Intelligent Public Transportation Multi-Agent Model *

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1. PROBLEM DEFINITION, RELEVANCE AND REQUIREMENTS

Today's cities transportation systems usually consist of many different forms of transport: scooters, metro, bus, train, bikes, taxi and shared cars. Current navigation apps mostly see the passenger as an isolated individual and find the optimal path and form of transportation. Although things like traffic jams are already included into the calculations (to recommend alternative routes) we would like to propose a system where the transportation instances communicate and collaborate. In such a system, passengers with similar destinations would be categorized into groups and their needs would be solved more efficiently. Also, a ride could be seen as a dynamic process, i.e., a passenger could be suddenly and unexpectedly invited to disembark the current vehicle and switch to another one during his ride. Like this, the usage of all forms of transport could be optimized and lead to a more balanced load. At the same time a more intelligent distribution of shared vehicles to more requested locations comes as a side effect.

Our concept is focused on today's problem of Lisbon related with transportation. Recent studies showed that 6 out of 10 citizens of Lisbon use personal vehicles which increases traffic and pollution [1]. We believe that a system that provides a comfortable and fast route using an intelligent combination of transportation systems, would be attractive for the citizens of Lisbon and may result that less people are using their own vehicles.

The system requires to know the location of the objects (every user) and the agents. The communication and coordination can be done via internet by sending information to the central server to process all the global information that are needed to calculate and estimate not only the distances of the path but also the costs.

A simulation update on the central server for all the agents has to be fast enough in order to be executed in real-time, i.e. in very small time-steps. Also it has to be capable of handling a big number of agents and passengers at the same time.

Some metrics to optimize and evaluate could be average travel time, individual travel costs or waiting time until a ride starts.

2. PROPOSAL OF OUR MULTI-AGENT-SYSTEM

The different forms of transport would represent the agents (scooters, metro, bus, train, bikes, taxi, shared cars ..). The users (passengers) are considered as objects (comparable to the boxes in our simple example) that have different preferences concerning the transportation systems and have different initial locations and different target locations. The objective is to bring all passengers from A to B. The agents have to negotiate prices for the users based on their availability (Are too many scooters at one location and have to be redistributed in the city?), capacity (Are roads full? Traffic jam? Is metro full?), target location, preferences of persons etc. This can be interesting, because all transport possibilities can be used more equally, high load traffic situations can be avoided / reduced, people do not decide on the transport system based on a fixed price but on usability and optimally for the whole system.

3. PROPERTIES OF THE AGENTS AND OF THE ENVIRONMENT

3.1 Agent Properties

Our agents are considered to be

- Autonomous: Agents decide for the optimal route and are able to navigate autonomously.
- Rationality (depends on the agent): Some (e.g. taxis) try to maximize their utility functions, whereas others (metro) just always follow their schedule regardless of the profit
- Reactive: Agents react based on the passenger/user location to calculate the current optimal path.
- Social: Agents communicate between each other to negotiate and calculate time, distance and cost.
- Collaborative: Agents interchange the passenger to achieve a collaborative goal.
- Mobile: Agents are mobile (they represent the different forms of transport).

3.2 Environment Properties

- Accessible: All agents should always be able to know about each other state and position to be able to communicate the optimal solution.
- Non-deterministic: At the beginning of a travel, the exact details of this run are not yet certain.
- Dynamic: Passengers as well as the other agents move in real time.
- Discrete: We thought about discretizing the map into a grid, where each cell represents an area in the real world and is considered a node in the graph.
- Non-episodic: Each travel has side effects, that affect other passenger's travels (e.g. a metro being full, a scooter brought to another location)

REFERENCES

[1] A triste verdade sobre o uso dos transportes pÃžblicos em lisboa... https://www.boleia.net/blog/estudo-triste-verdade-sobre-o-uso-dos-transportes-publicos-em-lisboa. Accessed: 2019-03-28.