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MAGPIE: Mobile computing with AGents and Publish/Subscribe for Intelligent u-hEalthcare

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Introduction

Nowadays, the population is ageing, which together with current lifestyles is contributing to a major prevalence of chronic diseases. In this scenario it is important to provide good healthcare services without increasing associated costs. A prominent way to tackle this challenge is through the application of personal health systems (PHSs), which provide monitoring technologies to patients in order to help them with the self-management of chronic diseases [1]. In this context, agents can simplify the modelling of PHSs as they are autonomous software entities that pursue a set of goals in an intelligent way, by applying artificial intelligence reasoning techniques [2]. In the MAGPIE project we propose the use of multiagent systems (MAS) in PHSs as a solution for monitoring patients affected by chronic diseases.

Aims

Patients' data in current PHSs are analysed in a remote server, a component that is common to all the patients and therefore an inherent bottleneck in the system. In MAGPIE we aim to improve the scalability of current PHSs by moving the computations related to the monitoring task from the remote server to the patients' smartphones. Thus, we are developing the MAGPIE framework, an agent platform for Android with the goal of providing a reusable software solution for the development of PHS. Another goal in the project is to model a cognitive agent mind that can be programmed with specific rules for monitoring different kinds of disease, and which is able to produce alerts according to the patient's vital signs.

The MAGPIE agent platform

The idea behind MAGPIE is that the patient's environment in PHS can be linked to the concept of an agent environment in MAS [3]. In order to integrate in a framework the use of agents in Android, the architecture of MAGPIE is divided into two levels: the Android integration level (AIL) and the conceptual level (CL). The AIL corresponds to all the classes, interfaces, methods, etc. that act as an adapter between the CL and the Android OS. The CL models concepts from MAS to monitor the patient. In particular, we model the interactions between three components: context entities, agents and the agent environment. Context entities encapsulate a source of information from the real world such as a sensor, and produce events related to the physiological measurements. Agents are entities responsible for monitoring the status of the patient according to the events produced by the context entities. Their goal is to produce alerts that are of interest in the particular disease. The environment is a component that mediates the interactions between agents and context entities. This design strategy, with the environment acting as a mediator, shields agents and context entities from the implementation details about each other, as in the publish/subscribe architecture.

MAGPIE agents

To carry out the monitoring task, the agents are composed of two main parts: a body and a mind. The body is a component responsible for connecting the agent mind with the environment, while the agent mind is responsible for producing actions according to the events perceived and how the medical knowledge is modelled in the particular mind. We define two different agent minds: a declarative mind based on Prolog, and an imperative mind based in Java.
The Prolog mind is conceived for monitoring temporal patterns of physiological parameters in chronic diseases. In this kind of mind, a set of monitoring rules modelling physiological patterns can be defined. In the context of a PHS, a monitoring rule is defined as a combination of events that trigger an alert to be notified, where an event is considered as the measurement of a physiological parameter categorised as high, normal or low.
The Behavioural mind is able to run behaviours programmed in Java. Here, a behaviour is defined as a task that can be carried out by an agent in response to an event happening in the environment. An agent can run N different behaviours, and different agents can use a particular behaviour, which makes this approach very modular.

Conclusions

In this article we presented our work on the MAGPIE project. In this project we are developing an agent platform for Android that will help with the development of mobile applications for PHS. Moreover, with this work we aim to improve the scalability of current PHS. We plan to use this

platform in the future with real patients. The source code of the platform is available at: https://github.com/aislab-hevs/magpie.

References

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