Proposal template
(technical annex)

Research and Innovation actions
Innovation actions

'Combating Physical and Societal Limitations Among the Elderly'

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1.   Excellence

Context

One of mankind's desires is to live a long and wealthy life. In the past decennia, the life expectancy is increasing and life has become more pleasant. This results in an increase of elderly people, whose physical abilities deteriorate while they age. Often, this means that these elderly become less physically active, which has a lot of bad effects on one's quality of life. For example, less active elderly (65 years and older) have higher rates of all-cause mortality, they are at higher risk of cardiovascular disease, exhibit lower levels of functional health and worse cognitive functions (WHO,   2016).
Research found that for a healthy lifestyle, elderly need at least 150 minutes of moderate-intensity aerobic activity and muscle-strengthening activities on 2 or more days in a week, or a programme similar to these activities. This is already a pitfall for many young people. Therefore, elderly will need a lot more motivation to achieve this (CDC, 2016).
Moreover, social loneliness is a problem that significantly increases when you get older. This is often a result of being less physically active (A.Scenario 1). Research done by the RIVM in the Netherlands showed that social isolation is a huge issue. Among the age group of 50-year-olds inhabitants of the Netherlands, over 40% stated that they feel lonely. Among the age group of 75- to 80-year-olds, nearly 50% feels lonely. And finally, at an age of over 85-year-old, nearly 60% feels lonely (Nationaal ouderenfonds, 2016). Therefore, the European Commision assesses this as one of the societal challenges which has to be resolved by 2020.
The societal challenge targeted in this proposal mainly focuses on developing a breakthrough for active and assisted living for elderly based on advanced ICT solutions. Some senior citizens need to have something that boosts their motivation to go outside and stay fit, which is the main problem trying to be combated here. By going outside and staying active, they will be able to maintain a healthy and active lifestyle. When elderly leave the house more regularly, they will get more in touch with neighbours and other people and they also stay fitter mentally. Our proposal, the social robot Kale, does this. He encourages people, mainly elderly, to go out for a walk and in this way stay physically and mentally fit, more healthy and social and this will eventually increase their quality of life.

In this report, we will describe the appearance of Kale, its objectives, the relation to the elderly, its impacts and its implementation. Furthermore, this will be related to the Horizon 2020 goals and other social desires to increase the quality of life.

1.1   Objectives

The key objective for project Kale is to **help the elderly retain their autonomy in their daily lives**. Specifically, this is focused on outdoor activities, as indoor activities have already been thoroughly examined by countless researchers and there are plenty of alternatives for robotics in this area. The key objective can be divided in several sub-objectives: to accomplish this preservation of autonomy the elderly should be assisted with their smaller tasks. These tasks include:

Objective 1: Planning and helping execute safe and fun trips

Kale will motivate the elderly to go outside and join activities by actively suggesting relevant and fun activities. He will escort the elderly on their way to the activity and make sure they bring along all the stuff they need. This will cause the elderly to meet like-minded people and stay socially active. It will also make sure that they stay active and physically healthy, and live a more fulfilling life.

Kale will also aid in the process of travelling. As it's equipped with a map and a global positioning system, it is virtually impossible to get lost. By having access to the location, the area can be scanned for fun things to do. This can be simple things like checking out a fountain in a park, or more complicated ones like attending a live-performance theater in the city.

Objective 2: Provide reminders for important activities

Forgetfulness is a trait that develops among many elderly. It can lead them to forget important appointments or to deviate from their regular schedule. Kale has a built-in personal agenda that can be accessed at all times. When important activities are coming up, Kale will aid the user's memory by giving a unobtrusive reminder. This system can also be used for medication. A comprehensive time-table of the medication schedule can be uploaded to the system, which can point out times when medication is due.

This feature is not only limited to scheduled appointments: it can also be used as a memory aid. It can be used to easily create and store notes like small grocery shopping lists. These can be retrieved later when needed.

Objective 3: Ensuring the user's safety and wellbeing

Kale always serves as a safety net. The users are constantly monitors, so when an emergency occurs, Kale will send out an emergency call to a caretaker or any other designated individual. An example of an emergency could be an unfortunate slip: the user has fallen and can't get up on their own. Because of Kale, help will be imminent, no matter where it happened. Kale is also equipped to warn the user when there is a dangerous situation ahead, be it stormy weather or other unpleasant situations.

1.2   Relation to the Work Programme

The proposal relates to the PHC 19 - 2014: Advancing active and healthy ageing with ICT: service robotics within assisted living environments. The main reason why this call exists is the risk of cognitive impairment, frailty, social exclusion and thus the quality of life of elderly persons in general. The specific challenge reads the following: *"Develop new breakthroughs for active and assisted living based on advanced ICT solutions."*

Our proposal, Kale, is a robot that encourages older persons to go out for a walk. By staying active elderly will be healthier for a longer period of time and that would improve their quality of life. Next to that, it is quite probable that the elderly will meet others on their way. That way they can make social contact and new connections and they could also maintain older ones by walking towards nearby living relatives to visit them. This will prevent social exclusion.

Kale is quite unique in its appearance. One could compare him to an exercise robot, for example the exercise robot described by Fasola (Fasola, 2010). This robot also encourages the user to exercise. However this robot only focusses on the physical health of the elderly while Kale also helps the user to retain a social life and he supports and accompanies the user during the walks. Moreover Kale reminds the elderly person of important events and makes sure the user won't forget important stuff when going out. This is not supported by the exercise robot made in Eindhoven. Another robot you could compare with Kale is the robot Pearl (Pollack et al., 2002). This robot reminds the user about routine activities, like eating, sleeping, taking medication and going to the bathroom, and guides him or her through their environments. Pearl's functionalities are already somewhat more extensive, however it helps the user only in the home environment, this is something on which Kale overperforms Pearl. And finally there several robots that try to fight loneliness among elderly, like

Paro (Robinson, Broadbent, & MacDonald, 2016) and Aibo (Fujita, 2004). You could see Kale as a combination of those robot, that is also able to go outside with its user.

Kale supports elderly on their walks. He helps them to feel safe, to find the route back home and warns them for steps and other difficulties on the way. Kale opens the doors for them and reminds them to take their valuables with them during these walks. Of course, walking with Kale feels more pleasant, because Kale will be your friend and will have nice conversations with you. This makes the older persons enjoy the walks more and this adds joy to their lives. So Kale helps elderly to stay active and assists them by doing this in a pleasant way. By doing so Kale will improve the quality of their lives.

1.3 Concept and Approach

The main objective of Kale is to help elderly keep an active and social life. This needs to be done in a safe way. As elderly are fragile and often scared of going outside for the dangers present, their motivation for going outside deteriorates quickly. Therefore, Kale will assist them in overcoming those challenges. What is needed for the robot is that it is able to keep track of the user, motivate them to go and assist them when going outside. It will give the user a safe and less lonely feeling when going outside. If Kale has access to the weather forecast and other databases, it can determine whether it is a good time to take a walk and what the duration of this walk should be. With enough information for its program, it should be achievable to make these calculations and even personalise it.

If Kale is just a robot with a simple interface, has a readable screen and is able to walk, one could say that its hardware is fairly cheap. On the other hand, its coding, detection, movements: In other words the software, could be a problem. Currently, this is what the engineers are researching and it could take a long time before having the (almost) perfect software within the moral boundaries.

The Horizon 2020 programme gives 7 years to finish this project. As engineers are currently working on this, and are already having results, this project should be achievable within the boundaries of Horizon 2020 and its aim for solving societal problems. New jobs can also be created from Kale. Not only for its research period, but also afterwards as people have to monitor its behaviour. A recurring theme among the elderly is that they wish to stay independent as long as possible. They are very hesitant about allowing other people, especially professional caretakers, to aid them in their daily lives and they might not even want them to enter their houses. This stubbornness makes the process of providing adequate care very difficult for caretakers, nurses and other members of the healthcare sector.

This is where Kale will come in sight. However, these robots do not need to be autonomous, so new jobs will be created to control them remotely. This has to stay private, though, as this is also a moral obligation. Of course, maintenance is also a job. This is also a goal of Horizon 2020.

Approach for objective 1:

To plan safe trips Kale as first needs to plan an activity (UC1.1). Kale will search on the internet for activities and compares them to a list of preconfigured interests of the user and also checks if the user doesn't already have any other activities planned, Kale then provides a list of options that match for the user to choose from. When the user goes out on a trip Kale provides a roadmap and travel directions (UC1.7), this can be seen as part of the assistance in carrying outdoor activities. Based on the planned activities and appointments, a route will be suggested.

At last Kale will help with carrying out outdoor activities (UC1.4): this includes reference guides for activities what steps need to be followed to complete an activity successfully and tips and tricks that are presented during the activity.

Approach for objective 2 :

To remind the user of appointments and other obligations (UC1.2) the user will be shown a timetable of activities (audio/visual/combination of both) at the start of each day. This timetable can be summoned at any time. Based on personal preferences an alarm can be set, reminding the user of his/her   obligations.
When the user goes out on a trip Kale presents a checklist with the stuff to take with him/her like keys, a wallet, shoes and a coat (UC1.3). This is to make sure the user doesn't forget anything.

Approach for objective 3

Kale will have sensors that are able to monitor the user's wellbeing, as well as monitoring the surroundings. If calamities occur, For example: the user has fallen and can't get up, appointed persons will be notified and If a crime occurs, For example: the user gets robbed, the authorities will be notified (UC1.6).

2.   Impact

2.1   Expected impacts

Currently, Kale is not available. Of course, research has to be done first. This temporary research of several years will create a lot of new jobs, too. With the development of Kale, a whole new perspective will be shed on social robots. The first deployment of such care robots can escalate in further and better future care robots. The software and hardware used in Kale can also be used in other types of robots. As this is only the beginning, the study of robotics will be a hot topic for the coming decennia. Here are some impacts on the different types of users.

Impact 1 (Quality of Life): If this proposal is carried out, the quality of life will increase for elderly. As said before, elderly are nowadays less physically active and this seems to increase with age. With the help of Kale, elderly can safely go outside for a walk and stay fit again.

Impact 2 (Social improvement): Not only does this help physically, but also socially. Since the elderly are encouraged to go outside and meet new or known people. They will also have a safe feeling when accompanied with Kale.

Impact 3 (Privacy): Kale will also keep track of specialised data, such as the time of walking, the duration and the fitness of the user. This means that privacy is kept safe. Humans are able to memorise actions, which could be a violation of privacy.

Impact 4 (Navigation): Another expectation is that Kale is able to navigate to different locations without the help of the user, but does keep the user's preferences in mind.

Impact 5 (Working opportunities): When Kale will be implemented, working opportunities are expected to increase. No actual caretakers are needed anymore when a senior wants to go outside for example. However, employees that monitor and maintain the robot are needed. Furthermore, the robots are personal, so they do not need to travel back and forth, as caretakers would. This saves time, effort, money and is better for the environment, too. If something comes up, the robots would be immediately alarmed, too.

Impact 6 (Education and Research): As Kale is in a first phase, a lot of research has to be done, which would be perfect as learning experience. Not only for the engineers, but also for the elderly. They will need to learn how to use Kale and could even adapt to its methods which could change their whole lifestyle.

Primary users (Elderly): As read in impact 1 and 2, the quality of life for the elders will greatly increase. They will feel a lot better, both physically and socially. Therefore, aging will become fun again and they might be able to appreciate their lives even more than they did before or keep their lives constant.

Secondary users (Relatives): As the primary users will try to have contacts again/more often, friends and family (secondary users) will benefit from this. Furthermore, elderly often forget their appointments. This is not only a hassle for themselves, but also for the ones they have appointments with. With the help of Kale, elderly cannot forget their appointments anymore. The frequency in which they are reminded of their appointments can be set individually, depending on their mental state.

Tertiary users (Engineers): A very indirect consequence of Kale would be the increase of working opportunities. While Kale is mostly autonomous, people are not fully out-of-the-loop. Frequent checks have to be done on whether the quality of life actually improves and if Kale's help is desirable and useful in the beginning stage. If that turns out to be right, people will still have to

constantly check if the elderly are progressing. Moreover, if Kale sends out an alarm, people will have to respond, check this and, if necessary, send the right team to the user. Furthermore, technicians and engineers have to be prepared to fix Kale if anything is broken or not functioning properly, as well as its software that needs to be updated once in awhile. For this reason, software engineers are also needed constantly to improve Kale.

Appendix A Scenarios, User needs and Use cases

Personas

Truus van Reeuwijk

Goals
- Have an auxiliary tool to help her in social situations
- Meet new friends
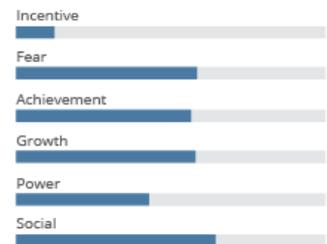- Reconnect with her family
- Live a more fulfilling life

Frustrations
- Finds it hard to do things without friends
- Generally feels quite lonely
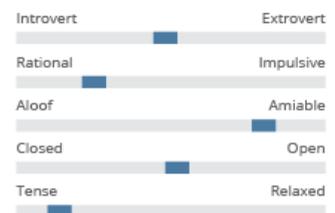- Has a hard time connecting to people she doesn't know.

Biography
Truus is an 80 year old widow. Since her husband has passed away, her social contacts have fizzled out. She does not go outside that often anymore, and could use a friend that helps her stay active.
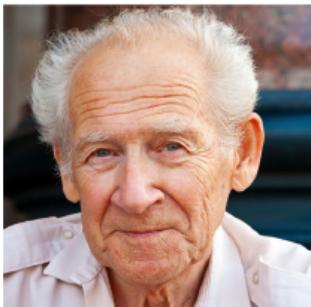
Age:	80
Work:	Retiree
Family:	Widowed
Location:	Suburban
Mobility:	Okay

Stubborn   Careful

Motivations
Incentive
Fear
Achievement
Growth
Power
Social

Personality
Introvert — Extrovert
Rational — Impulsive
Aloof — Amiable
Closed — Open
Tense — Relaxed

Kale Proposal - Persona [1 / 3]

Persona 1. 'Truus van Reeuwijk'

Willem Holthuijsen

Goals
- Be more time-efficient
- Be less anxious in situations where he does not know what to do.
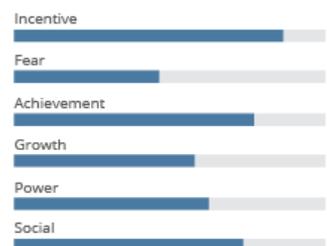
Frustrations
- Mind tends to drift away
- Forgets what he needs at the grocery store
- Loses track of time when shopping
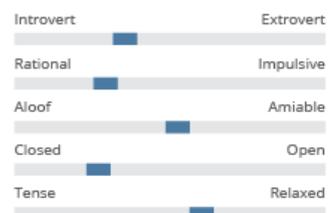- Gets overwhelmed in big crowds

Biography
Willem is an adventurous person. Day-to-day he makes a walk to the market to get groceries for him and his wife. However, this sometimes takes a long time, because he cannot remember everything he needs. This leaves him frustrated and makes him feel uncomfortable. Kale helps remind him what groceries he needs and also when he has scheduled appointments. Finally, Kale can also remind Willem to take his medication.

Age:	83
Work:	Retiree
Family:	Married
Location:	Suburban
Mobility:	Good

Forgetful   Helpful

Motivations
Incentive
Fear
Achievement
Growth
Power
Social

Personality
Introvert — Extrovert
Rational — Impulsive
Aloof — Amiable
Closed — Open
Tense — Relaxed

Kale Proposal - Persona [2 / 3]

Persona 2. 'Willem Holthuijsen'

Marga Berghorst

Goals
- Feel safe when going out
- Have an assistant for easy tasks when going out

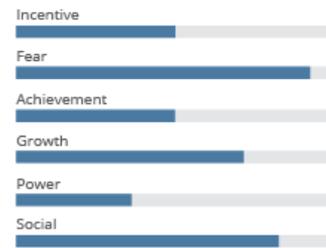### Frustrations
- Is afraid to fall and not be able to stand up again
- Is too scared to go to the social organisations she used to frequent.

Motivations
Incentive
Fear
Achievement
Growth
Power
Social

Personality
Introvert		Extrovert
Rational		Impulsive
Aloof		Amiable
Closed		Open
Tense		Relaxed

Age: 75
Work: Retiree
Family: Widow
Location: Suburban
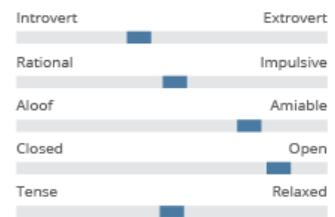Mobility: Poor

Anxious   Timid

Biography
Marga is 75 years old and has had a severe accident just over a year ago. She fell from the stairs and bruised her dorsal on several places. She has since recovered, although the accident has made her a lot more anxious and timid, which makes her miss out on fun activities.

Kale Proposal - Persona [2 / 3]

Persona 3. 'Marga Berghorst

Scenarios

Scenario 1. Loneliness	
Persona	Truus
Aim	Accompany elderly who feel lonely.
Expected benefit	The elderly will be more likely to go outside, because they have a companion and through this they are more likely to meet new people.
User needs	UN101 & UN102 & UN201
Secondary user(s)	Family members of the primary user
A user story	Truus is an 80 year old widow. Since her husband has passed away, she does not go outside that often anymore. She has less social contacts than she wants and feels lonely. Therefore, she feels as if she has no reason to leave her house. Her family does not visit her that often, because they claim to have a busy life. Also her grandchildren, whom she formerly took care of two days a week, are grown up now. Now she uses Kale, she thinks it is more pleasant to leave the house. Furthermore, during her walks, she meets new people. She does not feel that lonely anymore and it does not feel like a big step to go outside.
Use cases	(i) UC1.1 Planning activities

	(ii)	UC1.4 Interaction with the user

Scenario 2. Forgetfulness	
Persona	Willem
Aim	Help elderly remind tasks
Expected benefit	Elderly do not need to constantly think of their important schedule all the time, what makes their life less stressful.
User needs	UN103
Secondary user(s)	People with whom they have appointments with
A user story	Willem is an oblivious person. Day-to-day he makes a walk to the market for his groceries. However, sometimes that takes a long time, because he cannot remember what he needs. This leaves him in annoying situation and he does not feel comfortable anymore. Kale will remind him of appointments and can tell him what he needs to get in the market. Kale can also remind Willem to take is medication.
Use cases	(i) UC1.2 Reminders

Scenario 3. Fearfulness	
Persona	Marga
Aim	Provide a safe feeling for the elderly who are too scared to go outside by themselves.
Expected benefit	The elderly will be more likely to go to activities and come outside of their homes with a more relaxed feeling, because they are guarded by Kale.
User needs	UN101 & UN102
Secondary user(s)	
A user story	Marga is 75 years old and has had an accident a year ago. She fell from the stairs and bruised her dorsal on several places. She has recovered now, but she is a lot more cautious. Especially when she is not in her own comfort zone, her home, she is scared. She fears that she will fall again and is not able to stand up by herself. This results in less activity, which on its case leads to her not able to enjoy the clubs she used to go to. She attended the elderly gym every friday morning, where she could mingle with her peers. She had a eating club, where different elderly from the neighborhood come together. So she has lost many social contacts. Kale could guide her during the trips she wants to make. Whereby it could help her with the easy tasks and could call emergency help when needed.
Use cases	(i) UC1.3 Support

| | (ii) | UC1.4 Interaction with the user |
| | (iii) | UC1.5 Emergency call |

User needs

Primary user needs

User Needs ID	User Needs description	Persona		
		Truus	**Willem**	**Marga**
UN101	The motivation to go outside (socially).	x		x
UN102	The ability to go outside (physically).	x		x
UN103	Be reminded to take medication		x	
UN104	Protection against strangers that come in contact with the primary user.			x

Secondary user needs

User needs ID	User Needs description
UN201	Family members and relatives need to have the feeling that their loved ones are safe, so that they do not have to worry about them all the time.
UN202	People with whom elderly have appointments with, e.g. the physiotherapist.

Tertiary user needs

User needs ID	User Needs description
UN301	The software has to be updated once in awhile as the project is still in beginning phase. A lot of errors will be discovered in the implementation stage and need to be resolved then.
UN302	When employed, the robot might need to protect its user. For this reason, it can get damaged and maintenance is needed.

Use cases

Use case ID	UC1.1	Priority: medium
Use case name	Planning activities	
Scenario	1	
Actors	Elderly	
Description	When the user asks Kale for something to do, Kale will check nearby activities and compares them with a list of preferences of the user. Kale then suggests the options that match to the user. The user can choose what activity he/she likes to join.	
Pre conditions	• Access to the internet to find activities. • Have a list of preferences of the user • Have an agenda with all the appointments of the user • Access to weather conditions.	
Post conditions	• An activity is planned and added to the agenda of the user.	

Use case ID	UC1.2	Priority: high
Use case name	Reminders of appointments	
Scenario	2	
Actors	Forgetful elderly	
Description	Kale will remind the user of appointments in their agenda and is able to help them remember small things like grocery lists or birthdays of family members.	
Pre conditions	• Accessible agenda. • Accessible to-do list.	
Post conditions	• The user now knows/remembers his/her appointment.	

Use case ID	UC1.3	Priority: high
Use case name	Remind to take important stuff	
Scenario	2	
Actors	Forgetful elderly	

Description	Kale will remind the user to take important stuff on their walks. Like keys, a wallet, shoes and a coat.
Pre conditions	• Accessible list of the important stuff
Post conditions	• The user never forgets to bring important stuff

Use case ID	UC1.4	Priority: medium
Use case name	Support	
Scenario	3	
Actors	Elderly	
Description	Kale can support the user while walking. Kale is also able to protect its user.	
Pre conditions	• Being able to move • Being able to assess the situation	
Post conditions	• Support the user with walking • Warn the user for potential hazards	

Use case ID	UC1.5	Priority: high
Use case name	Interaction with the user.	
Scenario	1, 3	
Actors	Elderly	
Description	Kale is able to answer the user's questions and can accompany the user while walking. Kale is like the user's friend and can have nice conversations with the user during the walks	
Pre conditions	• Ability to listen to the user and to answer accordingly to asked questions	
Post conditions	• Have (nice) conversations with the user and keep the user company. • Redirect the planned route when there are sudden obstacles on the route	

Use case ID	UC1.6	Priority: high

Use case name	Emergency call
Scenario	1, 2, 3
Actors	Elderly, caretakers, authorities
Description	When the user, for example has fallen and cannot get up, Kale can send out an emergency call to someone who can help the user.
Pre conditions	• Have telecommunication • Be able to detect when the user is in trouble
Post conditions	• Ambulance staff or a caretaker will be called and can come over to help the user.

Use case ID	UC1.7	Priority: medium
Use case name	Providing a roadmap and directions	
Scenario	1, 2, 3	
Actors	Elderly	
Description	When the user goes outside for a trip Kale will provide a roadmap and directions for the user based on the planned activities	
Pre conditions	• Know what activities are planned for the trip • Have access to a map or GPS	
Post conditions	• The user is provided with direction for his/her planned activities	

Appendix B Bibliographic References

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