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Route planning and its applications for electric vehicles in Colorado

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Abstract

This project examines the wide array of existing literature on pathfinding algorithms, particularly these algorithms' applications for electric vehicles (EVs), to suggest an effective distribution of EV charging stations in a theoretical city in Colorado, as well as more broad implications for Colorado's EV infrastructure. The study involves spatial data locating existing EV charging stations in Colorado, as well as statistics on quantities of newly purchased EVs in Colorado, and utilizes established pathfinding models as applied to EVs. These models include and reflect the one proposed by Shen et al. (2019) for optimizing both travel time and battery energy efficiency, or the one proposed by Jafari and Boyles (2017) for estimating charging cost based on time spent charging. The preliminary result is a set of outcomes of these models given real locations of charging stations, as well as these outcomes' implications on future urban planning for EV adoption, especially as applied to cities in Colorado.

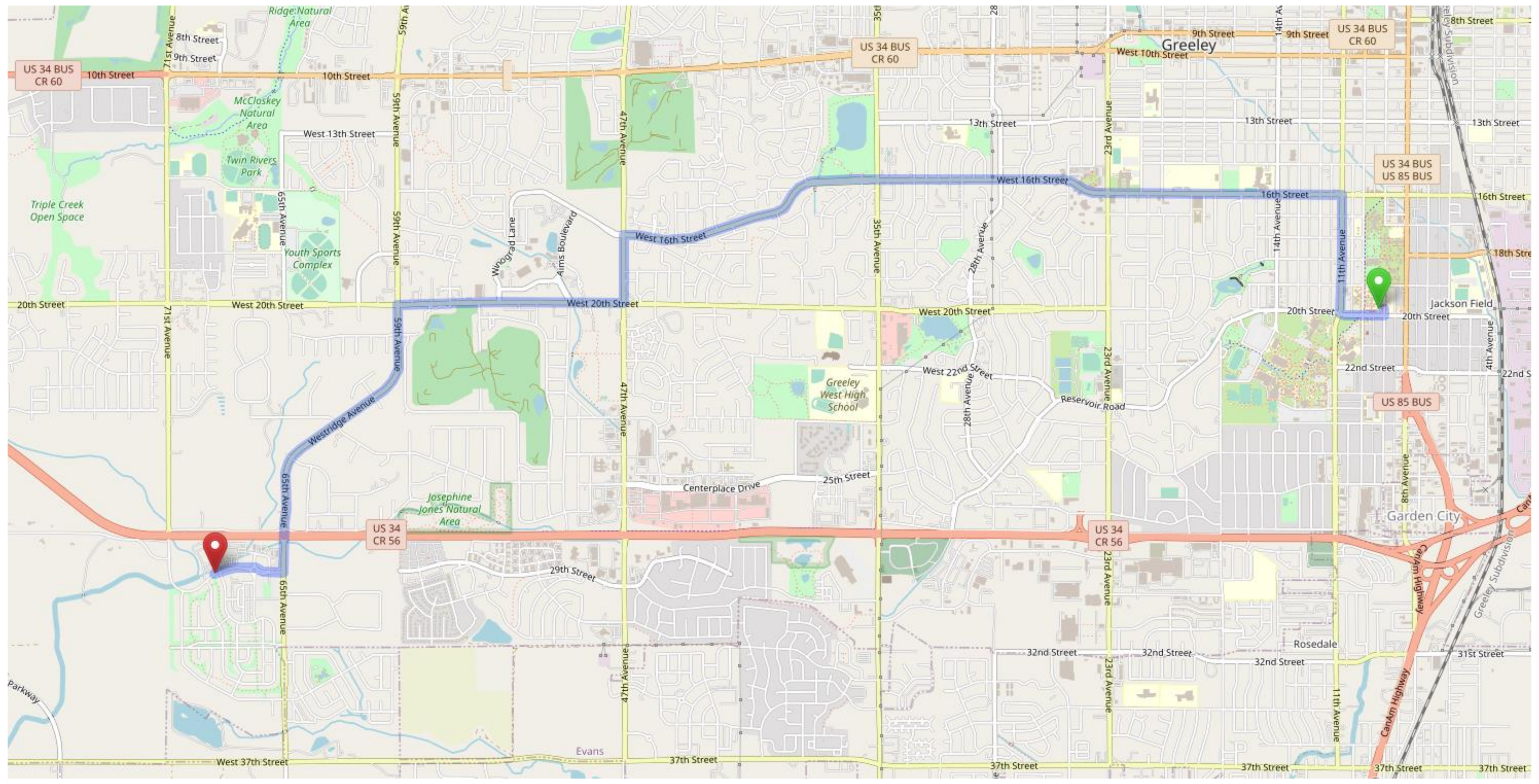
Study Area

Upon examination of the data available through EValuateCO that locates all EV charging stations in Colorado, the city of Greeley became the ideal study area due to its relatively sparse charging infrastructure. Qin et al. (2019) produced an interesting study incorporating Colorado's land area and population distribution in a proposal with implications for charging station infrastructure. The next logical step, then, is to apply the study's knowledge of Colorado's population metrics on the assumption that Greeley represents a typical urban environment in Colorado. Combining this with an appropriate established pathfinding algorithm should yield a comparison between theoretical need for EV charging station locations and actual charging station locations in Greeley.

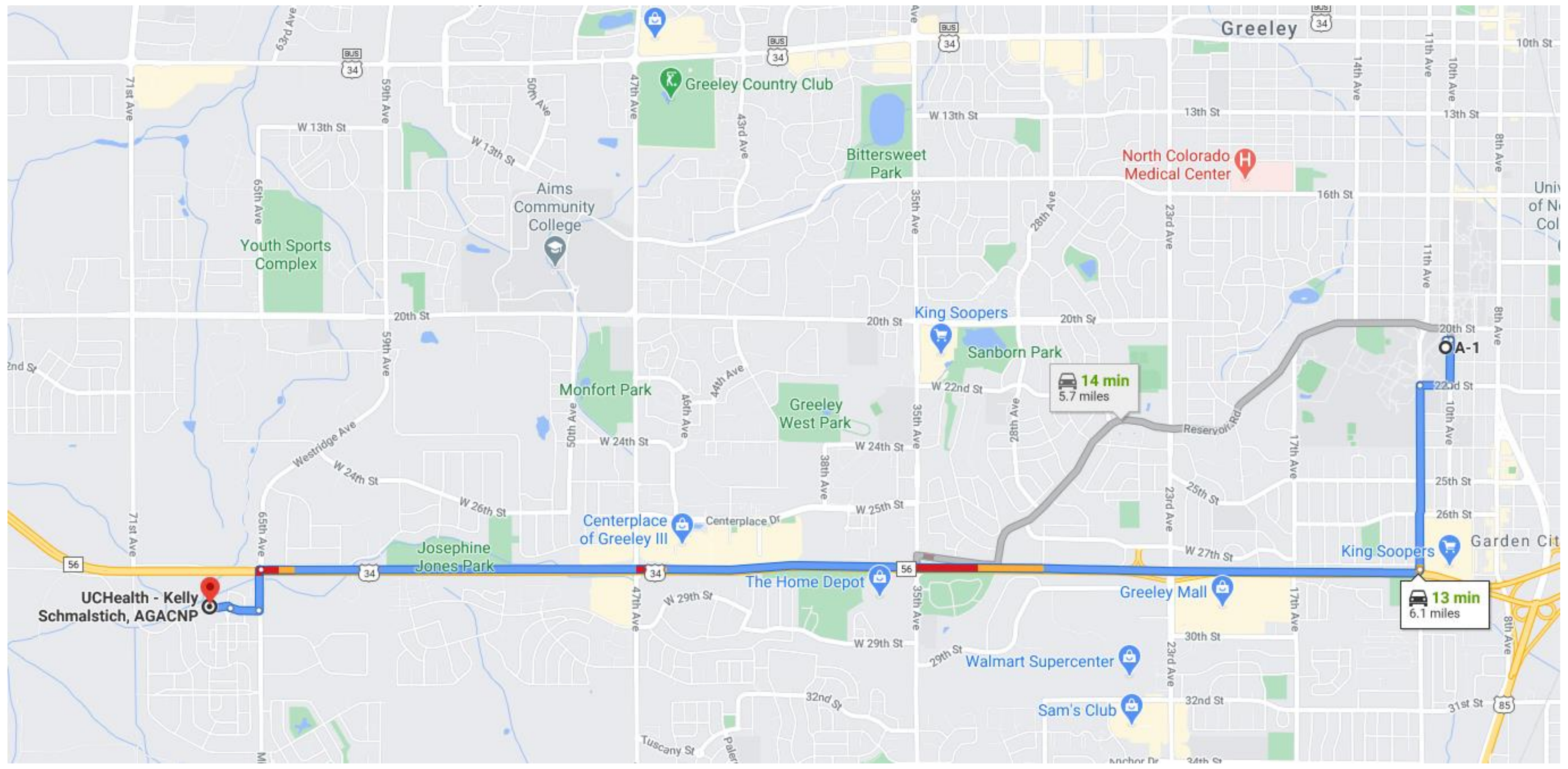
Research Question

How can route planning research, particularly pathfinding algorithms, be applied to infrastructure supporting electric vehicles on a level relevant to Colorado?

Maps



OpenStreetMap interpretation of a route between two EV charging stations in Greeley



Google Maps interpretation of a route between two EV charging stations in Greeley

Data and Methods

Data is a product of EValuateCO, an interface for exploring publicly available metrics on EV incorporation onto Colorado's roads. These include number of registered EVs by make, power networks managing the charging stations and their shares of the availability, and projections of distributions for various types of charging stations, among plenty of other figures. EValuateCO draws data from sources such as the U.S. Department of Energy's Alternative Fuels Data Center, which offers filters that allowed this study to narrow the entire country's alternative fuel sources to the EV charging stations in Greeley.

Conclusions

The data from EValuateCO and the appropriate models from Shen et al. (2019) and from Jafari and Boyles (2017) reveal a need for a more robust EV infrastructure in Greeley. The city trails behind others in Colorado, such as Boulder, in its incorporation of EVs onto its roads. Considering greater infrastructure issues emerging in the United States, bolstering infrastructure for EVs and, by extension, other alternative fuel sources, may appear insufficient to solve these, problems, but further consideration of this new knowledge of EV route planning may provide both urban and natural landscapes some relief.

References

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Map sources: Google Maps, OpenStreetMap