER ENGINEERING

PROBLEM STATEMENT

Most mainstream applications with pathfinding functionality only consider distance and few environmental factors, mainly traffic or road inaccessibility, when determining the best route to a destination location. Our main goal has been to develop a proof of concept application that increases situational awareness in pathfinding by taking into consideration weather conditions when determining a route.

REQUIREMENTS

- Android Smartphone with:
  - minimum 4.3 OS
  - GPS
- Internet connection

How does weather affect drivers?

> Approximately 21% (1,235,000) of all vehicle crashes a year are weather-related.

> Nearly 5,000 people are killed and over 418,000 are injured in weather-related crashes each year.

> In Seattle, travel time delay increases by 21% during adverse weather conditions.

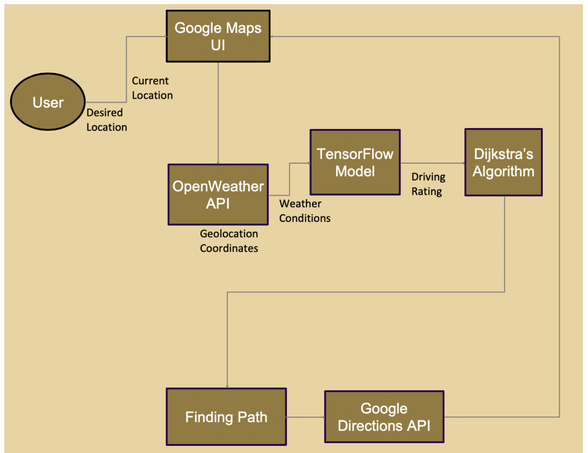
"Weather-related" crashes are those that occur in presence of adverse weather and/or slick pavement conditions.

Source: Federal Highway Administration (FHWA)

IMPLEMENTATION

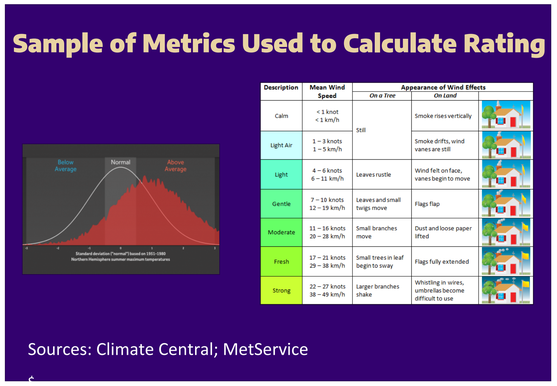
1. Google Maps API as UI
   - User's current location is automatically tracked and desired destination may be inputted.
2. OpenWeather API to access weather data
   - Current time weather data for the two locations, along with intermediate points, are retrieved.
3. TensorFlow ML model to rate conditions
   - Weather data is inputted into a model and a overall driving condition rating is outputted.
4. Djikstra's Algorithm to find the minimum-cost path
   - Each intermediate point has a cost given to it found by weighing distance vs. model rating.
5. Google Directions API to map the path
   - The path determined by step 4 is then added to the UI using waypoints.

Product Design



RATING STANDARDS

The weather rating is calculated by 7 different metrics: temperature, humidity, ATM pressure, minimum temperature, maximum temperature, cloud coverage and wind speed. The rating increases as these values deviate from the norm. Certain features like temperature have optimal conditions at average values like temperature (15° C). Other features like wind speed have optimal conditions at 0 (mph).

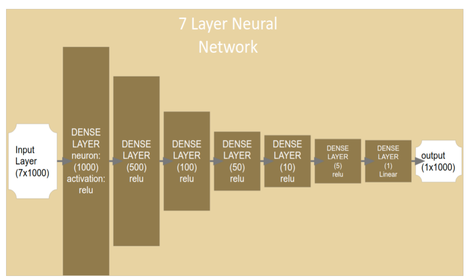


We are able to use these metrics, in addition to ones not shown, to calculate a weather rating value from 1 to 10. 1 is the most optimal driving condition and 10 is the least. More adverse weather features produce a higher number on the rating, i.e: high temperature, low pressure, high humidity, overcast, high wind speed would probably produce a value 6 or higher.

Current Rating Examples

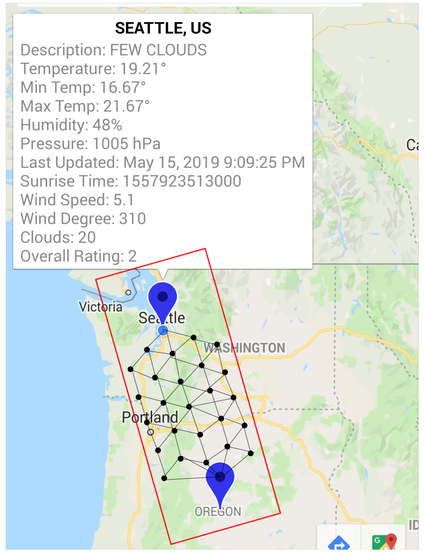
temp (C)	pressure (hPa)	humidity (%)	Temp min	Temp max	OverCast (%)	Wind (mps)	rating
19.04	1015	82	18.33	19.44	75	2.6	1
10.96	999.98	66	10.96	10.96	11	10.59	4
-38.64	1013.898	91	-38.64	-38.64	47	10.33	7
-49.44	1037.45	100	-49.44	-49.44	100	4.51	10

MODEL ARCHITECTURE



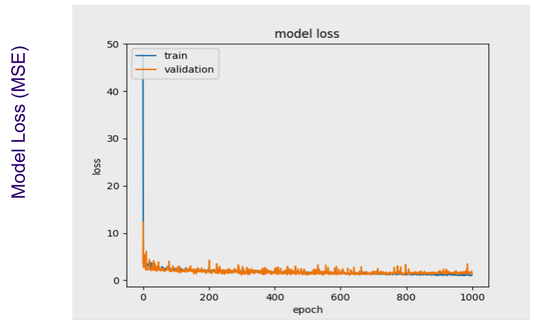
This model predicts the overall driving conditions rating.

APPLICATION DEMO



Application demonstration with conceptual process overlayed: a graph of intermediate nodes are created between the user's current location (Seattle) and their desired destination location (Oregon). The graph uses the ratings from the model to calculate an optimal path.

MODEL PERFORMANCE



Epochs of Training for Current Model

Mean squared error (MSE) is the metric used to show the difference between actual and predicted data. The MSE for our model is less than 1.5 so more accurate ratings are produced.