Poster: M-SEven: Monitoring Smoking Event by Considering Time Sequence Information via iPhone M7 API

Bo-Jhang Ho and Mani B. Srivastava
Networked and Embedded System Lab
University of California, Los Angeles
{bojhang, mbs}@ucla.edu

1. INTRODUCTION

Smartphones are equipped with various sensors that provide rich context information. By leveraging these sensors, several interesting and practical applications have emerged. Accelerometer data has been used, for example, to detect transportation [3], exercise activities [2], etc. A typical approach is to classify activity directly based on features extracted from raw sensing data. Cheng *et. al.* implemented a different approach by using two-stage classification: the system first detects several sub-behaviors, and uses the combination of attributes to infer higher-level behaviors. Built upon this approach, we foucus on exploring the *time sequence* of activities, which is an underexplored, yet natural and information-rich indicator. In this work, we explore this time sequence concept through detection of smoking events.

In the public area, smoking is usually prohibited. Thus, smokers normally go to outdoor areas with fewer passerbys to smoke. Instead of detecting bio-signals through wearable sensors [1], we leverage movement patterns as indicators; smokers normally start from a stationary state (either the phone is on the desk or in their pocket), walk to the smoking spot which is usually outdoors, stand there for several minutes, then go back to their working area and resume stationary state. Although there are various activities with similar patterns that might cause false positives, e.g., buying lunch from an outdoor food truck, we believe there are subtleties in the sensor data to distinguish them apart, e.g. differences between standing casually (smoking), versus moving periodically when waiting in line (food truck). In this work we demonstrate the detection of the smoking movement pattern through data collected from the primary phone of one smoker for two days.

2. METHODOLOGY AND RESULT

We use iPhone 5S to collect the data from people's daily activities. The system collects 1) location information and 2) activities by M7 API. We use coordination accuracy to distinguish indoor from outdoor. An error larger than 20 meters is considered an indoor activity in our experiment. By querying M7 API we can get a list of records as activity history. Each activity record has attributes in a combination of the four states: *is_stationary*, *is_walking*, *is_running* and *is_driving*, along with start/end time and three-level confidence. The system overview is presented in Fig. 1. Building on top of these 4 low-level states, we segment into 3 different labels: *stationary*, *standing* and *walking*. We use a rule-based approach to get labels, that is to set thresholds to separate them. In our approach we consider high-confidence records before lower ones. Since there might be outliers, a sliding window filter based on majority voting is applied. Then we combine the same labels into one segment. If the system detects 5 continuous segments as follows: stationary => walking => 2-to-7-minute-outdoor standing => walking => stationary, such a pattern indicates a smoking behavior. Our system successfully detects 10 out of 12 events with no false alarms throughout working hours (8am-6pm).

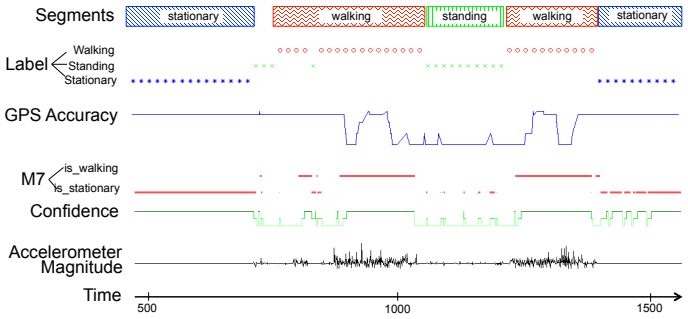

Figure 1: One example of how our system detects the smoking event. We put accelerometer data for your reference only.

3. REFERENCES

[1] A. A. Ali, S. M. Hossain, K. Hovsepian, M. M. Rahman, K. Plarre, and S. Kumar. mpuff: Automated detection of cigarette smoking puffs from respiration measurements. IPSN '12. ACM, 2012.

[2] H.-T. Cheng, F.-T. Sun, M. Griss, P. Davis, J. Li, and D. You. Nuactiv: Recognizing unseen new activities using semantic attribute-based learning. MobiSys '13. ACM, 2013.

[3] S. Hemminki, P. Nurmi, and S. Tarkoma. Accelerometer-based transportation mode detection on smartphones. SenSys '13. ACM, 2013.

MobiSys'14, June 16–19, 2014, Bretton Woods, New Hampshire, USA.
ACM 978-1-4503-2793-0/14/06.
http://dx.doi.org/10.1145/2594368.2601451.