Chapter 6

An Ontology-based Context-aware Approach for Behaviour Analysis

Shumei Zhang, Paul McCullagh, Chris Nugent, Huiru Zheng

Computer Science Research Institute and School of Computing and Mathematics, University of Ulster, BT37 0QB, Northern Ireland, UK

zhang-s2@ulster.ac.uk

Abstract

Abstract: An ontology-based context-aware framework for behavior analysis and reminder delivery is described within this Chapter. Such a framework may be used to assist elderly persons maintain a healthy daily routine and help them to live safely and independently within their own home for longer periods of time. Behavior analysis associated with the delivery of reminders offers strategies to promote a healthier lifestyle. Current studies addressing reminder based systems have focused largely on the delivery of prompts for a prescribed schedule at fixed times. This is not ideal given that such an approach does not consider what the user is doing and whether the reminder is relevant to them at that specific point in time. Our proposed solution is based upon high-level domain concept reasoning, to account for more complex scenarios. The solution, referred to as iMessenger, addresses the problem of efficient and appropriate delivery of feedback by combining context such as current activity, posture, location, time and personal schedule to manage any inconsistency between what the user is expected to do and what the user is actually doing. The ontology-based context-aware approach has the potential to integrate knowledge and data from different ontology-based repositories. Therefore, iMessenger can utilize a set of potential ontological, context extracting frameworks, to locate, monitor, address and deliver personalized behaviour related feedback, aiding people in the self-management of their well-being.

6.1 Introduction

People are becoming more motivated to maintain their health and avoid illness. Full engagement with regular physical activity may reduce symptoms associated with chronic
diseases such as heart disease and chronic pain [1]. Analysis of behavior and acting upon these offers strategies to promote a healthier lifestyle [2]. Deployment of ubiquitous computing in a smart environment (e.g., intelligent home) has the potential to support the monitoring of activities of daily living (ADLs) and hence provide sufficient data for behavior analysis. Activity monitoring combined with delivery of context-aware reminders has the ability to improve well-being, especially for elderly persons living independently in their home. More specifically, activity-aware reminders can stimulate people to engage in a set of predefined activities and hence improve their behavior.

Current reminder systems normally deliver messages according to a predefined routine, based only on fixed times [3]. With such an approach the system does not take into account what the user is doing and whether the reminder will be useful or relevant to them at that particular point in time. For example, the user may deviate from their normal routine and get up in the morning at 6:50am as opposed to their normal time of 7.00am. Without taking into account such context related information, the system may deliver an alarm and a message to remind the user to get up at a time, when the person is already up and preparing their breakfast. This scenario may be perceived by users as being ineffective and most probably annoying. In order to deliver the reminders effectively, it is necessary to take into account the multiple contexts of the user such as their current location, activity, vital signs and environmental variables such as background noise.

Ontologies have the ability to describe the concepts and relationships that are important in a particular domain, providing a vocabulary for that domain and a computerized specification of the meaning of terms used in the vocabulary [4]. An important technology for a context-aware system is the integration of intelligent agents that utilize knowledge and reasoning to understand the contexts and share this information. Ontologies support the sharing, integration, reuse and processing of domain knowledge [5]. Ontology based solutions have utilized intelligent agents employing knowledge and reasoning to understand the wider context and to share this information in the support of applications and interfaces [6].

In our current work we have developed an ontology-based context-aware approach referred to as iMessenger (intelligent messenger) for activity monitoring and behavior analysis. Within this model a smart phone and intelligent environment were used for data collection. Ontology modeling and querying were used for the behavior analysis and delivery of the context-aware reminders based on temporal relationships between multiple contexts.

The remainder of the Chapter is structured as follows: Related work is presented in Section 6.2 and the ontological context extractions are presented in Section 6.3. Section 6.4 is