Smart Watches for Home Interaction Services

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Abstract. The demography of the Federal Republic of Germany predicts that the average age of the society rises in future. A generation ago, elderly people died only a couple of years after being retired. Nowadays elderly people enjoy their after work-life for approx. 20 additional years. These are very active and they enjoy traveling, meeting friends or find new purposes in life. The research project "Home Interaction Service" develops new mobile assistants by using Smart Watches for continuously monitoring of physical activities to identify life anomalies and to assist elderly people in their daily life. New algorithm also enables the Smart Watch also to be a new gesture interaction device to control home consumer products and to support new services that might become available in future.

Keywords: SmartWatch, Activity, Sleep, Pattern Recognition, Acceleration Sensor, Mobile Assistance.

1 Motivation

In future, the demographic change will affect the everyday life of elderly people. Years ago, each generation of a family lived together in one household and they did take care about each other. Nowadays the family is separated; elderly people often are living for their own or left alone in nursing homes. Furthermore, the low birth rate leads to the circumstance that fewer children can take care and communicate for a higher number of parents and grandparents. In the most European countries, the birth rate is very low. In Germany the total fertility rate has been rated around 1.4 in 2010 [1] but should be about 2 to ensure a constant population.

A century ago, elderly died in relatively young age (only a short period after their retirement), now people become much older. Even ill people who would die in the past are today obtaining a good medical care and enjoy additional years of living. This leads to the condition that the relation of available caregivers to elderly people is decreasing tremendously.

The elderly people in the age between 65+ and 85 are a new class of people in our society, the fit elderly. Some of the elderly people are using computer, mobile phones and touch pads, but the internet communication services are not well designed for them.

C. Stephanidis (Ed.): Posters, Part I, HCII 2013, CCIS 373, pp. 293–297, 2013.
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Elderly people are used to wear wrist watches. Currently the technological progress provides a new kind of watches on the market: Smart Watches. Smart Watches with integrated sensor functionality and wireless connectivity are capable to provide new methods of user support. These devices are inexpensive and enabling a new usage of internet services for elderly people.

The aim of this work is to show that the integrated sensors of Smart Watch recognizes not only physical activity such as walking, doing homework or car driving but also provide important information about periods of being physically and socially inactive. Hereby a new algorithm enables a detection of the duration and performance of sleep, periods of recovery and number of received or sent messages and compares these parameters to activity pattern during the day.

2 Related Work

2.1 Hardware

Smart Watches are wrist watches with additional computer functionalities. Smart Watches provide a wireless connectivity to a phone or to the internet. An important component is the sensing feature of acceleration forces. The first Smart Watches were designed in the early 80s to be a permanent but small "window to internet news" [5]. Nowadays the main functionality of a Smart Watch is the displaying of short messages, e.g. SMS, facebook-, RSS messages, or incoming calls. One of the main advantages of smart watches is not to have to take the phone out of the pocket, to see who is calling.

Current models of Smart Watches provide a micro display in the dimension of approx. 100 x 100 pixel, an acceleration sensing with 32 Hz and Bluetooth connectivity. Some watches can´t compute data on board, they are event triggered. These watches have to transmit every event (display touch, button event, sensing data) via Bluetooth to a smart phone. Also the other way round, the action events (vibration, screen display) are also to transmit wirelessly which costs a lot of transmission energy on both devices.

The other type of watches are capable to process all data on board, a wireless connection is only needed for external data exchange. Depending on the hardware, internal design and application purposes, the battery stamina is about a week. For future watch models the prediction is a battery lifetime of up to a year.

Figure 1 shows a commercial Smart Watch (Meta Watch [6]), equipped with an activity recognition algorithm. The watch itself contains an integrated 3D acceleration sensor, light sensor, Bluetooth connectivity, 96x96 pixel monochrome display and 256kb ram/flash memory.

2.2 Application

The main purpose of Smart Watches is the usage of the micro displays to present various messages. For displaying social messages (by e.g. facebook) the watch need the access to the internet. Specialized hardware is designed to be applied in nursery or private homes to monitor elderly or handicapped people. The manufacture of Limmix

watch, a device with integrated GSM module, Loudspeaker and microphone, is the world first watch which directly can call the emergency [4] by pressing an emergency button. Other watches [7] are using ISM connectivity to send button triggered messages to a connected external device or a phone. This phone is able to send emergency calls with phone generated GPS positioning information.

The usage of a constantly worn sensor enables new interaction possibilities as well as a monitoring of physical activity or vital life signals. Industrial applications are using Smart Watches as an interaction device to control maintenance video on tablet PCs, which is not possible in case of wearing gloves or having greasy fingers [2]. The constantly monitoring of physical activity might allow an automatic emergency call in case of detected anomalies. The idea of internet of the things could be shown by the eWatch [3], designed to be one of many connected devices of the wearer or intelligent environment.

The commercial Sophia Vivago watches are used for monitoring elderly people [8] and are sending alarms in case of a detected inactivity. Even these devices are excellent for elderly monitoring, they don´t cover social connectedness or social interaction.

The potential of using of physical activity, inactivity, and sleep pattern or communication behavior will be used in our approach to achieve new communication input for a social communication between the generations.

3 Basic Concept

The combination of Smart Watches, tablet PCs and smart phones can be used for a new approach of an unobtrusive, social connectedness. The basic concept is to support elderly people by providing an easy to use and inexpensive monitoring and interaction system that opens the internet world for them. Hereby a digital picture frame (realized by an android tablet or digital t.v.) is used as the main gateway to the internet. The metaphor of a digital picture frame is used because the user is not forced to react immediately to the displayed information. Some elderly people enjoy having more time to receive and work with information. The concept of asynchrony also occurs on SMS or Emails but unfortunately only a few elderly people are used to these new technologies.

Because a digital picture frame is just displaying information, a further back channel is needed. This back channel can be realized by touch interaction on the screen of the device, similar to a browser webpage. Another very promising approach is the constantly monitoring of the user by the integrated sensors of the Smart Watches. Beside the effect of retrieving activity data, the wearer can use the Smart Watch as a gesture interaction device and remote control for other devices e.g. t.v., light control or other purposes. The ensemble of all these devices is collecting data about the frequency of the received and outgoing messages.

This concept enables that for instance the adult son can check if grandma is doing fine, he can communicate by electronic messages and is able to post pictures or messages to the grandma´s display. The elderly still can use traditional information methods, e.g. to write a note on a piece of paper with a pen and hold it in front of a camera for sending these picture messages to their relatives.

4 Project Home Interaction Services

The research project "HIS – Home Interaction Service" combines the given basic concepts and intents to let elderly people live comfortable and safe in their own homes. Primarily, HIS is developed for seniors and people needing care. HIS is a central communication platform, which provide transparent, simple to configure and user-friendly intelligent services to connect seniors with their family members, careers or other peoples. Beside easy messages or picture posting, various services can be integrated by external service-providers.

Furthermore, the project supports the connection of seniors with the younger generation, the Facebook generation. The family members can check if the elderly person is doing fine (anomaly recognition, sleep and unconsciousness separation), communicate by electronic messages or pictures. Finally a senior gets useful information i.e. medical reminder, food plan or important dates.

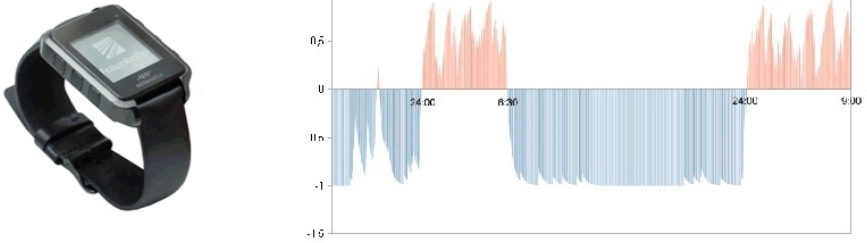

Fig. 1. Sleep (red) and Activity diagram (blue) of two days, recorded by a Smartwatch

HIS combines home automation and assistive technologies in the home environment for an ambient assisted living. The main features are security, health, comfort, information, activity, services, anomaly recognition supported by Smart Watches and social living. The frequency and quality of received or sent messages is checked and if someone seems to suffer of social communication, some auto-generated messages will transmit to the senior. Furthermore, coffee-meetings or other events between or with seniors will be automatically organized by electronically generated invitations (like senior flash-mob). The project HIS is funded by the Federal State of Mecklenburg-Vorpommern, Germany.

5 Conclusion and Future Work

Smart Watches are a new technology for the new generation of interaction, messaging (alarming) and micro displaying that is originally designed for the young internet generation. Smart Watches enable multiple application fields because of their free programming capabilities, the nice display and sensor functionality. Smart Watches

will push especially elderly people into the world of internet. The research project "HIS – home interaction service" addresses new services and technologies to support healthy elderly people in their everyday life and enables their way into the internet. The first indicators show that Smart Watches and a specified backend technology are well suited for this purpose. The project HIS provides new services and possibilities, e.g. identification of anomalies, sleep recognition, gesture interaction.

The further work of this project is to improve activity monitoring with wrist worn sensors and to design a complete message pipe to the elderly people. This message pipe should provide the optimal tradeoff between too much information (information overflow) and only a few (seldom messages). This will raise the acceptance for the complete system.

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