POLLUTION-AWARE ROUTE PLANNING

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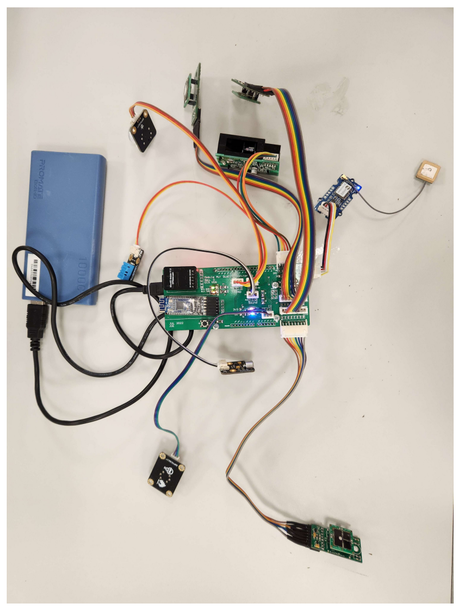
What's this project about?



Pollution sensing platform
(Luke Hawinkels, 2022)

Studies show that air pollution negatively impacts human health, and increases mortality rates [1]. New Zealand is also affected despite relatively low pollution levels [2]. The aim of this research is to create a tool to help users reduce their exposure to air pollution by planning better routes for travel, commute, or sport.

An appropriate pathfinding algorithm was to be found for use in the backend of the system, with a database that contains pollution data collected from a pollution sensing platform.

Data

Pollution data and road information are stored in the database. Road data is collected using a script in the persistency layer of the system.

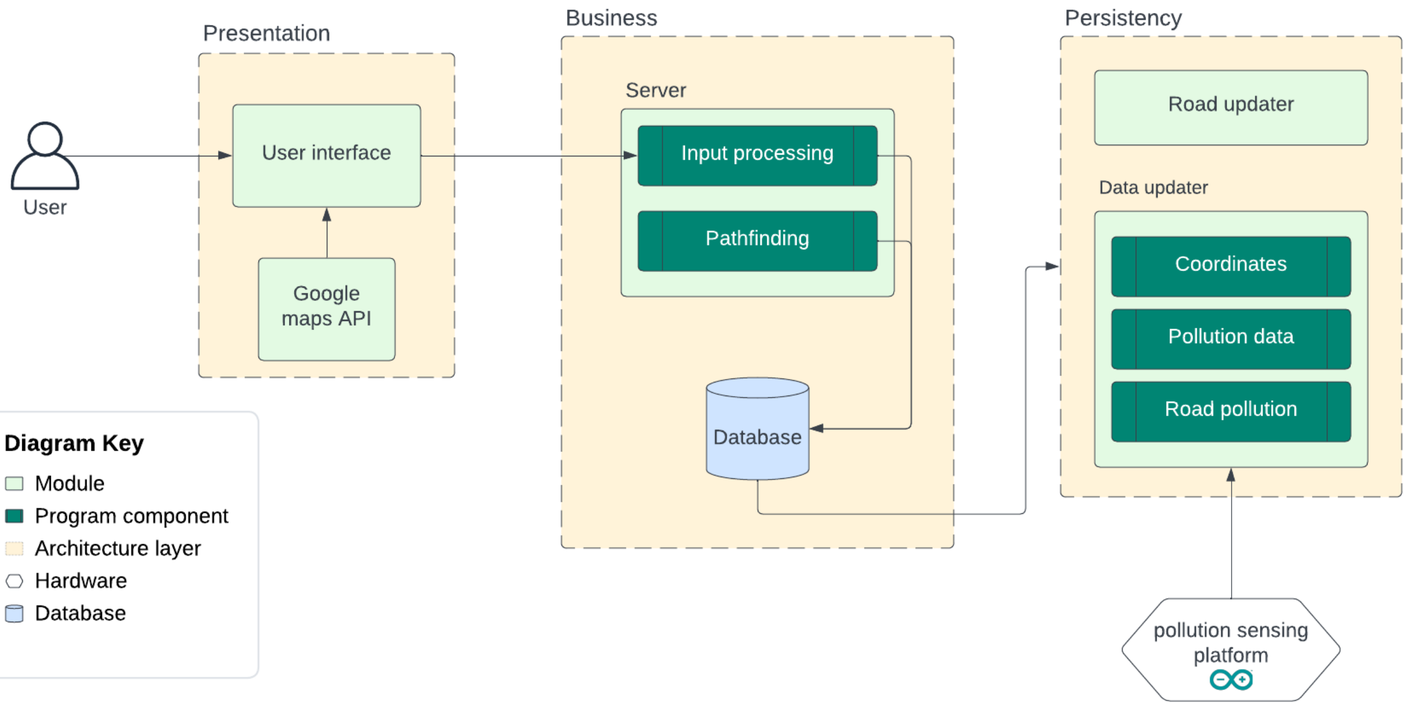


Figure 1. Diagram of the system architecture.

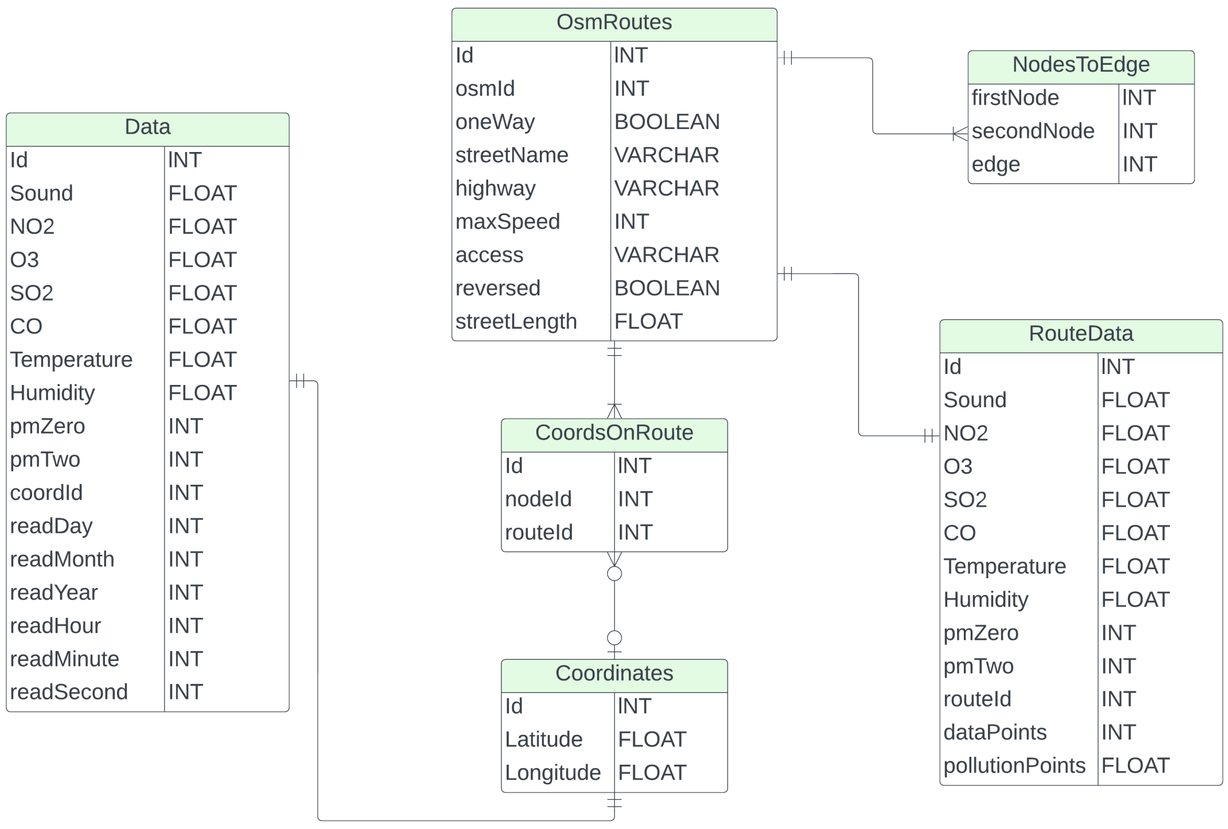


Figure 2. Entity relationship diagram showing all the database tables and attributes.

Results

The resulting tool allows the user to search for a path with the best air quality.

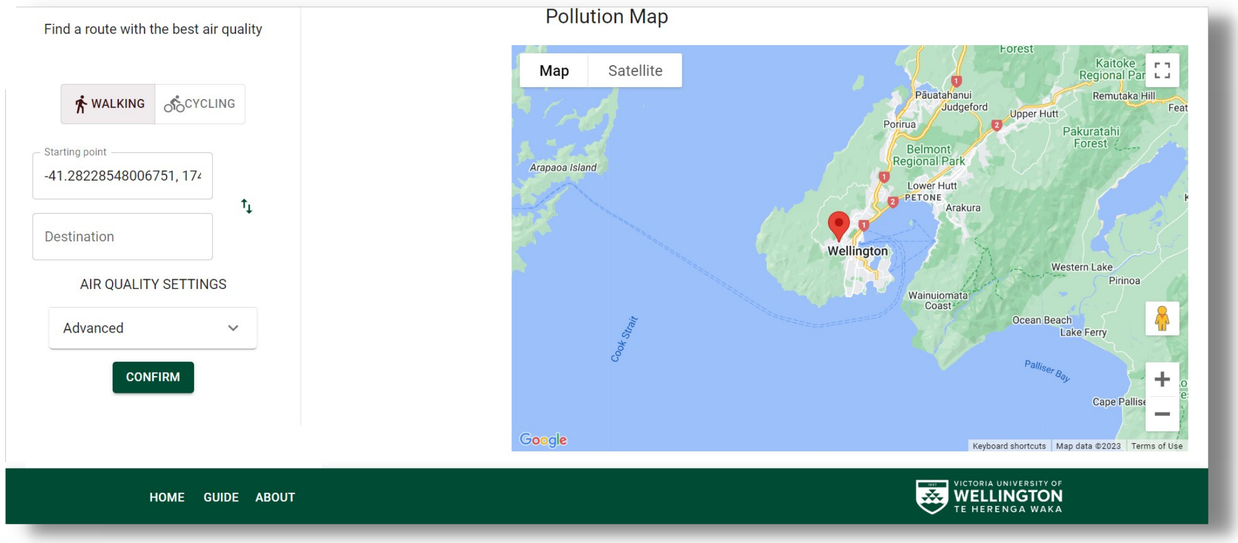
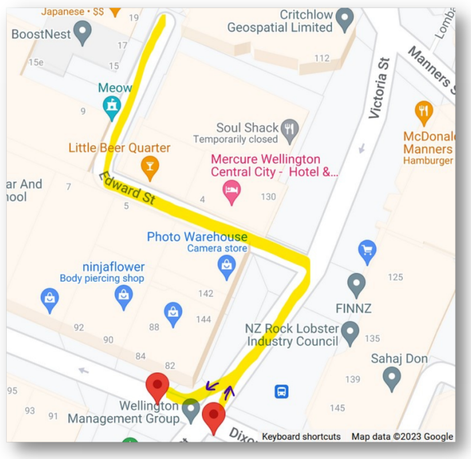
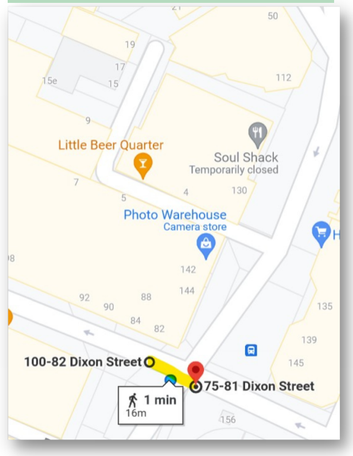


Figure 3. Proof of concept of the tool's frontend.

The resulting path depends on the pollution levels only:



Best path found on Google maps:



Figures 4 & 5. Comparing pollution-aware route planning with Google Maps. Pollution route map calculated using generated (not real-world) pollution data.

The resulting route-plan finds a path between two points, ignoring the distance and time that the route will take and only finding a path with the least pollution using Dijkstra's algorithm.

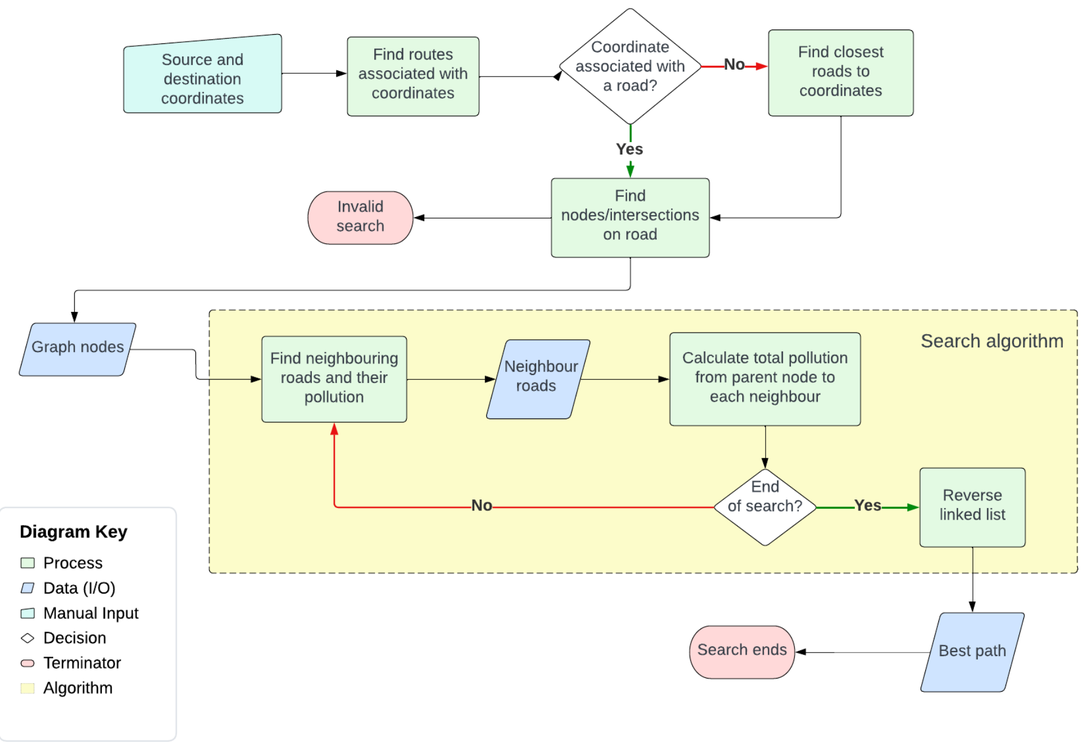


Figure 6. Flowchart showing how the optimal path is found in the backend.

Conclusions

1. Queries will become slower with the expansion of the database, so it should be migrated to PostgreSQL with PostGIS for real-world use.
2. Using an algorithm that is optimisable with heuristics like A* is better for larger networks.
3. The paths found can be improved and made more practical by adding more constraints other than pollution. e.g. time.

References

[1]G. D. Thurston et al., "A joint ERS/ATS policy statement: what constitutes an adverse health effect of air pollution? An analytical framework", European Respiratory Journal 2017, doi: 10.1183/13993003.00419-2016.
[2] S. Hales et al., "Air pollution and mortality in New Zealand: cohort study", Journal of Epidemiology and Community Health (1979-) , May 2012, Vol. 66, No.
5 (May 2012), pp. 468-473.

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