Demo: Unsupervised Indoor Localization

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ABSTRACT

We propose UnLoc, an unsupervised indoor localization scheme that bypasses the need for war-driving. Our key observation is that certain locations in an indoor environment present an identifiable signature on one or more sensing dimensions. An elevator, for instance, imposes a distinct pattern on a smartphone's accelerometer (see Figure 1); a corridor-corner may overhear a unique set of WiFi access points; a specific spot may experience an unusual magnetic fluctuation. This form of urban sensing and activity recognition has already been demonstrated in literature [1, 2], but not yet applied in pure localization applications. We hypothesize that these kind of signatures naturally exist in the environment and can be envisioned as internal *landmarks* of a building. Mobile devices that "sense" these landmarks can recalibrate their locations, while dead-reckoning schemes can track them between landmarks. Neither war-driving nor floorplans are necessary - the system simultaneously computes the locations of users and landmarks, in a manner so that they converge reasonably quickly. We believe this is an unconventional approach to indoor localization, holding promise for real-world deployment.

1. DEMONSTRATION

We previously designed and conducted real-life experiments with 3 different users in 3 different university buildings - Computer Science, Engineering, and North Gate shopping mall. We covered approximately $1750m^2$, $3000m^2$, and $4000m^2$ respectively, in these buildings. Each user walked around arbitrarily in the building for 1.5 hours, covering multiple floors; they carried 2 Android NexusS phones with UnLoc, one in the pocket and another in the hand with the screen facing up. The results of those experiments are shown in Figure 2. The mean instantaneous localization error for those experiments was within $1.69m$.

We propose a live demonstration of the UnLoc system, similar to the ones conducted previously, to show its localization capabilities. We will conduct this demonstration on site at the Low Wood Bay hotel. Prior to the day of the demonstration, we will bootstrap the system; this entails having multiple people walk around various parts of the hotel carrying phones with UnLoc in order to generate a database of landmarks.

On the day of the demonstration, we will invite demo participants to walk around the vicinity while holding Android NexusS phones installed with our system. They will be able to track their location on the screen of their phone through a floor map display. Meanwhile, other participants at the demonstration site will be able to view a more detailed graphical display, showing the location of every user on a floor map as well as the location of the landmarks that were generated beforehand.

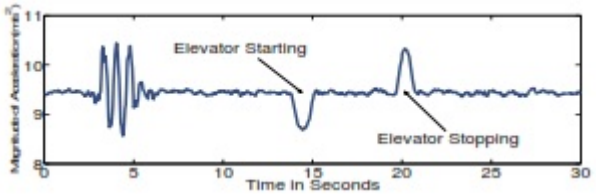

Figure 1: Accelerometer signature inside an elevator (caused by the elevator starting and stopping).

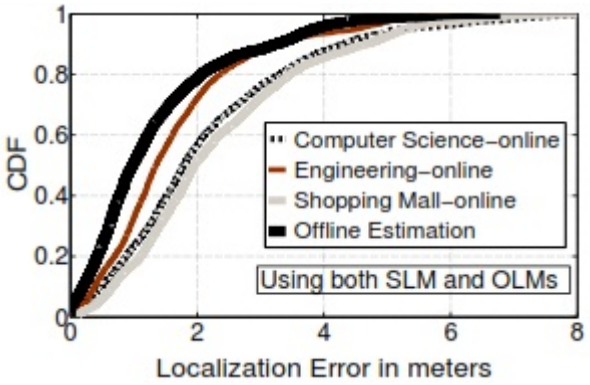

Figure 2: CDF of localization using both SLMs and OLMs

2. REFERENCES

[1] J. Chung et al. Indoor location sensing using geo-magnetism. In *MobiSys*. ACM, 2011.

[2] L. Bao and S. Intille. Activity recognition from user-annotated acceleration data. *Pervasive Computing*, pages 1–27, 2004.