Problem description : *TraffiX*

Designing a software architecture

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1 Introduction and motivation

In this document we present the initial problem description for *TraffiX*. This is a system that enables drivers to find parking spots more easily and helps avoiding traffic congestion in large urban areas.

The governing body of a large city wishes to facilitate the finding parking space for its citizens. Over the last couple of decades the number of cars has only grown, causing significant traffic in down town areas as well as the periphery of the city. Although efforts have been made to promote public transport services and cycling, the problem largely remains. When analyzing the issue, one of the identified causes was that finding parking space efficiently delayed traffic, possibly frustrating drivers. In this kind of environment mistakes are made easily, causing accidents in the process.

The analysts proposed to make use of the data available in parking meters and public parking lots with payment system to discover available parking space.

Discovered parking spaces can then be communicated to drivers looking for a parking spot.

As a secondary objective, the city wants to monitor incoming traffic from the periphery to anticipate congestion in important nodes. By timely diverting traffic, the city's council hopes to reduce accidents as well as costs due to significant time losses as a result of traffic jams.

The rest of this text is organized as follows. Section 2 describes the overall problem solution envisioned by the analysts. Section 3 gives an overview of the stakeholders involved in the project. Section 4 lists a selection of scenarios that illustrate how the system is to be used and how it should behave.

2 Description of the problem domain

2.1 Parking metering

A parking meter is a apparatus enabling someone to obtain the right to park his/her car in exchange for money. Older versions of parking meters only accept coins, but today, more and more parking meters allow digital payments or payments per SMS. As a result, many of the current parking meters already have some technology, albeit limited, built into them.

A company has been found that would manufacture specialized hardware and software to extend these parking meters and monitor their corresponding parking spots. In this document we make an abstraction of this technology, so further we will refer to it simply as the parking meter instead.

Each meter corresponds to a specific set of parking spaces. When a client parks his/her car, he/she will have to get a parking certificate from the correct meter. Next this data will have to be combined with those originating from other meters. With this information the system will be able to get a relatively accurate picture of the overall occupancy of parking spaces. This information can then be distributed among the drivers looking for a parking spot.

There are two communication channels used to send data from the parking meters to the rest of the system: SMS and transmission via a local area network. SMS can be used by customers who send the required data directly to a central communication service where requests can be processed, whereas the network is used for registering traditional and digital transactions.

2.2 Data mining

Traffic experts and scientists, as well as policy makers want to gather information on important nodes in the street network, for example to adjust and plan roadworks. This data can also be used in predicting and avoiding traffic congestion as explained further in section 2.3.2.

2.3 Route planning

2.3.1 Parking

Along with mapping free parking spots, also comes computing and visualizing efficient paths to get there from a current location. Analysts propose to extend an existing global positioning system with the parking data.

2.3.2 Traffic congestion

Similar to how parking is addressed, traffic congestion prediction and handling can be done by integration with existing GPS technology. Anonymous GSP data could be used to get an idea of the number of cars that aim to arrive at a certain destination.

To get a better idea of the traffic flow, i.e., average number of cars passing a certain point along the road within a set time interval, additional meters are installed at important nodes. These will give updates on the traffic flow at regular time intervals, allowing the system to form a better picture of the amount of vehicles on specific roads.

Combining both destination and traffic flow, accurate models can be formed about from which predictions about traffic congestion can be derived.

3 Stakeholders

In our system we can identify the following stakeholders:

- **Vehicle drivers** : Drivers want to reduce the time they spend in their vehicle and arrive safe and efficiently at their destination. By providing clear directions and suggestions, the system helps in achieving these objectives.
- **Parking space managers** : Parking metering is either done by the government or private companies. In the second case especially, as for private businesses a financial incentive is in play, whereas the government should be as neutral as possible. As a result, suggesting parking spaces should be done in a transparent and fair way.
- **Policy makers and researchers** : Government officials will want to use data found by traffic researchers to create and adjust traffic policies and plan roadworks.
- **TraffiX technicians** : Technicians are responsible for installation and maintenance of the different metering devices.
- **TraffiX system administrators** : System administrators are responsible for addressing failures or bugs that occur in the system and maintaining databases and software updates.

4 Scenarios

4.1 Installing parking meters

A new parking meter has to be installed for a set of parking spaces. A technician sets up the hardware at the appropriate spot in the street and connects the device to the network. Next the parking meter is configured to start sending parking data to the rest of the system.

4.2 Setting up a client profile

A car driver wishes to start using the TraffiX system. The person connects to TraffiX and creates a new account. The client then configures his remote device to communicate with TraffiX and receive the desired updates.

4.3 Congestion prediction

A TraffiX user has entered his/her destination in a GPS. TraffiX computes suggestions based on the current available data. According to the user's actions, TraffiX updates the system data to recompute new suggestions.

4.4 Perform traffic research

A Traffic researcher logs on to the TraffiX research platform and enters a query. TraffiX computes the result and visualizes it. The researcher can perform additional queries on the result.