Demo: I am a Smartphone and I can Tell my User's Walking Direction

Nirupam Roy
University of Illinois at Urbana-Champaign (UIUC)

He Wang
University of Illinois at Urbana-Champaign (UIUC)

Romit Roy Choudhury
University of Illinois at Urbana-Champaign (UIUC)

1. ABSTRACT

We present a demonstration of WalkCompass, a system to appear in the MobiSys 2014 main conference. WalkCompass exploits smartphone sensors to estimate the direction in which a user is walking. We find that several smartphone localization systems in the recent past, including our own, make a simplifying assumption that the user's walking direction is known. In trying to relax this assumption, we were not able to find a generic solution from past work. While intuition suggests that the walking direction should be detectable through the accelerometer, in reality this direction gets blended into various other motion patterns during the act of walking, including up and down bounce, side-to-side sway, swing of arms or legs, etc. WalkCompass analyzes the human walking dynamics to estimate the dominating forces and uses this knowledge to find the heading direction of the pedestrian. In the demonstration we will show the performance of this system when the user holds the smartphone on the palm. A collection of YouTube videos of the demo is posted at `http://synrg.csl.illinois.edu/projects/localization/walkcompass`.

2. SYSTEM OVERVIEW

The core intuitions in WalkCompass are based on simple analysis of walking dynamics and can be explained with the following key points. First, we performed an analysis of human walking patterns that helps us understand how different forces act in different directions to keep the human body stable during a walk. We found that, when a user walks, her heel strikes the ground creating a distinct vibration that resonates through the entire body. This vibration reflects on the accelerometer data across all holding positions, even when the user is holding the phone against her ears. WalkCompass uses this vibration as a reference, scans the signal backwards, and extracts specific samples from a time window when the body's movement is dominantly in the heading direction. These samples represent the user's motion vector. The signal is then processed with the gyroscope data to compensate for instability of the phone's coordinate system. This motion vector is projected to the plane orthogonal to gravity, and averaged over few steps to converge upon the *local* walking direction.

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3. DEMONSTRATION

WalkCompass has been implemented on Android, using the Jellybeans version, and tested using a variety of Samsung phones. Figure 1(a) shows a screenshot of the tentative application with the (thicker) gray cone showing the compass direction; the (thinner) green cone denotes the user's walking direction. The width of the cone is proportional to the variance of error in the walking direction – a useful visualization for debugging in real conditions. In the demonstration we will have the WalkCompass application running on smartphones. The users can walk with a smartphone in hand and can observe the application indicating the correct walking direction on the screen, despite changes in orientation of the smartphone. We have observed that WalkCompass can estimate the walking direction even when the user is walking backward. Figure 1(b) shows a QR code for the WalkCompass webpage [2].

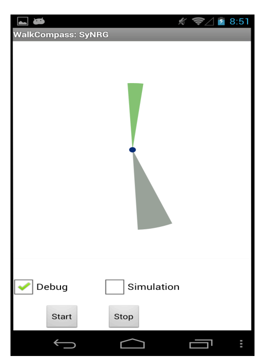

Figure 1: (a) WalkCompass screenshot. (b) QR code for WalkCompass demo.

4. REFERENCES

[1] N. Roy, H. Wang, and R. Roy Choudhury, "I am a smartphone and i can tell my user's walking direction," in *Proceedings of the 12th international conference on Mobile systems, applications, and services*, ACM, 2014.

[2] "Walkcompass demo." `http://synrg.csl.illinois.edu/projects/localization/walkcompass`.