

Enabling Implicit Interaction in Wearable Applications: Don't use sensors only for one task.

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Abstract

Although, today, a broad range of sensor technology is already available that ranges from simple temperature sensors to complex acceleration sensors, recognizing context in wearable computing is still challenging. It involves the analysis, filtering, clustering and classification of sensor signals which are getting even more complex when sets of sensors are used to recognize context. However, the availability of context information is important to enable appropriated human-computer interaction (HCI) for wearable applications.

As the idea behind wearable computing is that they are continually worn to support their users, knowing what the users are currently doing allows for guiding them through an application without explicit interaction. Although context recognition with sensors is a popular research topic where many work has already been published [1, 2, 3], an often used approach is to equip the user with as much sensors as possible to record detailed data. However, this is typically done without paying attention to the usability of a wearable application. Thus, users are equipped with a large number of special sensors attached to different areas of the human body, cables etc. Additionally, they have to use interaction devices for operating the application. These circumstances currently neither lead to a better acceptance of wearable computing, nor are they unobtrusive as claimed in the research community [4, 5].

Therefore, we argue not only to increase the number of sensors used for context recognition without any limit, as this will result in loosing usability of the entire application, but to use already existing sensors users carry with them.

Although many interaction devices for wearable computing already have strong sensing capabilities by built-in sensors, they are exclusively used to gather information needed during explicit user interaction. Therefore, we propose to use as much as possible already available on-body sensors, e.g. those of interaction devices, for recognizing context and achieving implicit interaction. The idea is to use interaction device sensors whenever these are temporarily idle, i.e. if not used for explicit interaction. Following this, wearable computers can become more unobtrusive and provide more relaxed movement as the number of devices/sensors needed for an application can be reduced.

To prove the general feasibility of our proposed approach, we built a wearable application used for maintenance. In this application the user is only equipped with one interaction device. This device is a data-glove, featuring a liquid tilt-sensor, micro buttons and a RFID reader. It is used in explicit interaction mode for navigation through a list-orientated user interface. When sensors are idle, they are used for implicit interaction, by recognizing different task activities, e.g. “hammering” or “screwing”. For recognizing these activities with sensors of the interaction device, machine learning was used with a C.4.5 decision-tree classifier. As features for the classifier, we used a standard set including mean, variance and zero-crossing rate. By using these features in our experiments an overall recognition rate of 89.47% was achieved, which is comparable to recognition rates of past work on activity recognition with more complex sensor setups [6].

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