FAKULTA APLIKOVANÝCH VĚD ZÁPADOČESKÉ UNIVERZITY V PLZNI

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Driving Range Estimation and Trajectory Planning for Electric Vehicles

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1 Introduction

The main objective of this study is to design a solution of trajectory planning for electric vehicles, taking into account the location of charging stations and their power. The next objective is to display driving range on the map as a polygon with respect to the vehicle's battery capacity.

The supervisor of the thesis is Porsche Engineering Services s.r.o. The developed algorithms and HMI will be used in a demonstration vehicle by the company.

2 Driving Range Polygon

Today's vehicle market provides, in most cases, only a circle to show driving range. This radius does not provide us an accurate solution. It is computed as great-circle distance and it does not account for the diversity of the roads, so by using the help of the Google APIs, we get a more accurate solution.

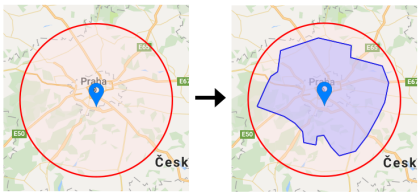

Figure 1: An example of driving range shown as polygon shape on the map.

3 Trajectory Planning and Optimization

Using several approaches and Google APIs was created an algorithm for route planning. There were chosen two graph algorithms to solve this problem. The first one was Floyd-Warshall algorithm and the second one was Dijkstra graph algorithm. Both algorithms can find the shortest path between two vertices in the graph.

3.1 Problem definition

The idea of the algorithm is to find the path between origin and the destination through charging stations with respect the optimal time results. On each station may be or not the battery charged to the full capacity.

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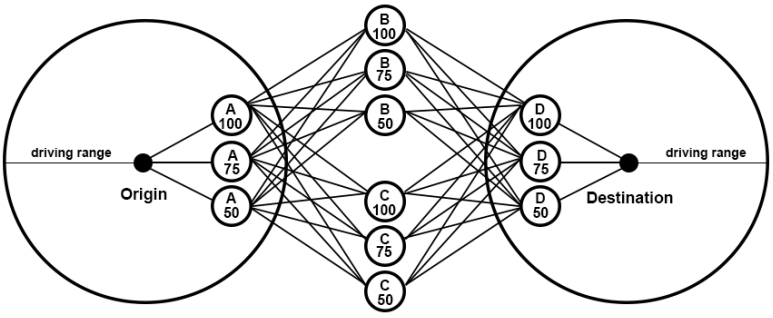

Figure 2: Route planning with different states of charge.

3.2 Proposed solution

The algorithm is divided into two parts. The first part is based on dynamic programming which finds the shortest time path through charging stations. In the second part of this algorithm is the founded path checked with Google API. There is returned more accurate time result with consideration of actual traffic conditions taken into account.

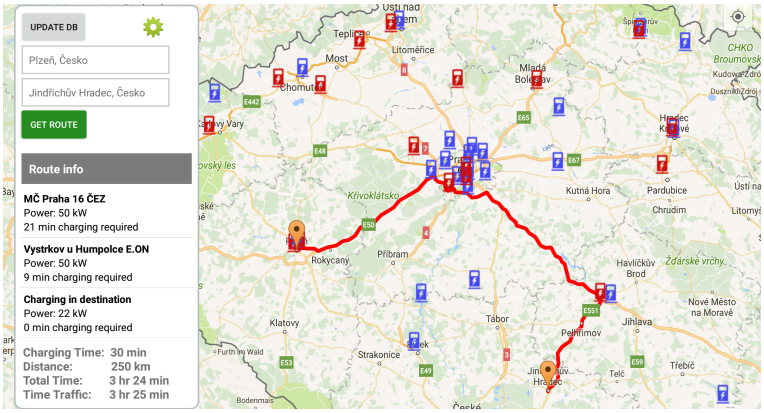

Figure 3: An example of route planning including route information summarization.

4 Implementation to the Delivered Application

The developed algorithms were implemented in a java-based application for Android. Application was tested using software in the loop approach (using a recorded data) and also directly in a demonstration vehicle.

References

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