Automated ridesharing suggestion system for Covoituliège – Integrated project

1 Context

In an attempt to reduce the number of cars heading to its campuses, the University of Liège has started a project of a ridesharing service named Covoituliège. For its users, the service works in three simple steps detailed hereafter.

1) Register the travel habits: every user enters the travel he is doing, either on a regular or a unique basis. Each travel consists of a starting and an ending point and a time objective, either “arrive before” or “start after” a given time.
2) Automatic matching: an algorithm analyzes all the travel habits in order to find travel suggestions that satisfies a maximum of users.
3) Suggestions' evaluation: users come back to the platform to indicate which of their travel suggestions they are interested in. When at least to users are interested in the same suggestion, a travel is scheduled.

While this system can deliver satisfying results for people with very regular travel habits, it can become tedious for people having more complex travel habits.

This project consists in working on a system whose goal is to automatically discover the travel habits of users based on their GPS traces, hence relieving them from having to go through the first step of the process, and thus making the ridesharing service easier to use.

2 Covoituliège

Initially proposed as the integrated project of the academic year 2015-2016, the ridesharing service Covoituliège has since received a continuous effort from many people at the University in order for it to become a reliable product. Covoituliège has its development team based in Montefiore.

Shortly after its first stable release in September 2017, the service has been adopted by the CHU of Liège as well as the City of Liège. Accessible to more than 30.000 people, about a third of them have registered themselves on the service, proving a widespread interest for an alternative mobility. During the past year, the service has been regularly used by a growing number of people and has seen major activity pikes during public transportation strikes.

In September 2018, the service is going under a new major change with the introduction of a mobile application, which will increase the access to the solution as well as offering new development opportunities.

3 Objectives

The goal of the project is to provide a complete software solution that is able to collect the GPS traces of users, to transform them in well-structured travel habits and finally to emit travel suggestions based on the discovered habits.

The solution should follow a client-server architecture, where the client is a mobile application and the server handles most of the computation. The solution as a whole should comply with the best practices regarding modern software development.

3.1 Collecting GPS traces

The mobile application has to handle the collection of the GPS traces. Its design should be very simple, allowing the users to only start and stop the collection process at any given time. The collection process should pay attention to two very important parameters: battery usage and cellular data.

It is not an option to make a continuous capture of the user position as it would have a dramatic effect on the battery usage. A custom strategy is therefore needed to ensure the least possible impact on the battery.

Also, the transmission of data over cellular network should be limited or even avoided as it is costly, has a higher battery usage and may be more unreliable. Instead, the mobile application should aim at syncing with the server when a local network is available.

3.2 Analyzing GPS traces

The output of the trace collection will take the form of a list of position points, each associated to a timing. This list needs to be analyzed in order to extract the travels made by the user. Each travel should be described by at least the path followed by a user and the associated timings.

It is also interesting to try to evaluate which transportation mode is used for each travel. Indeed, in most cases the use of public transportation implies a significant detour or at least a slower travel, which negatively impacts the travel time. So, knowing the transportation mode should lead to a better estimation of the flexibility a user has for his travels.

3.3 User based model

Once the trips made by a user are known, it is possible to build a per user model of his travel habits. The goal of this model should be to learn the habits of the users in term of, at least, departure and arrival places as well as timing objective and flexibility.

Once the model has been trained, it can be used to predict what are the next possible travels for any given user, and thus when ridesharing could be useful. For this system to be interesting to use, the model should have some indicator of its learning quality as well as be able to adapt itself over time.

3.4 Creating suggestions

The final step consists in comparing user models to build suggestions that consists of at least two models that can lead to a travel. As Covoituliège has already its algorithm, this step should be oriented around an efficient comparison of any pair of models.

4 Integration with Covoituliège

Depending on the progress of the project and the development team availabilities, it might be possible to integrate the GPS trace collection module in the existing Covoituliège application in order to work on the other modules with a realistic dataset. It is also possible to have access to the places each user is likely to go to in order to have some hints that could ease the trace analysis process.

As such opportunities require careful planning, it is very important to evaluate them as soon as possible and either choose to pursue or to discard them.

5 Other requirements

This project make sense only in a context where there is a lot of users and data. Thus, it is important to keep in mind at all stages how your solution behaves when it has to work with a lot of users.