# Smartwatch for active ageing as part of an open EU framework

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## 1 Introduction

With an aging population, care cost rising, and care-bots, robots, and smart homes progressing, accepted solutions for active aging of elderly are still not available. A new system is introduced as part of a uniform open elder-care EU framework within the H2020 IN LIFE project. The main advantages are modularity and adaptability to different types of users. A new approach toward fall detection systems is described and tested in laboratory setting where it achieves 94% accuracy for fall detection. Large pilot tests are being performed on 150 elderly (average age 78). Feedback and usage closely analyzed, pilot tests help to identify problems with the systems and provide possible improvements.

## 2 System overview

After extensive interviews with potential users we identified two main issues/concerns. The elderly fear to be perceived by society as someone who cannot live alone and requires help to function. In addition, people suffering from dementia have problems to adapt to new technologies and tend to forget or even refuse to use them. This led our research for solutions on non-intrusive wearable technologies, such as wristbands and smart watches.

The main feature of the system is automatic fall detection. This is a challenge since the wrist is one of the worst locations for activity recognition (hands are used in almost every daily task and activity). We tested several ML methods on laboratory scenarios with 6 different people using different sensors, the best results were achieved with kNN (k=5), yielding 94 % accuracy. The second most important feature is a statistical model that determines unusual behavior of individual users compared to the past 10 days. This may help identifying problems such as whether the user is feeling sick and lying in bed more than usual, or if he is in pain that prevents him doing regular movement. Users also voiced fear for not being found in case of emergency. To help, in case of emergency the watch sends to server its current location gathered from GPS, Wi-Fi, or GSM triangulation.

## 3 Pilots

Promising results in laboratory setting were followed by a pilot test. Different profiles of users, at least 65 years old, were selected based on their living arrangements (living at home, in secured housing, or in nursing home).

After using the system for 3 months, we distinguished two types of users. Those who lived in nursing homes quickly lost interest as they already felt safe. On the other hand, most users that lived at home (alone or with a spouse) and were otherwise active - going on hikes, riding bike, and similar, used the system much more regularly. However, these users were typically only using the system when going out instead of continuously. We also noticed some correlation between the continuous usage in the first couple of days and later use. Users who used the system continuously during the first 7 days were four times more likely to use the system until the end of the pilot trial.

The accuracy of the system in real life was, as expected, lower than in the laboratory setting. It is hard to quantify it by a number, because users often pressed the SOS button just to test it or in some cases did not report a fall when the system did not recognize it. Surprisingly, false alarms (avg. 1 per day) did not bother the users as much as we initially anticipated; in fact, users were actually happy to see that there is someone actively taking care of them, in some cases they used this opportunity to socialize with the call operator.

## 4 Conclusion

Although the pilot study on 150 users had lower accuracy than in laboratory, the users do not seem to mind. The system successfully promoted a more active lifestyle, as they felt safer going out and being active. We found that the current version of the system is not appropriate for users at late stages of dementia who cannot remember even the basic commands.

According to the initial feedback, regardless of age, people with certain familiarity with mobile or wearable devices were more confident wearing the smartwatch. Thus, it is important that users get familiar with the system earlier, when not necessary needing its security features. We believe the best approach is a modular system that "grows" with the user. The user would first use general functions, such as sport tracking or social media, and will already feel comfortable with the system when fall detection and other security modules become relevant. Within the H2020 European IN LIFE project, we aim to set European standards for future technologies in assisted aging.