Newsletter #4

December 2017

This issue

www.frailsafe-project.eu

Editorial

2017 has not only been a year of fine-tuning the tools, devices and architectures developed in 2016, but also the time when new applications were created to complete the FrailSafe system.

It was also a time when the developed tools and devices where tested out by our volunteers in Cyprus, Greece and France. Our team met some of them in Cyprus and had a discussion on what they thought about the project. We take their feedback very seriously, as they are the ones able to tell us if the selected and developed devices are user-friendly or not. Indeed, they helped the team improve the smart vest.

This 4th edition collects the main progresses of the project, but many more is to be found on the website.

We wish you happy end-of-year festivities,

The FrailSafe Team

Reflection on the Use of Big Data to Detect Frailty

As a matter of fact, frailty is unavoidable. Each and every one of us will experience it at some point in later life, but its duration and the impact it will have can vary significantly. Even though, it is a condition that will affect a huge proportion of our older population, the spotlights of scientific research have been neglecting it as the main focus has always been to fight disease and not condition. In FrailSafe we strive towards a larger goal when it comes to investigating frailty. We are not only interested in basic research that will help us detect it, but we decided to walk the extra mile and using advanced data mining and analytics science, to be able to predict transition in frailty, and even to suggest interventions that could delay its progress and sometimes (why not?) reverse it.

Diagnosis of a condition rather than the disease is definitely a medical challenge on its own, but in the context of FrailSafe, it is also a major challenge from a computer science point of view. Such a condition is not bound to change significantly over the rather limited duration of the project for most individuals. The progress is slow and the indicators are very hard to identify, especially in an age group of people that is quite turbulent in many aspects that are monitored by our sensors. Picking up the useful information out of tons of massively huge and noisy data that is the key to success. Our focus has been shifted in optimally managing the information that is being collected in a seamless, efficient and error-proof pipeline. Obviously, such techniques and methodologies that are being developed within the context of FrailSafe can be extremely useful and find numerous applications in other data overwhelmed domains, such as genetics, engineering, physics and many other fields where the accumulation of data is happening faster than it can be processed. A few decades ago, information was so scarce that the challenge was to exploit it as much as possible and even artificially augment it, in an effort to improve statistical viability. Nowadays, the tables have shifted and soon we will realize that not only it is impossible to efficiently handle big data, but also it is soon going to be a challenge to store it for later or future use and analysis.

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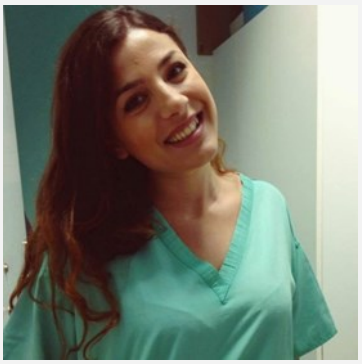
Within FrailSafe, we have adopted our analytics approach to be scalable and ready to tackle the streams of data that our sensors are constantly collecting. We are collecting all information, in an unstructured, no-sql database that is optimized for the management and analysis of big data on the cloud. Then via continuous discussions and close interaction of the various teams within FrailSafe we have opted for various levels of analysis for each given dataset and need. For instance, some data are analyzed online, some other offline, some information is first preprocessed or aggregated and then prepared to be communicated.

All in all, we are now well into the big data era, where efficient management and analysis of information is going to be of uttermost importance and eventually it will shape our future society. Within FrailSafe we are confident, that through our novel and multidisciplinary approach we will be able to efficiently detect transition in frailty and thus provide the knowledge to prolong independence and joyful life in the later years of an ever-ageing population. After all, wasn't George W. Curtis right when he was preaching that age is a matter of feeling and not of years?

FrailSafe Medical News



What Do FrailSafe Nurses Think of the Study?

The FrailSafe study is taking place in three different pilot sites: Patras (Greece), Nicosia (Cyprus) and Nancy (France). A medical team, composed of general practitioners (GPs), psychologists, neurologists, and nurses, follow the volunteers that signed up for the study.

This time, we wanted to have the perspective of the nurses working on FrailSafe. Rafaela Tsela, from the Patras site, and Anne Freminet, from the French site INSERM, were interviewed to know what their work consists in in the framework of FrailSafe and what they think about the potential of the project.

What is your role in FrailSafe?

Rafaela: I am a nurse working 100% on FrailSafe. My week is summarized as follows: On Monday, I make appointments with the volunteers in Patras (I visit 40 people every 2 months); on Tuesday I visit them and proceed with the FrailSafe sessions – meaning giving them the FrailSafe devices, helping them putting on or off the smart vest, explaining the virtual games; in between, I pick up the devices from each participants and on Sunday I upload the collected data to the FrailSafe's Electronic Case Report Form (eCRF). I remain available for the volunteers throughout the week; they know they can call me whenever they need help, e.g. in case of a problem with the tablet, smart vest, blood pressure monitor. In other words, I am their direct contact person when it comes to the FrailSafe study. I take on many roles, as I am recruiting the volunteers, going to the older persons' place, present them with the FrailSafe devices, carry on the clinical assessments, do the follow-up, upload the data, and report to the technical partners if there is a problem with the devices.

How could FrailSafe solutions prevent frailty among older people?

Anne: The FrailSafe package helps prevent frailty at different levels thanks to the FrailSafe tools. For example, the Red Wings Game helps detect muscular frailty by using the dynamometer and the pedometer and GPS tells us more about the frailty caused by a sedentary lifestyle. It already happened that we observed abnormal blood pressure measurements and had them sent over to the participant's GP to take the appropriate actions. All these applications, games and devices help us see when a measurement is not normal, and therefore helps us react accordingly to prevent frailty among older people.

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What do you think of FrailSafe?

Rafaela: I am really enthusiastic about it. I think it's a useful, helpful and innovative programme. It has a lot to give to the participants. The volunteers are always in contact with a doctor or a nurse. Through the eCRF, doctors or nurses can see if something is wrong. I think that those who will benefit from the final FrailSafe solutions will be able to better monitor their health and act accordingly when needed. Also, thanks to the study, volunteers try new technologies such as the wearable vest and the games and they benefit from using it. Through their participation, they perceive research projects in a different way, and thanks to their positive opinion, they helped us recruit new volunteers.

What problems have you faced so far?

Anne: The most frequent issue is when the participant accidentally stopped his/her smartphone. If the participant is aware of this, I visit him to switch it on again. For us, the smart vest is also an issue. Participants can't plug the recording device to the vest and switch it on on their own. For the moment I go and see them in the morning to put it on and come back again in the evening to put it off. They keep the vest only for one day. We regularly inform Smartex about the pros and cons and share with them what the volunteers tell us. Therefore I'm sure that the updated smart vest will enable the participants to put it on and off alone for a whole session later on.

Do you think older people would use an online system to monitor their health?

Rafaela: If someone trains them to use the virtual patient model (VPM) and explain to them how to access their medical data and how it can be used, they will use it. They are a little inexperienced with the use of technology at the beginning, but if you are patient enough to show them how it works, they like it. Some of them have decided to buy a tablet after using it for the FrailSafe study. But it's important to point out that the system has to be easy, otherwise it won't work.

In your own words, why should other medical centers consider FrailSafe?

Anne: This system is designed in such a way that it prevents different types of frailty (muscular, physical or cognitive frailty). Frailty will then be addressed as a whole and no longer in a specific aspect, allowing for frailty prevention at a very early stage. In the end, this could increase the quality of life of people aged over 70.

The full article is available here.

FrailSafe Technical News

Indoor Localisation Application

The symptoms of frailty can be detected not only through the clinical measurements of physical or cognitive properties of an older person, but also through behavioral parameters. Patterns of indoor movements of the older person around the house are significant indicators of his/her health status, since they are correlated to the physical condition of an individual (e.g. difficulty of movement due to pain), to clinical issues (e.g. the fact that a person visits the toilet too often), or to the individual's psychological condition (e.g. depression, leading to very limited movement).

This is why a part of the FrailSafe project involves the development of methods for monitoring the movements of an older person within his/her house. The proposed solution is an **indoor localization application**, developed by the Centre for Research and Technology Hellas (CERTH).

The indoor localization application is based upon the use of Bluetooth beacons positioned in the older person's home. Bluetooth beacons are small devices which constantly emit a unique identifier (ID), using the Bluetooth technology. They act as "lighthouses", sending a signal to any nearby device that is "watching". The distance from a "watcher" to the beacon can also be estimated from how "dim" the beacon's signal is at the position of the watcher.

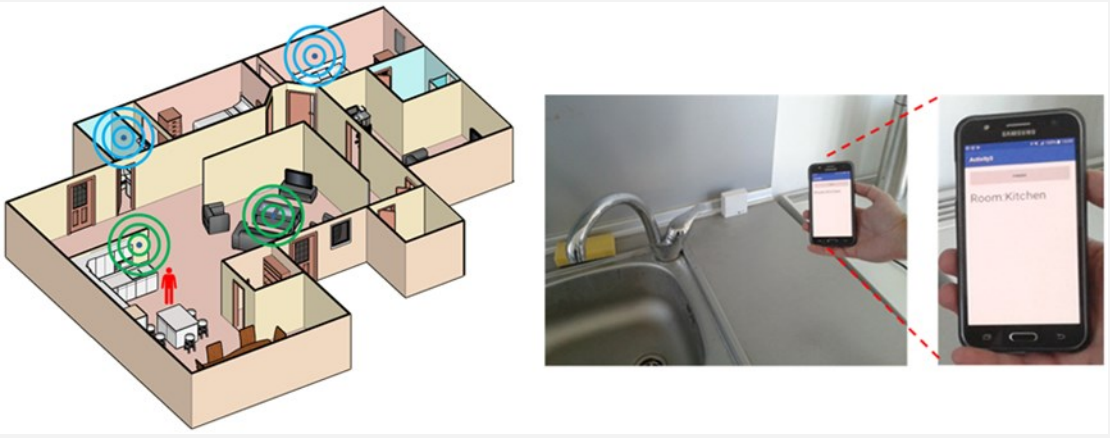

Fig. 1: Setup of the FrailSafe indoor localization application within a participant's house. A few Bluetooth beacons are placed within the house. The older person, carrying a mobile device, moves around the house. The mobile device measures the signal strength from all beacons and uses it to infer the room that the participant is currently in.

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The “watcher” in FrailSafe is a mobile device, such as a smartphone or a smartwatch, which can pick up the Bluetooth signal sent by the beacons. When a mobile device is in the proximity of a beacon, it can read the beacon’s ID and estimate the distance between itself and the beacon. Placing a few beacons in the house and letting the person carry the mobile phone as he/she moves, allows the estimation of the person’s current room, as shown in Figure 1. The older person is supposed to constantly carry the mobile device throughout the desired monitoring period, which normally is several days, in order for any further data analysis to capture significant movement patterns.

A preliminary training phase is performed by the clinical staff before the real data collection with the older person. The clinical person will define the rooms to be monitored and will move randomly in each of them for half a minute. The preliminary phase is necessary as the application needs to learn how the signal strength responds in the different rooms that are monitored.

The indoor localization application is part of the FrailSafe data acquisition methods.

The data collected are uploaded to the FrailSafe cloud repositories to be further analysed by other FrailSafe components. Using the localization data, patterns of indoor movements and activities can be computed to extract behavioral features of the older persons. Such features, in combination with different types of measurements from other FrailSafe devices and games, can be valuable for the definition of frailty metrics and the early detection of frailty, which are the ultimate goals of the FrailSafe project.

For further technical information about the indoor localization application, please contact Kostas Votis (kvotis@iti.gr).

FrailSafe Technical News

The FrailSafe Smart Vest 2.0

The Italian-based company, Smartex, is the partner who designs and creates the wearable sensor device WWBS ("Wearable WBAN system") used by the clinicians in the FrailSafe study. It measures individual medical parameters related to heart, respiration and physical activity. A prototype had been presented in December 2016 to the FrailSafe partners and tested out by the clinicians themselves (see Fig. 2). Since May 2017, volunteers of the FrailSafe study in the different sites (Nancy, Nicosia and Patras) have worn it and have expressed their opinion about the 1.0 version of the smart vest to make it more user-friendly (Fig. 3).

Smartex has taken their feedback into account and will produce 15 units of the updated smart vest. The 2.0 version still has the same equipment in terms of sensors, namely 1 fabric electrode for 1 electrocardiography lead, 1 fabric sensor for respiration, 3 inertial platforms (1 on the chest and 2 on upper limbs). However, the 2.0 WWBS includes recommendations from the end-users: a well visible LED flashing information in a simple colour code; a stronger case (some of them were broken and replaced during the 9-month trial); simple connectors (the previous one was too hard for weaker people). Suggestions also came from the clinicians for a better data collection. They asked for a larger battery to enable longer monitoring period and a dedicated battery for the internal clock, to ensure a correct date recording in files.

The Italian company will deliver the 2.0 WWBS by the end of this year to the FrailSafe pilot sites.

Fig. 2

Fig. 3

FrailSafe Technical News

Memory Augmented Reality Game

Frailsafe Gaming involves assessing the cognitive capabilities of an older person in regular intervals. These assessments serve both as an absolute metric for the relative skills required (e.g. short-term memory, logic etc.), and as an early warning system in case of a rapid decline in scores. **The Memory AR** is an Augmented Reality (AR) Game developed by CERTH that assesses the cognitive skills and short-term memory of the user. It is meant to be played with the AR Glasses.

The user will wear the AR glasses and will be seated while she/he explores his/her surrounding space. By moving his/her head, the person will discover several virtual objects (see Fig. 4) and will have to remember the order of discovery. When all objects have appeared, the user is asked to say the order of appearance of the objects, which is linked with the short-term memory skills.

While the aforementioned game mechanics are simple to understand, they enable personalized difficulty capabilities. By manipulating the game parameters (e.g. number of objects, color diversity, search space boundaries, allowed time), it is possible to create progressive difficulty for all levels of frailty, providing a larger assessment value range.

The game collects various data during a game session, including:

- The direction the user is looking at all times while playing the game;
- The order in which he discovered the items;
- The various characteristics of the virtual objects' configuration;
- The user's best guess of the order of discovery.

The data collected is stored by the game and transmitted to the Frailsafe Cloud Services, along with extracted aggregated metrics (e.g. related to the accuracy on tracking a moving object, the time to respond to appearing objects etc.) that potentially correlate to cognitive capabilities. All those data are then analyzed by the Frailsafe Offline Analysis module, which will extract alerts if needed and track progress.

For further technical information about the indoor localization application, please contact Victor Kyriazakos (kyriazakos@iti.gr)

FrailSafe Technical News

Loss of Orientation Application

The Loss of Orientation is a potentially life-threatening and a common behavior seen among older people, specifically people with Dementia and Alzheimer's. Between 60% to 70% of people with Alzheimer's will wander and possibly get lost at some point during the course of their disease. Among them, a staggering 50% will get hurt or die if they are not found within 24 hours . The Frailsafe Outdoor Localization module uses the smartphone's GPS system and other sensors to track the user at all times. The module transmits the relevant information through the Outdoor Localization API to the Frailsafe Cloud. Among the real-time data management and data mining methods included in the Online/Offline Analysis module, is the **Loss of Orientation (LoO) application**. The application processes the localization logs from each user in order to identify irregular and/or unwanted walking patterns.
The application contains the following key features:

- Geo-fencing: It is often desired by caretakers to ensure that a pre-frail/frail person is not walking outside a set of routine places and paths. Geo-fencing defines a virtual boundary (Fig. 5) which, once crossed, signals an alert of a potential wandering episode.
- Detection of irregular walking patterns: The LoO application detects unwanted travel patterns that are often linked to Loss of Orientation episodes (pacing back and forth, circuitous movements, random walking patterns etc.)

The application acts as an early warning system for wandering events, providing the Frailsafe Online Analysis module with a metric indicating the regularity of the person's current walking pattern and generates an alarm when the person enters, leaves or moves within a specific geographic area (geo-fencing), allowing the detection of being lost and generating appropriate intervention from the caretaker.

For further technical information about the indoor localization application, please contact Victor Kyriazakos (kyriazakos@iti.gr)

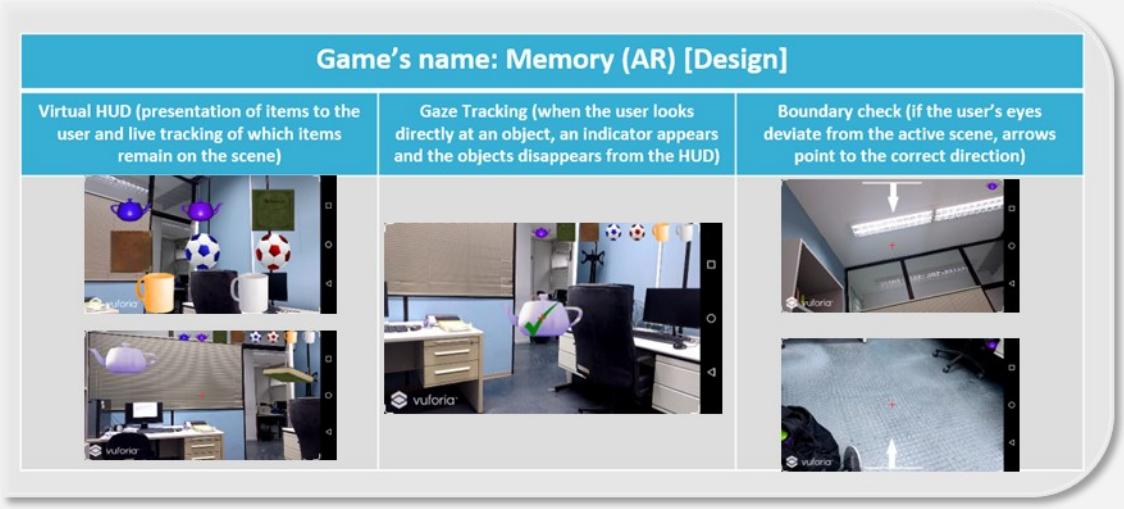

Fig 4. Brief description of the key features included in Memory AR.

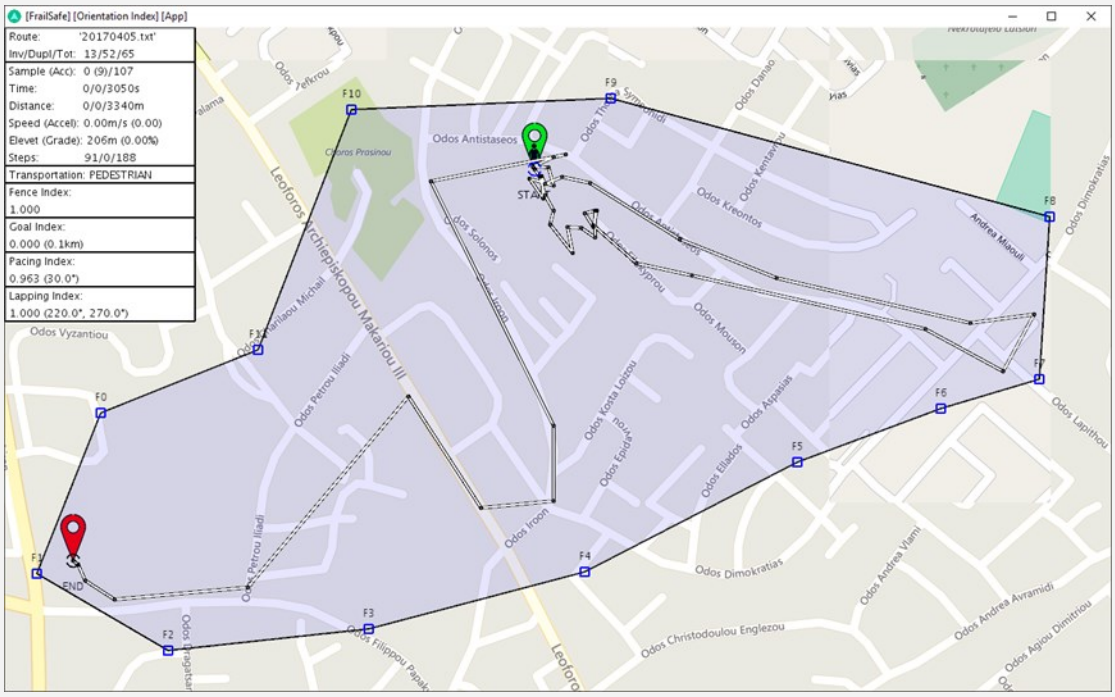

Fig. 5. Example of the geo-fencing feature of the Loss of Orientation application.

EU News

State of Health in the EU

In November 2017 the European Commission revealed 28 Country Health Profiles. The reports reveal common challenges faced by EU health systems. By offering comprehensive data and insights, they aim to support national health authorities in tackling these challenges and in making the right policy and investment choices. One of the key findings is that 80% of health care costs are spent on treating chronic diseases, but only 3% on prevention. Shifting to prevention not only tackles inequalities in health and quality of life, but also offers enormous economic return. Moreover, the report concludes that "the digital transformation of health and care has great potential for strengthening the effectiveness of health systems. Patient-centered health data contributes to patient outcomes, whilst reducing wasteful spending in healthcare". The report is available here.

I-Prognosis

The i-PROGNOSIS project released the iPrognosis application in Greece, Germany, Portugal and the UK as part of a new research study aiming to improve the early detection of Parkinson's disease. If you are aged over 40, living in the aforementioned countries, download the application for free for the Google Play Store. Further information here.

Progressive Workshop

A workshop on standardisation for ICT and active and healthy ageing was organised by the EU-funded project Progressive last October 2017. **Gruppo Sigla** was there to contribute to the debate and most importantly, extract standardisation advice for the Frailsafe system. More details about the workshop is available here.

For further information

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