ZhiWo: Activity Tagging and Recognition System for Personal Lifelogs

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ABSTRACT

With the increasing use of mobile devices as personal recording, communication and sensing tools, extracting the semantics of life activities through sensed data (photos, accelerometer, GPS etc.) is gaining widespread public awareness. A person who engages in long-term personal sensing is engaging in a process of lifelogging. Lifelogging typically involves using a range of (wearable) sensors to capture raw data, to segment into discrete activities, to annotate and subsequently to make accessible by search or browsing tools. In this paper, we present an intuitive lifelog activity recording and management system called ZhiWo. By using a supervised machine learning approach, sensed data collected by mobile devices are automatically classified into different types of daily human activities and these activities are interpreted as life activity retrieval units for personal archives.

Categories and Subject Descriptors

H.4 [**Information Systems Applications**]: Miscellaneous; D.2.8 [**Software Engineering**]: performance measures

Keywords

Lifelogging, Activity Recognition, Lifelog Retrieval

1. INTRODUCTION

Sensor technology has become prevalent in recent years as the cost of wireless communication and digital sensing devices decreases. Hence we have seen that more and more people start to use various of sensors for recording their lives, from photo capture to personal healthcare monitors and loggers. The output of such sensing activities is large amount of personal sensor data that, if semantically analysed, has significant potential to provide insights into a personal activity.

Lifelogs can be captured in many distinct ways with an abundance of types of sensors, both wearable and non-wearable. Wearable sensors include Fitbit, Bodymedia, GPS locator, Looxie, mobile phones, biomedical wearable textiles, Sensecams, wearable video glasses, etc. Such sensors can record aspects of live activity both individually and socially. An example is the SenseCam, a wearable camera integrated with Passive Infrared (PIR) sensor and accelerometer designed to record scenes we experience[1]. It is also possible to capture data from non-wearable sensors, such as environmental sensors or software sensors to capture our interactions with information. While there are many sources of sensor data, the challenge is in extracting meaningful semantics and providing appropriate retrieval facilities over vast lifelog archives.

Within an Information Retrieval framework, a search engine, such as Google, is a step on the way, in that it allows text based searching of hyperlinked multimedia content, but this is only part of the solution as lifelogs pose major semantic gap challenges that can not rely on the presence of latent human annotations to index content. However, early systems that have been developed show potential of addressing the challenge. Zhou et. al. developed a lifelog events browsing system for group sharing[6]. Lee and Luštrek et. al. both proposed to use wearable sensors to recognize activities[4, 5, 2]. In this work, we develop a browsing interface through a timeline of semantic life activities, called ZhiWo. We propose that the semantic life activities can be automatically extracted from sensor sources present in a modern smartphone (photos, GPS, accelerometer etc.) and that we can automatically segment life activities into a sequence of activities and present in an easy way to browse daily timeline. This could have many potential uses, from healthcare monitoring, to new sources of contextual data for omnipresent information retrieval, to general quantified-self inspired lifelogging. The demonstration presented here is part of a larger project that addresses the creation of a cognitive science inspired, densely linked, hypermedia archive (the MemoryMesh) of life activities that can be browsed and searched in an omnipresent manner using both mobile and desktop devices.

2. THE ZHIWO SYSTEM

ZhiWo is a prototype human activity recognition system based on a concept of "*Knowing Me*". The data source for ZhiWo is a raw sensor stream sampled from a smartphone worn on the body. ZhiWo semantically processes the sensor stream to identify distinct user activities (e.g. walking, resting, commuting, eating, shopping, etc.) based on a machine learning model trained by human annotation of activities on the mobile device. It provides browsing techniques based on an activity time-line view and can support locating specific activities of interest from within large lifelog archives.

2.1 Data Gathering with Mobile Phone

To achieve the greatest accessibility of data gathering for various users, we developed an application for smartphones (Android OS) for collecting lifelogs (see Figure 1). Users col-

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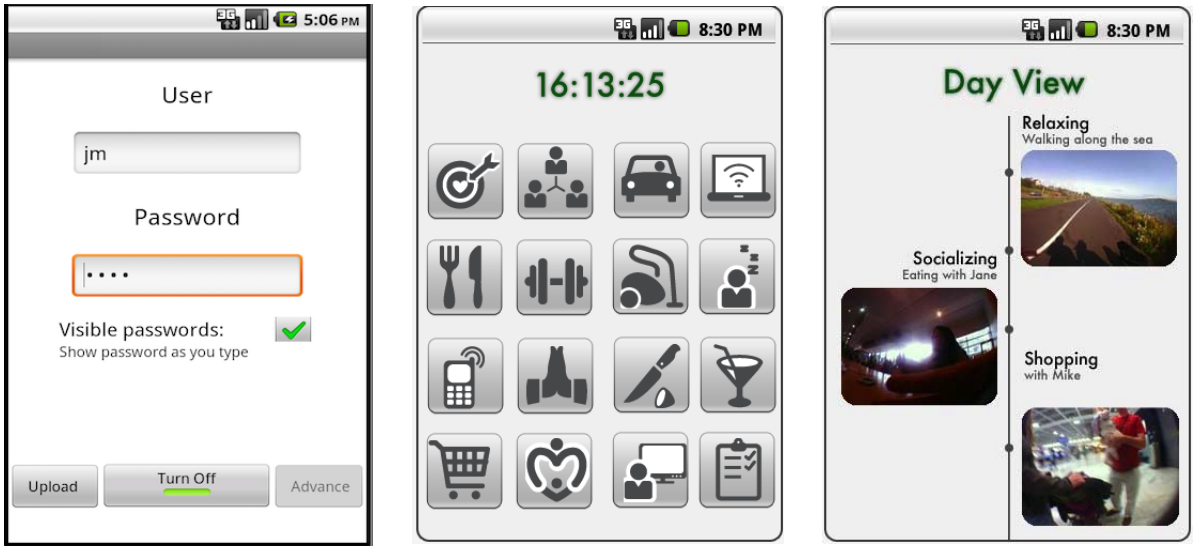

(a) User Login (b) Activity Annotation (c) Activity Timeline

Figure 1: Snapshots of the interfaces of ZhiWo personal daily activity tagging and recognition system

lect data by wearing the smartphone on a lanyard about the neck, or otherwise attached to the clothing in a manner so the smartphone camera is orientated towards the activities the user is engaged in. The data collected includes photos, tri-axial accelerometer readings, GPS, WIFI, bluetooth signals, and ambient environmental measurements such as temperature. This data can be either transferred to the server in real-time, uploaded on demand, or uploaded in bulk upon charging to save the battery power of the smartphone.

2.2 User Annotation of Personal Activities

Our experience shows that personal activity recognition models with supervised machine learning (ML) model outperform naive approaches of setting thresholds. Therefore, we applied a supervised ML method to identify different activities automatically (see Figure 1(b)). The ML technique we employed was an Support Vector Machine (SVM) with a linear kernel. We have identified a set of the sixteen most enjoyable life activities as defined in previous work of Kahneman et. al.[3] and our software automatically identifies appropriate activities, chosen from this sixteen. The source data for training the SVM is the sensor stream data, segmented into events, and the user annotation of life activities, which they can do by identifying their current activities through the interface of the smartphone application.

2.3 Activity Browsing and Retrieval

After training the activity recognition model, we obtain a predictive model to detect real-life human activities and to annotate them with the appropriate labels. The activity recognition output is a timeline of daily activities, segmented into days. Users can correct misclassified activities manually and this acts as an additional source for the activity detection model. As can be seen from Figure 1(c), users can view their past experiences as a sequence of activities across a timeline. Every activity is associated with a timeframe, an automatically selected keyframe image and a label, with a scale of days/months/years and can retrieve past activities according to a chronological or categorical query.

3. CONCLUSIONS

In this paper, we present a mobile platform for users to collect and manage their daily life activities based on lifelog sensor data. The system utilises SVMs to provide a predictive model to detect real-life human activities from sensor data collected from the mobile devices and to annotate them with appropriate labels. The aim of this research is to build a personal lifelog management and retrieval system based on activity recognition for personal life assistance.

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