Chapter 1 Introduction

Transportation problems arise frequently in areas with high population density. Examples that come to mind are people standing in line for services, traffic congestion on roads, and overcrowded public transportation. Many of these problems become accentuated when notable events occur, such as concerts, people going on holidays, and traffic accidents. Designing an infrastructure with these potential problems in mind can certainly minimize the troubles they cause. However, infrastructures are typically designed with a particular context in mind and consequently do not respond well to serious changes in the area, such as an increasing number of people. Costs are high when roads have to be expanded, changed, or constructed, and maintenance costs increase as roads more regularly need to be renewed when the everyday traffic in the area increases. For these reasons, it is advantageous to achieve better utilisation of road networks, such that costs of overburdened roads can be lowered as well as saving time for the people stuck in traffic congestions. This leads to an initial problem for this project: How can we analyse traffic to detect current and possibly future problems, such that initiatives for alleviating them can be considered.

Læs intro. Måske nogle ting her, der tilhører relevans. Skal vi havde noget med hvordan det påvirker folk physik

Chapter 2 Problem analysis

2.1 Relevance

Estimates show that the number of cars in the world is increasing year by year.This leads to an increase in traffic congestions, which in turn increases the need for more efficient traffic flow systems.

Cite source: http://wardsauto.com/ar/w

As mentioned in 1 there are several problems related to traffic congestion, such as:

- Wear on heavily trafficated roads
- Pollution
- Waste of work hours
- Stress

If the traffic can be distributed more evenly on the whole road network, the overall wear on the roads will be less, and therefore the maintaining of these roads can be more efficiently spaced. This can lead to less congestions, Since these are often a consequence of roadwork, especially on heavily trafficated roads.

@Kristian: fix this section

One of the main things that are desired is to reduce the time wasted when waiting in line at a congestion. The time wasted in a traffic jam is also time that the involved people could have used better, and since this time is also a stress factor for many, then there is a possibility for healthier people.

Pollution

The time spent waiting in line at a congestion, is time wasted. Congestions are often a mean of people getting to and from job, these can lead to stress for many of the drivers.Which again can lead to frustrated drivers that begins to drive reckless.Which can ultimately cause even greater problems in an already congested site. Even if the stress doesn't show as frustrated drivers it might have an impact on the drivers in other parts of their life.

Cite source: (stress-related) http://psycnet.apa.org/journ

Cite source: http://www.sciencedirect.co

2.2 Existing work

The simple way of receiving changing traffic information is through the radio in your car. This method is still a used to inform people if there has been some incident or if there is heavy traffic on some road. Though this is only to inform people and they usually do not suggest alternative routes to avoid the heavy traffic, and the message is typically announced once.

Får radioen information fra tippere på stedet?

Måske skal det her op i introduction

There exists vast ways of planning a route on different devices and there is a lot of research in this field as well, trying to figure out ways to improve the already existing technologies and techniques. The earliest versions of simple GPS-devices, which could aid in finding a route, only considered the shortest path or the fastest path to your destination.

Source?

The recent years there has been focus on trying to predict other things like live traffic patterns and changing conditions on your route.

Source?

In the following section relevant existing technologies and scientific articles will be explored so as to gain insight into the existing work of the problem domain.

Dedicated GPS products

A typical GPS, such as a TomTom device works by using satellites. It locates your position and then locate the point you want to navigate to, then it computes a route on a map, which is usually on a SD-card inside the TomTom device. There is no historical data applied to generate the routes.

It also uses a technology called RDS-TMC (Radio Data System-Traffic Message Channel), which is a service that provides live-time traffic updates to your GPS. RDS-TMC works such that if there is an incident on a road, such as a crash, bad weather or queues it transmits data about this to a central information centre, that further transmit the information to a TMC information service provider. The information service provider encodes the traffic information, and transmits it to a FM radio broadcast where the information is then sent out in RDS signals which the GPS-device receives and decodes to a visual representation.

Web Mapping Services

Google Maps developed by Google is a Web Mapping Service that people can download to their mobile devices such as smartphones. It has a feature

where the suggested routes will be coloured green, yellow or red indicating respectively clear, slow-moving or heavily congested traffic.

Google Maps creates the routes from historical data and live data which is sent by sensors and smartphones. The historical data includes information about what day it is and what time of the day it is, to be able to try to predict if there can occur traffic jams. The live data which are sent by sensors are placed by the government or private companies who gather traffic information, where the live data from the smartphones are from people who are driving on the roads, reportinghow fast they are moving on a particular road. The map is not hardcoded on your device, but depending on your route and your whereabouts, segments of a map is downloaded to your device.

source

Hvordan? Rapporterer enheden selv, eller skal man indtaste

Intelligent Transportation Systems

So far we have discussed the more or less chronological order of popularity of transportation systems technologies. However these devices rely on relatively simple route planning mechanisms. Now, we turn to a more advanced form of transportation system, namely the Intelligent Transportation Systems. An Intelligent Transportation System is a broad term, describing a system that provides traffic services, such that different kinds of users can better utilize transportation networks. This implies, that ITS are not necessarily 'intelligent', as to act and make decisions for the users, but can be more of a tool for users to assist in making smart choices.

Mere eller mindre selvskreven definition, måske anvend definition fra ITS handbook

Obtaining traffic data

Any ITS must consider some data if it is to be of any real use for the user. Obtaining data is therefore one of the aspects of such a system. [1] describes fixed sensors on a road network, as a means to obtaining data about the passing traffic. However most of these sensors and detectors suffer from performance issues related to the changing conditions in the surrounding environment. Furthermore the fixed type of sensors are often expensive to implement and maintain[1].

Fixed sensors - Detectors on roads, identifying vehicles by unique id (need source)

Mobile probes - Triangulation through cell-towers- GPS-based methods

Cite a source

Cite a source

Cite Morten's source

(cars are either equipped with mobile GPS device, built-in GPS device, or GPS-enabled smartphone etc.) - Built-in systems on vehicles (p2p network of data exhange of vehicles, sensors on cars to detect and exhange data of other vehicles, streetsmart traffic) - Mesh network of cars

Analysing traffic data

* When data i readily available for an ITS, the system must perform some kind of analysis to determine useful information about transportation networks. Blablaproposes to partition road networks into road segments, such that information relevant for each segment is linked with the respective segment. How can traffic data be analysed? - Traffic states - Road segmentation, city segmentation - Statistical data about road segments

Cite a source

2.3 Current limitations

This sections will examine the limitations of this kind of system. These limitations can be fx. security, data collection and privacy. This section will not propose a solution for these problems but focus on illuminateing them.

What are the limitations with building a smart GPS system. Data collection are the most important, for without the data there are no system. There are different ways of collecting traffic data where privacy is not a concern because there are no way of difference one car from the other. The drawback of these methods are that they are so costlig in setup and maintenance. Another problem is that they are static, this means that we only get the data for a small area around the measuring equipment. So there are no way of finding flow pattens for larger areas.

måske indsætte et billede

Then theres is the mass of data need for the system to function. If the data pull is'n larges enough and cover a large enough area, then the 'presistion' of the system goes down.

Another way of collecting data is for the is for the drivers to supply them. This then raises the question if they are willing to do so. This then becomes a question about if they fell the possible downside outweigh the benefits.

2.4 Methodology

For the project we will be using a GPS data set from Beijing from 10.000 taxies over a period of a week, as our historical data. A problem regarding this data is the short time span, since it does not cover holidays, or other special days, which are often at fault for massive traffical problems. We are also going to use a large data set from Beijing to simulate real-time data, this data was gathered over a period of 5 years, and include a testbase of 182 people.

2.5 Solution criteria

There are several criteria to evaluate a solution from such as: Is the average speed on the normal congested road improved Is the cars using the navigation getting to their destination in a optimal way, not having to drive a massive detour, Is the traffic distributed in a good manner over the whole road network Is the time spent in congestions reduced

There are some crucial criteria for the route: It has to get the vehicle from it's start point to it's destination, using the existing road network, and it has to comply to the restrictions that the roads have

2.6 System Overview

The system shown in figure 2.1 are our current vision for the system.

The flowschart shows how the user inputs their destination at the start, which sent to a central server together with the source start address. Ther server then uses the data to calculate a route based on the request. The route calculation is based on a initial model of the roadnetwork, such as speedlimits and other restrictions on the roads, and also historical data that have been gathered over time from the users. The route is then sent back to the user, while driving the user will send data back about the drive, this will be the GPS points of the route. This information is then processed and analyzed to check if traffic conditions are as they are supposed to be, and if not the information can be used to recalculate routes for all the drivers which are passing through a that given segment.

So there are 2 processes involved in keeping the data for the map realistic:

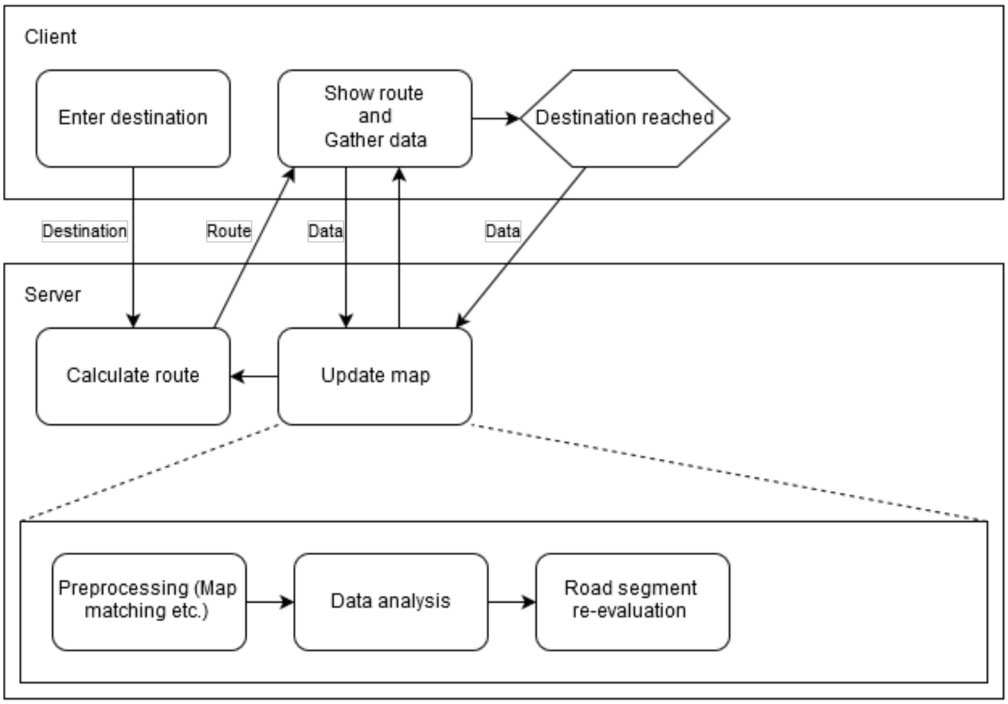

Figure 2.1: A course grained system overview.

- Traffic pattern analysis of historical data
- Live traffic data analysis

The main idea of the traffic pattern analysis is that the data gathered over a given period, at some point will be bulk processed to see if traffic patterns keep the same. Such that the system allways have the best image of the traffic for a particular day, and use these patterns for the best route calculation.

The live traffic data analysis is used check if there are any abnormailties at a given segment, and then being able to propagate this to devices that are going through that segment. Eventually redirecting drivers such that they don't end up at a congested segment, unless nothing else is possible.

2.7 Problem formulation

Can traffic patterns be identified by analysing live as well as historical GPS-data of moving vehicles, giving a more understandable picture of the traffic

situation, such that road networks can be better utilised?