Real-Time Vehicle Monitoring System for Helsinki

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Abstract

In the high-tech generation that we live in, it is important to have a real-time view of the traffic. In this direction, there have been a lot of movements from google maps to public transportation apps. The primary concern of our project is the real-time monitoring of the vehicle. This project is designed to monitor and provide the user with useful routes in Helsinki, via public transportation.

Introduction

A tracking system for vehicles has become a necessity in our current era due to the increasing number of vehicles on the road and the continuous advancements in technology. Most common among such systems are based on GLONASS or GPS to locate one car, but in recent years other methods have been added such as using image recognition with the help of machine learning technologies.

These types of tracking approaches are categorized in 2 ways: *passive* and *active*. The first type contains devices that gather data such as GPS location, destination, speed etc. The active ones also store the same information, but also broadcasts the data to a computer, a phone or data centers in real-time. Nowadays, most of these devices are a combination of those two described, resulting in an application that is always available. Even when a network connection is nonexistent, the data is being stored in the internal memory and it will be later transmitted to the server when the connection is restored.

A central dispatch center and two-way radio communication in each vehicle are the usual methods for tracking the movement of commercial fleet vehicles. Police departments, delivery firms, and taxi fleets all employ this method around the world. The usage of a two-way radio communication device requires the driver to remove one hand from the steering wheel, diverting their attention away from the road and posing a severe potential hazard on today's congested highways. Fleet operators frequently employ vehicle tracking systems for fleet management purposes such as routing, dispatch, onboard information, and security. Monitoring driving behavior, for example, by an employer of an employee or a parent of a teen driver, is another application. Vehicle tracking systems are also common in passenger cars.

Monitoring driving behavior, for example, by an employer of an employee or a parent of a teen driver, is another application. As a theft prevention and retrieval technology, car tracking systems are also common in consumer automobiles. The stolen

vehicle can be found by simply following the signal provided by the tracking system. A Vehicle Tracking System can be utilized as an addition to or replacement for a typical automobile alarm when employed as a security system. The existence of a car tracking device can therefore be used to lower insurance costs because the danger of a vehicle being stolen is greatly reduced.

Existing solutions

Both consumer and commercial vehicles can be outfitted with RF or GPS units to allow police to do tracking and recovery. In the case of LoJack, the police can activate the tracking unit in the vehicle directly and follow tracking signals.

Haulage and Logistics companies often operate lorries with detachable load carrying units. The part of the vehicle that drives the load is known as the cab and the load carrying unit is known as the trailer. There are different types of trailers used for different applications, e.g., flat bed, refrigerated, curtain sider, box container.

Navigation devices frequently receive traffic reports on the Traffic Message Channel (TMC). TMC messages have several sources: the police, permanently installed sensors like traffic cameras or inductive loops, and traffic reports of volunteers. In 2007, Google extended Google Maps by adding Google Live Traffic, the visualization of traffic information in real time. In contrast to TMC, Google uses position data of smartphones with the Android operating system, which results in a significantly faster mapping of the traffic flow. This data is called floating car data (FCD). Position data is determined by the navigation system or, as in the case of Google Live Traffic, by the smartphone and is transmitted to the service provider via a mobile phone connection. Compared to TMC, this allows the generation of traffic information in real time.

In the same year, as part of the Google Street View project, Google took pictures from the street perspective with the help of specially equipped vehicles. At the same time, the vehicles saved position information of wireless routers. Routers can be clearly identified by their MAC address and SSID. The traffic flow data is not only visualized by Google Maps but, since 2011, has also been used to optimize route calculation in Google Navigation. Traffic jams can therefore be detected in real time and avoided.

Proposed implementation

As earlier mentioned, our project is focused on monitoring the public transportation in Helsinki. The goal is to be able to get the route from a specified location to the desired destination. We are displaying the routes on a map using Leaflet. Route planning algorithms and APIs are provided by Open Trip Planner (OTP). OTP is a great solution for general route planning but in order to provide top-notch journey planning other components such as Mobile friendly user interface, Map tile serving, Geocoding, and various data conversion tools might be needed.
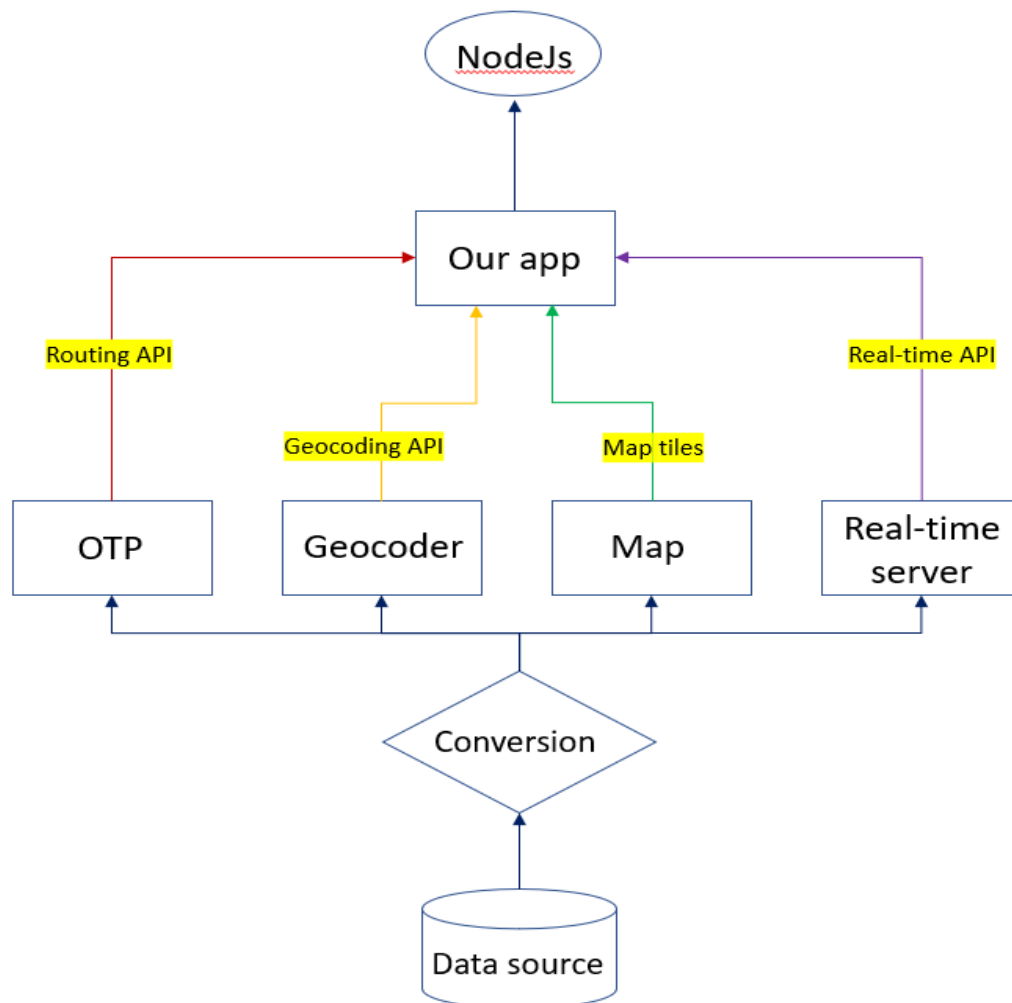
APIs:

- Routing API - Routing API (OpenTripPlanner) provides a way to plan itineraries and query public transport related information about routes, stops and timetables.

- Geocoding API - Geocoding API provides a way to perform address searches and address lookups (also known as geocoding and reverse geocoding).

- Map API - Provides raster map images (background map tiles) as well as vector map tiles for stops and other points of interests like ticket sales positions, city bike stations and park and ride areas.

- Real-time API - high frequency positioning - Provides real-time vehicle locations in a JSON format over MQTT.

Our app has two types of components: UI and API Service components. User interface is a responsive application built with JavaScript and HTML. Application connects to NodeJS server and then to backend APIs.

Because the purpose of the app is to monitor the public transport fleet in the region of Helsinki, some search fields were implemented:

1. Transport Mode - select only one type of vehicles: bus, tram, train, ferry, metro or ubus (subway bus replacement)
2. Operator ID - show only vehicles operated by a certain entity. The code should be 4 digits long, so add 0s before the actual code (e.g. 0012 for operator 12)
3. Vehicle Number - show only a certain vehicle on map. The code should be 5 digits long, with 0s (e.g. code 01215 for vehicle 1215)
4. Route ID - show only vehicles on one route. The code should be 4 digits longs, with a digit between 1-9 and eventually, 0s (e.g. 1001 for route 1, 2113 for route 113)
5. Direction - either 1 or 2, because each route has 2 directions

The operators in the Helsinki region are:

Operator ID	Name
12	Helsingin Bussiliikenne Oy
17	Tammelundin Liikenne Oy
18	Oy Pohjolan Liikenne Ab
20	Bus Travel Åbergin Linja Oy
21	Bus Travel Oy Reissu Ruoti
22	Nobina Finland Oy
30	Savonlinja Oy
36	Nurmijärven Linja Oy
40	HKL-Raitioliikenne
47	Taksikuljetus Oy
50	HKL-Metroliikenne
51	Korsisaari Oy
54	V-S Bussipalvelut Oy
58	Koillisen Liikennepalvelut Oy
59	Tilausliikenne Nikkanen Oy
60	Suomenlinnan Liikenne Oy
89	Metropolia
90	VR Oy
195	Siuntio

Conclusion

From the experience of currently launched apps, people acknowledged the fact that these types of systems are a must in our fast-changing lives. Since there are a lot of ways, we can receive data and process it, we can now determine multiple factors that affect the live traffic, such as accidents, congestions, fuel consumption and more. With our app, we calculate the route we can take with a public transport in Helsinki.