Trigger-Action Programming for Context-Aware Elderly Support in Practice

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ABSTRACT

Remote monitoring services should be strongly personalised to the specific needs, preferences, abilities and motivations of elderly, a population segment whose characteristics can largely vary and even dynamically evolve over time for the same individual, depending on changing needs and usage contexts. We present a demo showing how a platform supporting End User Development (EUD) of context-dependent applications has been customized for remotely assisting elderly people at home. The user-editable personalisation features are specified by using trigger-action rules. The platform has been integrated with various sensors and appliances, and an application for remotely monitoring older adults at home. The resulting environment supports the possibility of creating trigger-action rules that can actually be executed when relevant sensors indicate that specific events or conditions occurred.

CCS CONCEPTS

• **Human-centered computing ~User interface programming**

KEYWORDS

Trigger-Action Programming, Elderly, EUD

1 INTRODUCTION

Nowadays, with the advent of the Internet of Things (IoT), context-dependent behaviour is acquiring increasing importance in various applications covering different domains, including Ambient Assisted Living systems for elderly. In particular, applications targeted to older adults (and their caregivers) not only have to support a highly variegated set of users (in terms of e.g. skills, abilities, interests and preferences), but they should be able to dynamically change their behaviour as elderlies have specific, ageing-related requirements that evolve individually over time. In such situations it is difficult to foresee at design time all the possible contexts of use in which applications and services will be used. EUD approaches [1] promote end user's active involvement in the creation or modification of software, to improve the flexibility and acceptance of technological solutions by final users. This can be obtained through tools that do not assume specific technical background from their users. In this paper we present an environment enabling end users to customize the behaviour and appearance of web applications and associated appliances in a context-dependent manner, by using an intuitive trigger-action paradigm. The approach has been applied to a remote assistance application, since in-house monitoring of elderly using intelligent ubiquitous sensors has emerged as a useful AAL service [2] due to its potential of increasing the independence, safety and quality of life of the elderly while minimizing the risks of living alone and avoiding the costs of more expensive hospitalization solutions. Our idea is that caregivers and patients (having some familiarity with technology) can be effectively empowered to facilitate the management of typical tasks concerning configuration of reminders, alarms, and messages, as well as checking medication adherence, promoting a healthy lifestyle, so adding new personalization possibilities not foreseen at design time, and specified in a context-dependent manner.

2 THE PLATFORM

The platform [3] is composed of a number of software modules. Through the Personalization Rule Editor, users can define suitable rules following the trigger-action paradigm, which connects dynamic events and/or conditions occurring in the current context (triggers) with expected reactions (actions). The events and/or conditions are associated with some contextual aspects, namely user, environment, technology, and social relationships. The Personalization Rule Editor provides intuitive panels allowing even

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non-professional users to intuitively select relevant contextual situations and consequent actions. After creation, rules are sent in JSON format to the Adaptation Engine, the architectural module aimed at handling the rules at run-time. The Adaptation Engine subscribes to the Context Manager, the module that monitors the current context, which informs the Adaptation Engine when a change in the context activates the execution of a rule. The Context Manager provides the functionalities to collect and store contextual data from external sources (e.g. sensors, devices). To this goal, it is composed of a centralised unit (the Context Server) and a set of software modules (Context Delegates) which are delegated to monitor relevant parameters of the context of use (e.g. temperature, noise, light, state of doors/windows) and are installed in relevant devices (e.g. a smartphone can host a software detecting the environment noise through the device microphone). The Context Delegates collect contextual data from the associated sensors and then continuously provide data according to which the Context Server updates its current view of the context. For each subscribed event and condition that occurs in the current context, the Context Manager notifies the Adaptation Engine, which extracts the list of actions from the verified rules (i.e., the rules having the 'trigger' part verified) and sends them to the application (and then to the relevant appliances, when necessary) for execution. The actions supported by the platform range from UI modifications, to sending messages, to the possibility of changing the state of appliances and devices available in the surrounding context. The platform also includes an Authentication server (based on the implementation of the OAuth 2.0 authentication protocol), which is used by platform components, applications, and users.

3 THE PLATFORM CONFIGURATION FOR THE TRIALS

An instance of the platform has been deployed in the AAL domain for showing its potentialities. In this configuration we consider a specific application and set of sensors and appliances. In particular, the Remote Assistant (see Figure 1) is the web application we considered. It supports remote monitoring of elderly, thus it includes a number of functionalities providing information about the elderly e.g. health information, wellbeing goals settings, planning of the activities, personal profile and main contacts, as well as the possibility to receive motivational messages for improving the current lifestyle of the elderly. In addition, within the Remote Assistance Application it is also possible to control some lights installed in the elderly's home. In particular, the lights considered for our demo were Philips Hue lamps equipped with Philips Hue Bridge 1.0. The Bridge allows to connect the light system to a smart device (e.g. for controlling the lights). When the Hue bridge is connected to the router, it is possible to remotely control the lamps. The platform configuration also includes an Android-based device (a Lenovo Yoga Tablet 2 based on Android 5.0.1 or a Samsung S5 Neo smartphone), in which the Remote Assistant will be running. Moreover, a set of sensors are used to detect surrounding contextual conditions. There is a PLUX BITalino[1] chest band, which includes some biosignal sensors, so providing data associated with heart rate, number of steps, current position of the user (including e.g. 'supine', 'prone', 'standing'), respiration rate, temperature. The associated Bitalino context delegate is contained within the mobile device. We also use a Fitbit[2] Charge 2 fitness wristband with the associated Fitbit app (running on the mobile device and used to create a user account), equipped with a Fitbit context delegate (installed on the mobile device).

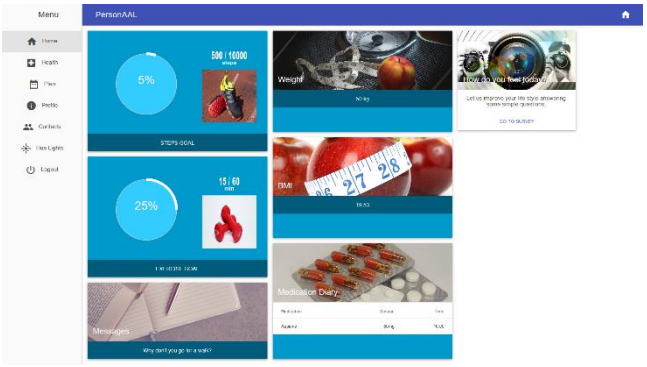

Figure 1: Remote Assistant Application

Furthermore, we exploit some Estimote[3] Proximity beacons (included in the Developer Kit) to derive the position of the user. The beacons provide three proximity zones: immediate, near, far, according to the strength of the signal received (from a few centimetres to some meters). The configuration of the sensor network will be composed of an Arduino Master Uno (enhanced by an Ethernet shield to provide the Arduino board with Internet access) and multiple Arduino Micro (Nodes) connected to it. Each Arduino unit will be equipped with a NRF24L01 module, a transceiver that allows to make a wireless communication between two Arduino elements. As for the Nodes, we will have an Arduino-compatible sensor for gas (MQ5), another one for detecting temperature and relative humidity (DHT11), and one for detecting motion. In such configuration examples of possible rules are: if gas leakage is detected in the elderly's house, send an alarm to the elderly and to the caregiver and open the kitchen window; if the elderly has not yet taken the medicine and it is time to do it, blink twice the lights in the room where the user currently is, and show a reminder with the image of the medicine to take and its dosage.

4 CONCLUSIONS AND ACKNOWLEDGMENTS

The presented platform supports personalisation of context-dependent applications in AAL scenarios. It has been integrated with various sensors and appliances, as well as an application for remotely monitoring older adults at home. The platform will be used by elderly in field trials to test its effectiveness in real settings. This work was partially supported by AAL PersonAAL[4] Project.

[1] http://bitalino.com/en/
[2] http://www.fitbit.com
[3] https://estimote.com
[4] http://www.personaal-project.eu/

REFERENCES

[1] Lieberman, H., Paternò, F., Wulf, V., (eds.), End-User Development, Springer, 2005.

[2] Rashidi, P., and Mihailidis, A., A Survey on Ambient-Assisted Living Tools for Older Adults. IEEE Journal of Biomedical and Health Informatics, Volume: 17, Issue: 3, May 2013, pp. 579 – 590

[3] Ghiani, G., Manca, M., Paternò, F., and Santoro, C., 2017. Personalization of Context-Dependent Applications Through Trigger-Action Rules. ACM Trans. Comput.-Hum. Interact. 24, 2, Article 14 (April 2017), 33 pages.