Realizing Seamless Travel through a Seamless Backend Service

By Ilkka Pirttimaa

Introduction

Since smartphones have become accessible, blind and partially sighted people, too, have been using mainstream navigation apps. In contrast to sighted users, however, they require additional information to travel safely and independently. To this end, various outdoor and indoor orientation and navigation apps for this specific user group have been created. They are based on different mainstream maps (commercial, crowd-sourced, POI data from social networks), but provide additional information for example description of intersections. Some of these apps were developed by very small teams, some even by only a single developer. Yet, all of them had to solve similar problems, for instance finding a good source for map data and extracting as much as possible additional information required by blind and partially sighted travelers.

In this report, I will lay out my ideas as to how relevant map data and services could be made available and shared, to allow all interested developers to include information from multiple sources in their apps. I will first describe current challenges concerning different kinds of data (outdoor, indoor, and public transport live data). Then, I will describe how all this information could be made available through just one backend service, for example Ningo, if Ningo's scope could be extended to include data from multiple sources and services.

Data

Outdoor Map Data

Currently, outdoor information includes streets, intersections, and points of interest. One free source available for this kind of information is OpenStreetMap. OpenStreetMap will become more and more important, because other providers of location data services such as Google places and Foursquare will soon require payment for use of their information. In contrast, OpenStreetMap includes free and open location information data collected and updated by volunteers. Access to this information can be expected to remain free, making OpenStreetMap the best and safest source of free outdoor map data.

Indoor Map Data

Indoor Mapping Data Format

Apple have created an open standard to map indoor spaces called IMDF (Indoor Mapping Data Format), relying on the GeoJSON specification. GeoJSON is an accepted standard for vector data that can be used to map indoor and outdoor spaces, and it allows to include additional attributes. Apple have defined attributes necessary for indoor mapping, for instance floor index, floor, name, website. Apple have also created plug-ins that can be used to export this kind of information. Resulting files are owned by the holder of the premises, and Apple currently do not provide a service to host these files. Now, how can this data be made publicly available?

Using OpenStreetMap Data Indoors

As discussed earlier, OpenStreetMap would be an excellent source of map data, but what would be an easy way for clients to use this information indoors? Ningo could be the solution. The WikiBeacon project, which can be accessed through Ningo, contains Bluetooth beacons located all over the world, listing their longitude and latitude, their UUID, and their major and minor numbers. This data allows to

determine a user's position on the globe but gives no information as to what place they are at or what is in their surroundings. However, Ningo complements this information by looking up, on a weekly basis, the points of interest that are located within a 40 meters radius of each beacon listed in the database. Ningo also provides SDKs for iOS and Android developers, allowing them to use beacon information in their applications.

It remains to be seen, however, if this information is sufficient for successful indoor location and navigation, because it does not include important data such as beacon manufacturer, beacon model, power setting, mode of beacon (proximity or triangulation).

- Beacon manufacturer and model: affect at which distance beacon is detected. Sometimes even different models from the same manufacturer may yield different results. Best results can be achieved by using the manufacturer's SDK.
- Power setting: affects range of beacon.
- Proximity mode or triangulation mode: affects if points of interest are indicated by a dedicated beacon each, or if POI are located between different beacons.

Still, I consider Ningo to be an excellent basis and would like to see it tested in different use cases. As its API allows for additions to each beacon entry, a system could be implemented where users and orientation and mobility specialists could suggest additional information relevant to blind and partially sighted travelers.

Public Transport Live data

Public transport is crucial for blind and partially sighted travelers. A navigation app geared towards these customers should not only inform about the location of train station and bus stops, but also provide easy access to bus and train schedules, as demonstrated in this BlindSquare video. BlindSquare fetches this information using a number of third-party APIs. However, this feature is only available in Scandinavian countries as well as in the UK and New Zealand. Providing public transport information requires integration of feeds of local public transport providers. Unfortunately, this is not scalable if data from numerous regional, national, and international sources is to be included.

Locating Travelers

Outdoors, GPS can generally be used to determine the user's location. Indoors we can rely on Bluetooth beacons or Wi-Fi.

Apple's Indoor Maps

Apple's Indoor Maps is based on Wi-Fi and fingerprinting of buildings. It is easy to implement for developers. Just as GPS, it returns the user's latitude and longitude, as well as the floor they are currently at. The user is located via Wi-Fi once per second. Indoor Maps is not directly related to IMDF. Indoor Maps allows to determine the user's location, while IMDF is merely a standard to organize data describing locations. Even Android applications could use IMDF data, but would have to rely on either beacons or GPS (where available) to determine the user's location.

Locating Travelers via Beacons

Relying on Bluetooth beacons entails several problems.

Firstly, apps can recognize beacons by their UUID, a long string of numbers and characters broadcast by each beacon. However, at a specified location an IOS app can only "listen" to a maximum of 20 UUIDs at once. If, at a venue, there are more beacons in the vicinity than the ones relevant for navigation, how will an app "know" which of the available beacons are important? This could be solved if apps could

connect to a database, for example Ningo. If the user is at a specified location, BlindSquare or other apps could query Ningo to learn what beacons to "listen" to at this location.

Secondly, although the Bluetooth standard is well recognized, Bluetooth can be interfered by other signals. Apple seems to have put a lot of effort into making sure that both older and newer devices detect beacons similarly, E.G. iPhones and iPads will recognize a beacon at approximately the same distance, even though a newer iPhone or iPad may have a better antenna. Unfortunately, this is not true for Android devices. As there are many manufacturers of Android devices, there is a multitude of different models, all with different configurations. All of these may, for example, "recognize" the same beacon at different distances. This makes it nearly impossible to install an indoor navigation solution where one beacon fleet is used by both iOS and Android devices and, at the same time, ensure the same user experience for everyone, regardless of whether they have got an Android device or an iPhone.

Putting It All Together

I suggest that all the information relevant to blind and partially sighted travelers i.e. outdoor and indoor map and beacon data as well as public transport data be made available through a common, shared repository, for example Ningo. Ningo could be a backend service: developed together, run together, providing both indoor and outdoor map information as well as live data. As discussed earlier, Ningo already includes beacon information enhanced by OSM data as well as SDKs for app developers.

IMDF Data

It might be worth considering integrating Apple's new Indoor Mapping Data Format (IMDF) into Ningo. This could be realized if GeoJSON files (the format IMDF is based on) could be uploaded to Ningo. Then, this information could be made available through the Ningo service for places where data in IMDF is available. Most likely, these will be venues where Apple have enabled Indoor Maps. Information would probably be returned as raw data and include points of interest, floors, elevators, and other features of the building.

Public Transport Live Data

To make live data from many different sources available to the end user, BlindSquare or other navigation apps will require a service they can query for public transport live data from all over the world. For example, if a BlindSquare user needs public transport information, BlindSquare could query Ningo, which in turn would fetch the information from the relevant public transport provider and transmit it back to the BlindSquare user through the same API BlindSquare also uses to request general map data.

Providing SDKs

Currently, Ningo offers SDKs for iOS and Android, allowing them to access beacon information stored in Ningo. If Ningo would make available all the information outlined above, access to this data should also be included in the SDKs. A common and shared SDK would help to ensure that apps using Ningo data would interpret data correctly. This is especially relevant where Bluetooth beacons are concerned. Ideally, an app would just send the user's location to Ningo and then all relevant information would be returned through just one API. The heavier the lifting done on the backend service, the easier it would be to create orientation and navigation apps for different platforms.

Going Open-Source

I would like to suggest that creating this common backend service be a shared effort. Code of developer SDKs, APIs and plugins to make map or public transport queries should all be open-source code and be shared on GitHub. This would allow the community to contribute code, create test cases, give feedback, and improve the code.

Conclusion

To promote a seamless outdoor to indoor navigation solution for blind and partially sighted people, I suggest that we consider traveling outdoors, indoors, and by public transport. We should

1. Test if and how well beacon data currently available on Ningo can enhance navigation and orientation indoors.
2. Extend the scope of Ningo to include outdoor and indoor OpenStreetMap data, indoor map data from other sources and in other formats, and also Public transport live data. Furthermore, Ningo should provide SDKs and APIs to allow developers to query Ningo from within their own apps.
3. Turn Ningo into an open-source project to allow the community to contribute code and give feedback.

Developing an extensive backend service covering outdoor, indoor as well as public transport live data will make it easier for developers to create powerful orientation and navigation solutions on various platforms.

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