Autonomous Campus Driver Assistant for Indoor and Outdoor Navigation

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Abstract

College campuses can be large, confusing, and intimidating for new students and visitors. Finding the campus may be easy using a GPS unit or Google Maps directions, but this is not the case when you are actually on the campus. There is no service that provides directional assistance for the campus itself. This project proposes a driver assistant application running on an Android platform that can direct drivers to different buildings and parking lots in the campus. The application's user interface lets the user select a user type, a campus, and a destination through use of drop down menus and buttons. Once the user submits the needed information, then next portion of the application runs in the background. The application retrieves the Campus Map that will be constructed for this project. When the path to the destination has been discovered, the campus map with the computed path overlaid is displayed on the user's device, showing the route to the desired destination.

Keywords
Mobile Computing, QR-code, GPS, RE-presentational State Transfer, Indoor Navigation, Outdoor Navigation,

1. Introduction

Indoor navigation is not a new concept. Many prototypes have been implemented over the last years. However, most of them use some external systems in order to compute the exact position of the device. Relying on external factors for the positioning has the advantage to be really precise but, the setup of the corresponding maps is fastidious since each external factor used for the positioning needs to be placed precisely on a map. Nowadays' smart-phones are equipped with sensors which data can be combined in order to create an autonomous indoor navigation system. Our best feature that distinguishes our project from the previous one is the optional fusion with external factors to re-adjust the current position of the user. In our case, GPS will work for the outdoor navigation and for indoor navigation the external factors are the QR codes that have been placed at strategic spots inside the building. They will use them to retrieve the initial position of the user. User will scan the QR-code to find its initial position and then ask to our application to find the destination. In this manner user will always be in sync with application and system will always get user current position to direct him/her further.

The complete software will be having 2 major components namely college server and a mobile client application. All information about college buildings, class rooms etc. will be kept on server and client application can make use of this information for navigation purpose. Along with navigation information, server will also updated with what activities are scheduled in which class room or building so that user will get more information about what's going on at destination. The client-side of our software architecture consists of an autonomous indoor navigation system for Android that consumes this REST-ful Web service to talk with server.

2. Related Work

1. **Foot Path: Accurate Map-based Indoor Navigation Using Smart phones:** Foot Path, a self-contained, map-based indoor navigation system. Using only the accelerometer and the compass readily available in modern smart phones we accurately localize a user on her route, and provide her with turn-by-turn instructions to her destination. To compensate for inaccuracies in step detection and heading estimation, we match the detected steps onto the expected route using sequence alignment algorithms from the field of bioinformatics. As our solution integrates well with Open Street Map, it allows painless and cost efficient collaborative deployment, without the need for additional infrastructure.
   The main contributions of this are:
   1) **Infrastructure less indoor navigation:** It use simple step detection and step heading detection, which then map onto a route using sequence alignment algorithms. Additional infrastructure, like GPS, UWB, Wi-Fi access points, and RFID can be avoided.
   2) **Localization on a route:** We know the route, the user intends to take. It reduces inaccuracy at corners opposed to further accumulating errors. Path matching is precise enough to allow for accurate indoor turn-by-turn directions.
   3) **Easy incremental deployment:** Deploying the system for a new building simply consists of entering the floor plan into Open Street Map.

2. **An outdoor navigation system using GPS and inertial platform:**
   The use of Global Positioning System (GPS) in outdoor localization is a quite common solution in large environments where no other references are available and positioning requirements are not so pressing. Of course, fine motion without the use of an expensive differential device is not an easy task even now that available precision has been greatly improved as the military encoding has been removed. In this project, present a localization algorithm based on Kalman filtering that tries to fuse information coming from an inexpensive single GPS with inertial and, sometimes uncertain, map based data. The algorithm is able to produce an estimated configuration for the robot that can be successfully fed back in a navigation system, leading to a motion whose precision is only related to current information quality. Some experiments show difficulties and possible solutions to this sensor fusion problem.

3. **Indoor Positioning and Navigation with Camera Phones**

   This low-cost indoor navigation system uses off-the-shelf camera phones to determine user location in real time by detecting unobtrusive fiduciary markers. The indoor navigation system we describe in this article takes advantage of associating locations with markers to provide an inexpensive, building-wide orientation guide that relies solely on camera phones. Whereas previous work on barcode based location tracking, such as QR Codes, relies on non-real-time "snapshot" processing, our approach allows for continuously scanning an environment in real time (15 Hz or more) in search of navigation hints. Thus, navigation scales from sparse, strategically placed fiduciary markers to continuous navigation in 3D.

4. **Indoor Navigation Using Smart phones**

   This project is for implementation and analysis of the usage of smart phone sensors for indoor navigation, without the use of Global Positioning Systems. This is to extend advantages of outdoor navigation for indoor navigation, by making use of existing technologies and devices to facilitate navigation for achieving this, without the use of extra/expensive hardware.

   Inertial navigation systems for positioning, that is, using sensor data from accelerometers and gyroscopes for accurate detection of movement. An INS system typically needs an accelerometer to measure motion, a gyroscope or similar sensing devices to measure direction, and a computer to perform calculations. The position relative to initial position can be calculated from the accelerometer measurements, which provides movement information relative to a previous location. With the accelerometer alone, the system could detect relative motion. The use of additional hardware such as a compass is necessary to tell the direction of movement. The output of the accelerometer is a measure of the acceleration in three dimensions; the velocity in an inertial reference frame can be calculated by integrating the inertial acceleration over time. Then the position can be deduced by integrating the velocity.

3. Conclusion

Mobile Autonomous Campus Navigation Application with indoor outdoor navigation is an application with unique functions and properties that delivered in a well user friendly way to typical users of the system. It apparently gives the user productivity with the combination of technical and user requirements in advance. This system is being introduced to enhance the user satisfaction and ease the self-touring experience within the college campus.

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