Poster: Smartwatch Knows How Much You Drink

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1. INTRODUCTION

Water accounts for about 60% of the human body, and when the body loses it (e.g., through urine, sweat, etc.) in higher rate than its intake rate (through drinking), dehydration symptoms occur. The dehydration causes many severe health problems like organ and cognitive impairment. Therefore, it is critical for the human to drink water in a sustained manner to avoid dehydration. To prevent humans from dehydration, continuous day-scale tracking of the water intake is needed. Nonetheless, it is challenging as we need to gauge the volume of water the user drink or use smart bottles like [1] to automatically keep track of the water intake.

In the previous studies [2, 3], wrist-worn devices are used to record food and medicine intake. They detected fine-grained human activities such as biting, using utensils during food intake; and opening medicine bottle, pouring medicine capsules during medication ingestion. Also, Amft Oliver and et al. [4] employ highly accurate wrist-worn inertial sensors to recognize fine-grained micro actions during the drinking activity. However, their method employs Xsens sensor which is very expensive and too bulky to be used during daily activities over large time. In addition, it does not target the estimation of water intake amount which is the enabler for potential health assistance Apps.

In this paper, we propose an unobtrusive method to recognize the drinking activity as well as estimate the water intake amount in milliliter scale by leveraging smartwatches. Our basic idea is to track the arm motion and discriminate the drinking activities from the similar hand-based motions like food intake, phone calls, etc. Thereafter, we estimate the water intake amount from the drinking duration. To achieve this, we adopt a two-layer classification architecture (Figure 1). The first classification layer (Macro-activity classifier) separates the drinking activity from other activities (walking, sitting, etc.) by using a large observation window. The second layer (Micro-activity classifier) detects the sequential micro-actions (hold the bottle, drink, and release it) taking place during the drinking activity using a smaller window.

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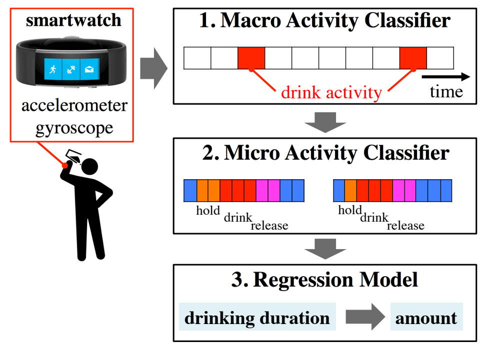

Figure 1: System Architecture

Both classifiers are conditional random fields which are built upon different statistical features from the gyroscope and accelerometer values. Finally, the amount of water intake is derived from the drinking-gesture duration through a regression model.

We validated our work by collecting 450 minutes dataset of seven different activities from six subjects using Microsoft band smartwatches. The results show that precision and recall of macro-activity recognition are 0.879 and 0.907 and for micro-activity inference are 0.890 and 0.906. Also, the system has the relative error of 15.2% in the estimation of water intake amount. These results indicate that our method is promising for recognizing drinking activity and tracking daily water intake. Currently, we are expanding our method in different directions including collecting larger dataset in the wild, using heterogeneous smartwatches, among others.

2. REFERENCES

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