Using multiple sensors to improve indoor localization accuracy and classify user's moving behavior

Students

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Description

We want to focus on implement a mobile sensing system for indoor localization.

Localization component

With the growing popularity of GPS modules embedded into mobile devices, outdoor localization is much more accurate than before. However, GPS signal has a drawback; one can locate himself only if the GPS satellites are directly in the user's line of sight, this means that if the user enters a building, GPS signal level will be greatly reduced, and leading to the inaccuracy of location info.

Our project aims at providing a solution of indoor localization. We've already searched several papers related to indoor localization by using smart phone ([1],[2],[3]). [1] is a good starting point and we aim our goal to have accuracy within 2 meters, utilizing all kinds of built-in sensors in current mobile devices, such as GPS, gyroscope, compass, wireless module, etc. In the online-version proposal, you mention that "as part of the PhoneLab project, we have made significant improvements over Android baseline proximity service to make it energy-efficient, easier to use, and precise." The difference between existing approach and our approach is that we want to use the method described in [2] paper to form a unsupervised indoor localization scheme by pass the need for human interaction (without using the localization tag but localization tag may help us to recognize the place).

Reminding component

When user upload those sensor data, we can perform data clustering with those data and abstract a high level feature. This step is same as the one we described on schedule section (3). But instead of using this result to do indoor localization, we can also use the result to clustering students with similar features.

Time table & Schedule

Our project approach for this part is described as the following:

Date	Mission
Before March	Set up github page (blog), set up basic development environment (Eclipse, Linux server)
Mar.1 - Mar.15	Develop android app to collect smartphone sensor data (Wifi, gps, compass,gyroscope). For server side, provide API and protocol to save and transmit those data
Mar.16 - Mar.31	Let the android app provide more accurate sensor data (filter out noise).UI design and develop. For server side, process those sensor data and clustering it (on sensor features and locations)
Apr.1 - Apr.30	Using clustering information and decision tree to detecting seed landmarks and form a new organic landmarks. Send back information to user side and display. Do experiment on how accurate (meter) this system can provide. Do experiment to see whether this system can self-evolved and achieved a better result after running few weeks.

Milestones

1. Programming Android phones to obtain all the sensor data (without consider the energy cost) and send to a server with timestamp.
2. Server abstract the sensor features and cluster it.
3. Server map those cluster on sensor features to locations of cluster members.
4. Server form a new organic landmarks (you can think it as an automatically generated location anchor) by using those info.
5. Server using decision tree for detecting seed landmarks (you can think it as an user tagged anchor).

Si Chen will focus on server side (Machine Learning part) and Junfei Wang will focus on Android development.

About the Result & Demo

We will mark each step described above as a project milestone and use github to organized our project. If everything goes smooth, at the end of this semester, we can create an app which can automatically pinpoint user's indoor location (assume we already have the floor plan). The final app may be able to classify a student by those sensor data. Like the app will show this is an "active" "Electrical Engineering" "driver" student.

0.1 Demo

We will collection sensor data on Davis 3rd floor.

In the end of this semester we will perform our demo by showing an app running on an android phone which can show whose office or lab the user is approaching (Dr.Demirbas - Room 313, Dr.Regan - Room 326, Dr. Selman - Room 349, PhoneLab etc..). We assume we have the floor plan in advance, but the location fingerprint is formed by our algorithm not manually added.

Contributation

Our work will greatly help smart habit project by improving the accuracy of indoor localization and provide a way to classify user's daily behavior by using smartphone's sensor data.

Ambition

We are aiming for grade A!

References

[1] Azizyan, Martin and Constandache, Ionut and Roy Choudhury, Romit, "SurroundSense: mobile phone localization via ambience fingerprinting," MobiCom '09, 2009.

[2] Wang, He and Sen, Souvik and Elgohary, Ahmed and Farid, Moustafa and Youssef, Moustafa and Choudhury, Romit Roy, "No need to war-drive: unsupervised indoor localization," MobiSys '12, 2012.

[3] Yang, Zheng and Wu, Chenshu and Liu, Yunhao, "Locating in fingerprint space: wireless indoor localization with little human intervention," MobiCom'12, 2012.