Frail or not?

An explorative mixed methods evaluation of

a sensory-based frailty assessment toolkit

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Abstract

The worlds population is aging (United Nations, 2015). As the aging population is more prone to developing frailty, it is important to assess and monitor this condition. Frailty is a state of health where ones overall well-being and ability to function independently are reduced, with an increased vulnerability to deterioration (Morley et al., 2003). Current assessment methods of frailty are prone to error due to human bias and memory loss and rely on well-trained clinicians to interpret results. Frailty is a dynamic condition and continuous assessment would assist in diagnosing the condition early on. A prototype of a frailty toolkit is being developed by Chao Bian and his team at the IATSL in Toronto to monitor and assess frailty in older adults' homes. This toolkit will assess frailty by measuring Fried's Frailty Phenotypes (Fried et al., 2001) through home monitoring technologies. It is important to involve older adults in the development of this toolkit as research shows that lack of user involvement is a reason for assistive technology abandonment. This study therefore researched older adults attitudes and preferences towards home monitoring technologies. A focus group study was carried out, which provided insights on what technologies older adults want to interact with and what issues were perceived with in-home frailty monitoring. Privacy proved to be a concern for most older adults, corresponding with previous research (Courtney et al., 2008). The data from the focus group was used to select technologies for the toolkit. This toolkit was evaluated with an online usability assessment. Results show that the toolkit in general was well received. However, participants indicated points of improvement such as the ability to personalize when users are prompted to interact with the toolkit. The results also suggested that proper explanation is needed to address why the toolkit is necessary for older adults and their clinicians.

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1. Introduction

We all know someone in our family who is getting older and experiences the effects of aging: painful joints, forgetfulness, a lower energy level and they might seem to have been shrinking over the past few years. Some of these symptoms are typical for aging, as one's bones and muscles tend to shrink or weaken when you age and your brain undergo changes which can affect your memory (Mayo Foundation for Medical Education and Research, 2018). Others however, might not simply be the cause of getting older. A lower energy level might be one of the symptoms correlated with the condition frailty. It is a state of health where ones overall well-being and ability to function independently are reduced, with an increased vulnerability to deterioration (Morley et al., 2003). Frailty is a condition which is correlated to aging, but is not equal to getting older. Frailty is defined as "a medical syndrome with multiple causes and contributors that is characterized by diminished strength, endurance, and reduced physiologic function that increases an individual's vulnerability for developing increased dependency and/or death'' (Morley et al., 2013, p. 393). There are two groups of researchers who mainly dominate the continuous discussion regarding the definition of frailty; one group defines frailty according to a broad definition including social and psychological aspects, whereas the other group defines frailty as a exclusively physical condition and therefore consists of only physical components (Collard et al., 2012). Most definitions also include a prefrailty state – a state in between frail and non-frail – recognizing that frailty is a dynamic process (Collard et al., 2012). A systematic review on the prevalence of frailty by Collard et al. (2012) shows that on average, 10.7% of community dwelling older adults are frail and another 41.6% are pre-frail (Collard et al., 2012). Other research also shows the condition increasing with age (Saum et al., 2014; Santos-Eggiman et al., 2009). The development of frailty often leads to increasing frailty, which in turn leads to higher risk of worsening disability, admission to hospitals and death (Clegg et al., 2013).

1.1 The impact of frailty and current assessment methods

It is no secret that the world's population is aging. Reports show that the population aged above 60 is currently at its highest level in human history, and will only grow more (He et al., 2016). The United Nations and World Health Organization (WHO) reported that the world's population aged above 60 will reach 2.1 billion by the time of 2050, which will make up 22% of the world's population (United Nations, 2015). As the aging population is more prone to developing frailty, it is important to easily assess and monitor this condition. The risk of admission into long-term care is higher in those with frailty compared to non-frail individuals (Clegg et al., 2013) and the future consequences of frailty is expected to place a great burden on older people, their caregivers and the health care systems. It is important to understand frailty and its outcomes as it can have effects on patient's treatment choices, care planning and cost of care. Personalised care can be made possible by early detection of frailty, which in turn can reduce the costs of care. Early identification might also even reverse the frailty by implementing exercise routines and nutritional interventions (Clegg et al., 2013; Morley et al., 2013).

As of now there are about 30 clinical frailty assessment scales used by clinicians around the world (Dent et al., 2016). Two popular assessment scales are Fried's Frailty Phenotypes (FP) and the CSHA Frailty Index (CSHA-FI) (Fried et al., 2001)(Rockwood et al., 2005). The FP considers frailty by its physical characteristics, and these define the condition as the presence of three or more: shrinking (unintentional weight loss of over 4.5 kg in the last year), weakness (low grip strength), self-reported exhaustion, slowness (walking speeds) and low physical activity (Fried et al., 2001). The CSHA-FI assesses frailty by examining 70 deficits, with items including the presence and severity of current diseases, the ability to carry out daily living activities, and physical and neurological signs observed during clinical examinations (Rockwood et al., 2005). Both scales rely heavily on self-report of previous diagnoses which is prone to error due to human bias and memory loss. Other assessment scales are too complex to be practically used in clinical settings

(Rockwood et al., 2005; Dent et al., 2016). It is thus important to look at other ways of assessing and monitoring frailty.

1.2 The development of a new assessment method

Technology will need to play an important role in the future of health care, as health care sources are becoming scarcer, leading to an increasing need for care at home (Hoey et al., 2012). More-over, older adults also seem to prefer to age in place ("Aging in place,'' 2018). Health care technologies can increase the range of care provision provided by medical personnel and aids to the wishes of older adults to age in place. For example, physical therapists can observe their clients working on their rehabilitation programs from home, without having to be physically present (Hoey et al., 2012). An example of a health care technology that can assess frailty from afar is the frailty toolkit that is being developed at the Intelligent Assistive Technologies and Systems Lab (IATSL) in Toronto, Canada. This toolkit will assess and monitor frailty in older adults from home, by measuring the Frailty Phenotypes (Fried et al., 2001). The toolkit is being designed to be able to continuously measure these parameters, and with this information predict whether someone is already frail and or has a chance of becoming pre-frail. This in turn could help clinicians to set up fitting treatment for older adults who are pre-frail or frail and maybe even reverse the condition.

The frailty toolkit that is being developed is considered to be an assistive technology (AT), which is a technological assistive device "whose primary purpose is to maintain or improve an individual's functioning and independence to facilitate participation and to enhance overall well being.'' (WHO, 2017). It has become more common to develop and use AT's in modern day health care, with examples ranging from a IT-based navigation device for visually impaired people (José et al., 2011) to a Smart Flower Stand that can act as a fall alarm, tracks the sleep-wake cycle and sends out notifications to caregivers when necessary (Nauha et al., 2018). The use of technology to assist people in their daily lives can be highly beneficial if the technologies are adopted by the user. However, while the potential usefulness of assistive devices is well-recognized, the adoption rates are very low (Lee & Coughlin, 2015). Many studies have researched why assistive technologies are rejected or abandoned. Related factors for abandonment or rejection were lack of consideration of user opinion in selection, perceived lack of need, poor device performance, misunderstanding and stereotyping of the target segment's characteristics and a lack of knowledge about how to use the AT (Lee & Coughlin, 2015; Phillips & Zhao, 1993; Davenport et al., 2012; Petrie et al., 2018).

1.3 Understanding the target audience

This raises the question: how do we develop a frailty toolkit that is not abandoned or rejected by older adults? To develop a successful AT it is important to look at the reasons for abandonment and use this knowledge to design a toolkit that is adjusted to the older adult's needs, priorities and knowledge. To meet older adult's needs it is necessary to know and understand the user. A user centered approach incorporates user requirements, user goals and user tasks into the design process (Czaja & Lee, 2007; Bastien, 2010a). Both focus group and usability have given great insights in user's perceptions about health monitoring and have proven to be successful user centered methods in the development of AT's. Two focus group studies of Demiris et al. show an overall positive attitude towards smart home technologies, but also reveal concerns regarding the user-friendliness of the devices, lack of human responders and possible privacy violations (Demiris et al., 2004; Demiris et al., 2008). The latter corresponds to Courtney's (2008) study, where findings suggest that privacy can be a barrier to older adults for the adoption of smart home technologies. However, the perception of their need for such home technologies may overrule the privacy concern (Courtney, 2008). There are plenty examples of successful usability studies researching the usability of health monitoring devices for the older population (Wildenbos et al., 2019; Holden et al., 2019; Mehra et al., 2019). These studies reveal large numbers of severe usability issues with mobile health (mHealth) applications, but also reveal satisfactory and positive rates for other mHealth applications. It shows usability assessment being capable of revealing major usability issues and being able to validate the usability by identifying less to no usability issues. Monahan et al. (2019) combined both methods to develop SymTrak, a tool that monitors chronic condition symptoms of older adults in primary care. Here, patients and caregivers were asked about the usefulness, potential applications and interpretation of the tool. These results were used for the development of the tool. The follow up usability test revealed that patients and caregivers found the tool easy to understand, easy to complete and enjoyable to complete without eliciting negative emotions (Monahan et al., 2019).

2. Research objective

Current clinical assessments of frailty are prone to error due to human error and memory loss, and they do not take into account the dynamic characteristic of the condition (Collard et al., 2012; Rockwood et al., 2005; Dent et al., 2016). The objective of this research is to develop a user friendly technology-based toolkit which can measure the frailty parameters in older adult's homes, to asses whether they are (becoming) frail. Research shows older adults abandoning AT's because of lack of user involvement, poor device performance and lack of knowledge about how to use the AT (Phillips & Zhao, 1993; Davenport et al., 2012; Petrie et al., 2018). It is therefore important to involve users in the selection process of this toolkit, as well as having the users test the usability of the prototype of the toolkit. The research questions in this study are twofold. First we will assess:

- How do older adults imagine in-home frailty monitoring in terms of the type of technologies to be used?
- How do older adults want to interact with frailty monitoring devices?
- What issues do older adults have with in-home frailty monitoring technologies?

After gathering answers on these questions, we will develop a toolkit prototype based on these answers and assess usability and acceptance by answering the following questions:

- How do users experience the frailty toolkit?
- What are user's attitudes about the frailty toolkit?
- What are the points of improvement for the toolkit?

3. Methods

3.1 Design

Data for the first study segment was collected during focus group sessions. Because the research interest was the opinions of older adults on potential in-home frailty technologies, a qualitative approach was used. Focus groups were selected because we were interested in multiple opinions and views on frailty technologies. Focus group discussions are a frequently used method to obtain knowledge, perspectives and attitudes of people about health technologies (Wong, 2008).

Data for the second study segment was collected with an online usability assessment of a video representation of the toolkit. Because the research interest was the experience of users with the toolkit, a qualitative/quantitative approach was used. The usability assessment was selected because we were interested in how people would receive the toolkit and if they experienced any issues or violations. A usability assessment can be done to assess the degree to which the designed system is effective and efficient while it favors positive attitudes from the users (Bastien, 2010b). Usability assessment is a way of ensuring that interactive systems are adapted to their users, their tasks, and that they cause no negative outcomes (Bastien, 2010b).

3.2 Sample: Size and Sampling procedure

Two focus groups, with five participants in each group, were held at the IATSL in Toronto. Older adults, ages 65 and up, living in Toronto, Canada were recruited. Three participants were male and seven were female. The average age of all participants was 71.1 years old. Participants were recruited online using the network of AGE-WELL NCE, which is Canada's technology and aging network. Recruitment flyers were also posted at the Rehab Science Building at University of Toronto (UofT) and University Health Network (UHN) hospitals (Appendix B). Potential participants were asked if they had experienced any physical decline over the past years to include older adults who displayed frailty symptoms. Two out of ten participants reported to have fallen over the last year, and two participants reported that it was sometimes difficult for them to perform light physical activities.

A total of 50 Dutch respondents and 30 Canadian respondents aged between 45 and 69 completed the survey. Ideally only participants aged 65 and up would have been recruited, but it was decided to also recruit a younger age group, ranging from ages 45 to 65, due to the COVID-19 related restriction of an online recruitment method. Participants were recruited through social media.

3.3 Procedure

A semi-structured series of questions guided the facilitator during the focus group (Appendix C). To introduce the participants to the topic of frailty, each session began with the facilitator asking the participants to describe someone in their environment experiencing physical decline, and to describe that someone's characteristics. Secondly they were asked about the importance of physical activity, and if they could think of a way of measuring specific frailty parameters such as walking speed and muscle strength. Thirdly, they were introduced with a sample of seven to eleven technologies which can measure the following five frailty parameters: activity level, weight, exhaustion, walking speed and muscle strength. Finally they were asked how and if they would want to interact with these technologies. The technologies with their respective measurements of the frailty parameters are visible in table 1. Pictures of the presented technologies can be found in appendix A. The focus groups were audiotaped and lasted between 90 and 120 minutes.

The audio from the focus group was transcribed verbatim and then analyzed with a mixed methods content analysis. With these results, technologies were selected that would make up the frailty toolkit. This frailty toolkit was represented by an immersive first-person point of view (POV) video of someone using these technologies.

Table 1

Technologies presented in focus group and respective frailty parameter measurement

Technology	Measurement of frailty parameter
Smart watch	Activity level, walking speed
Motion Sensor	Activity level
Depth Camera	Activity level, walking speed
Door Sensor	Activity level
Mat Sensor	Activity level, sedentary behaviour
Camera	Activity level, walking speed
Fridge Sensor	Food intake
Weight Scale	Weight loss
Dynamometer	Muscle strength
Smart Speaker	Exhaustion, food intake

Two versions (Dutch and English) of an online usability assessment were uploaded using the platform TypeForm. The online assessment introduced the participants to the subject of frailty by explaining what frailty is. The participants were then asked to imagine themselves in a situation where they were twenty years older than they were at that moment in time. The video introduced the participant being in the year 2040, watching tv and walking through their home while the toolkit asked them to answer questions and perform actions (Appendix D). After watching the video, a survey asked them open questions about their experience based on Nielsen's Heuristics (1994)(Appendix E). These open questions were followed by a questionnaire to self report the usability of the system (SUS) (Brooke, 1996)(Appendix F).

The SUS is a survey that can be used to asses the usability of a variety of products or services. It is composed of ten statements, each having a five-point Likert scale that ranges from *Strongly Disagree* to *Strongly Agree*. Previous research shows that there is a small correlation between age and SUS scores, meaning the SUS scores decrease with increasing age, but also show that there is no effect of gender (Bangor et al., 2008). The SUS yields a single number representing a measure of the overall usability of the system being studied. But how is this number interpreted? What is an acceptable SUS score? Bangor et al. (2008) believe that the university grade analog is ag good standard to interpret the SUS score. This analog compares the SUS score to university grades, going from 0 to 100. This would mean that passable products have SUS scores above 70, with satisfactory products scoring between the high 70s and upper 80s, and truly superior products scoring higher than 90. Product with scores lower than 70 would be considered to have usability issues that were cause for concern.

The SUS is a measurement of overall user satisfaction and the heuristic evaluation is used to find usability problems in an interface. While they are often not used together, there is research that shows that there is a relationship between more usability problems and a lower SUS score (Inal, 2018). Naturally, less usability problems would reflect into a higher SUS score.

3.4 Method of analysis

Qualitative data from the focus group was transcribed verbatim with the transcription software Transcribe.Wreally. The transcripts were analyzed with a mixed methods content analysis. Per question, meaningful sentences were condensed into meaning units. Condensation is the process of shortening the text while still preserving the core meaning (Erlingsson & Brysiewicz, 2017). These condensed meanings were then coded and given a label that most exactly describes what a particular condensed meaning unit is about. After coding, categories were formed by grouping together codes that were related to each other. Participant's responses whether they would (not) use a certain technology were tabulated and analyzed in SPSS. These responses ranked from *definitely would not use the technology* (score = 1) to *definitely will use the technology* (score = 5). The Kruskal-Wallis and Mann-Whitney U tests were used to determine differences in appreciation scores for the different technologies presented.

Qualitative data from the open-ended questions in the usability survey were organized in a table containing some of Nielsen's usability heuristics for user interface design, a description of violations and design recommendations (Nielsen, 1994). All quantitative data was tabulated and analyzed in SPSS. The

Mann-Whitney U test, Independent-sample T-test and One-way Welsch Anova were used to determine differences in SUS scores.

4. Results

4.1 Focus group

The older adults had various reasons for being physically active: some were physically active because they had been active in their previous years, while others mentioned they did not want to be confined indoors and thus used physical activity as their way of transportation. Reasons for not being physically active were the experience of pain during activity or because it was too exhausting. The most common form of physical exercise was walking, next to exercise at home, household exercise and exercising in the gym.

The walked distance was often mentioned as a way of measuring physical activity, along with the use of an activity tracker such as a pedometer or smart watch. One participant mentioned the measurement of the respiration rate. Most participants said to have used an activity tracker before (or using currently), and a reason for doing so was being motivated by the tracker to get up and move around. Participants were asked how they would measure various frailty parameters such as physical activity, but also muscle strength and sedentary behaviour. They did not really respond with technologies that could measure these parameters, but came up with rather subjective ways of measuring these parameters:

“Yes. It's called my wife.’’

“You can feel it. You can feel that how stronger the muscles are. I'm not sure about strength’’.

Table 2 shows the presented technologies with categories derived from the focus group sessions. Underlined is what has been said most often by participants. The categories were created by labeling meaningful segments and then grouping these labels. The focus group yielded answers to if and why participants would (not) use a certain technology, what their concerns were and how they would use the technologies.

For some technologies measuring physical activity, we see that participants would use them because they would be motivational, meaning they would create awareness of inactivity and thus motivate the participants to be more active:

"I think it's great because you know, if there's a certain standard of activity that you should be at and perhaps you're not there you think you're there, but maybe you're not it tells you you're not working hard enough. So you need to work harder.''

Part of motivating people is the daily monitoring of activity and providing feedback about someone's activity level, which was also mentioned as reasons of wanting to use the motion sensor and depth camera. While the camera was seen as useful for other people, participants did not mention reasons for using it themselves. This could be explained by looking at the concerns with the use of a camera. Privacy concerns were recorded most often with the camera, together with it being an intrusive technology:

"I would not like to use it. I would consider it an invasion of privacy''.

"Big brother is watching you.''

References to the book 1984 by George Orwell were made. However, it was also said that the camera would be used if it was really needed. Older adults thought the door sensor was non-intrusive, but this technology also came with accuracy concerns. The participants questioned whether it would be able to accurately measure if someone was actually being active outdoors:

" Is this a way for them to see that you open your door. and close your door. Well I mean somebody can do this. Open it: Okay, I'll come back 20 minutes later. Open it, close it and come back 20 minutes later.''

Table 2

Technologies and categories derived from focus group sessions

Technology	Categories			
	Reasons to use	Reasons not to use	Concerns	How to use
Smart watch (SW)	Motivational Use for specific programme Track distance	Privacy No need for tracking No interest in tracking		Continuously checking SW Needs a reminder
Mat sensor	Motivational Use if needed	Unnecessary Measuring limits		
Camera	Helpful for someone else	Inactiveness Intrusive	Privacy	
Motion sensor	Monitor daily activity	Not beneficial Not useful	Distinguishability Not affordable	
Depth camera	Provides feedback	People are not distinguishable	Privacy Measuring limits	
Door sensor	Motivational Not intrusive	Not interested Not useful	Accuracy	
Dynamometer	Awareness Use for clinicians office Exercise	Not necessary	Won't be used	
Fridge sensor		Nutrition awareness Not interested Not useful	Accuracy Distinguishability Confronting	
Weight scale	Weight management Health issues	Not necessary		
Smart speaker (food)	Feedback on nutrition		Privacy	Use for other measurements
Smart speaker (exhaustion)	Useful for healthcare Company Informative		Privacy	

***Note**:* Categories most often mentioned by participants are underlined.

The issue of accuracy in the form of being able to distinguish who is being measured also came up with the motion sensor and the depth camera:

“So if you live with somebody else or have guests over it would pick up their activity too so that's kind of not beneficial.’’

With many technologies, a reason for not using the tool was because the participants perceived it as not useful or they were simply not interested. Privacy was a major concern with the camera, but was also noted as a concern for other technologies such as the depth camera and the smart speaker.

“So, the smart technology that's inside of this, em does it listen to you if you're not directly interacting with it, you know like Alexa can't listen to you or I'm just thinking about surveillance technologies.’’

Participants did say however, that if the smart speaker systems were to be privacy secured, that they would be open to using the system. The participants seemed familiar with two technologies: the smart watch and the smart speaker. Participants have said that they themselves or their family had used the technologies before:

“Well, I actually I had a Fitbit but the Fitbit that I have wasn't the fitbit watch. I just had the one that I could clip on and things like that.’’

“We actually got one of those a couple of years ago as a gift we bought something else we gave it to my daughter and they use it all the time.’’

Participants of the second focus group were asked how often they would like to be asked questions by the smart speaker, and where. Various answers came along, with the location to be asked questions being in the kitchen or bedroom, in the morning and at night. Other participants said that it’s a personal decision:

“I think that's kind of a personal thing for each person’’

4.1.1 Quantitative analysis of the focus group

Responses whether participants would (not) use a certain technology were given a label ranking from *definitely would not use* to *definitely will use* the technology with a five-point Likert scale (table 3). The Kruskal-Wallis and Mann-Whitney U tests were used to determine differences in appreciation scores for the technologies for different aspects measured in frailty assessment.

Table 3

Translation of participant responses into labels and scores for analysis

Score	Label	Content of the meaningful segment
1	Definitely will not	I would not / I am not okay with
2	Probably will not	I guess I would not / I think I would not
3	Maybe	Has it's pro's and con's / on the fence / I am not sure
4	Probably will	I guess / not bothered / no problem with / I think I would
5	Definitely will	I would use / I am okay with

Activity level: A Kruskal-Wallis test was conducted to determine if there were differences in appreciation scores between the six activity level sensors for measuring activity level: “smart watch’’ (n=10), “camera’’ (n=10), “door sensor’’ (n=10), “mat sensor’’ (n=10), “motion sensor’’ (n=5) and “depth camera’’ (n=5). Distributions of appreciation scores of activity level sensors were not similar for all groups, as assessed by visual inspection of a boxplot. Appreciation scores were statistically significantly different between the different sensors, $\chi 2(5) = 13.748$, $p = .017$. Subsequently, pairwise comparisons were performed using Dunn's (1964) procedure with a Bonferroni correction for multiple comparisons. Adjusted p-values are presented. This post hoc analysis revealed statistically significant differences in appreciation scores between the smart watch (mean rank = 36.85) and the camera (mean rank = 14.85) ($p = .007$), but not between any other sensor combination (see table 4).

Table 4

Mean ranks appreciation scores (n) of activity level sensors

Sensor	Mean rank (n)
Smart watch	36.85 (10)
Camera	14.85 (10)
Door sensor	21.65 (10)
Mat sensor	27.85 (10)
Motion sensor	23.30 (5)
Depth camera	29.30 (5)

Walking speed: A Kruskal-Wallis test was conducted to determine if there were differences in appreciation scores between the three walking speed sensors: "smart watch'' (n=10), "camera'' (n=10) and "depth camera'' (n=5). Distributions of appreciation scores of walking speed sensors were not similar for all groups, as assessed by visual inspection of a boxplot. Appreciation scores were statistically significantly different between the different sensors, $\chi2(2) = 9.127$, $p = .010$. Subsequently, pairwise comparisons were performed using Dunn's (1964) procedure with a Bonferroni correction for multiple comparisons. Adjusted p-values are presented. This post hoc analysis revealed statistically significant differences in appreciation scores between the smart watch (mean rank = 17.25) and the camera (mean rank = 8.00) ($p = .009$), but not between the smart watch and depth camera (mean rank = 14.50) or any other sensor combination.

Food intake: A Mann-Whitney U test was run to determine if there were differences in appreciation score between the fridge sensor (n=10) and the smart speaker for food intake (n=5). Distributions of the appreciation scores for the fridge sensor and the smart speaker for food intake were not similar, as assessed by visual inspection. Appreciation scores for the fridge sensor (mean rank = 5.75) were statistically significantly lower than for the smart speaker for food intake (mean rank = 12.50), $U = 47.50$, $z = 2.871$, $p = .003$.

Weight loss, muscle strength, exhaustion: For the following frailty parameters only one sensor per parameter was tested. For weight loss we proposed a weight scale, for muscle strength we proposed a handheld dynamometer and for exhaustion we proposed the smart speaker. The mean score per sensor, 5 being the maximum, is reported in table 5. The next section will discuss what technologies were chosen to be used in the frailty toolkit, and why.

Table 5

Mean ranks appreciation scores (n) of other sensors

Sensor	Mean (n)
Weight scale	4.60 (5)
Handheld dynamometer	4.30 (10)
Smart speaker exhaustion	4.60 (10)

4.2 Selection of technologies

Following the focus group, a selection of technologies was made to be used in the frailty toolkit. This was done by comparing the focus group results per frailty parameter.

The smart watch was selected to measure the parameter activity level. The smart watch was appreciated most, and it suffered the least from privacy concerns. The participants also did not mention measuring limits and seemed to be more familiar with the technology, having used it before.

Three of the six activity level sensors were compared to choose a walking speed sensor. Again, the smart watch was appreciated most. The smart watch was therefore also selected to measure walking speed.

Two sensors were presented to measure food intake, an important part of the frailty parameter weight loss: a fridge sensor and a smart speaker. The smart speaker was appreciated most, and did not receive any accuracy concerns. The smart speaker was therefore selected to measure food intake.

The following technologies were presented to measure their respective frailty parameters: weight scale – weight loss, handheld dynamometer – muscle strength, smart speaker – exhaustion. With these three parameters, there weren't any other technology options presented. We see that the participant would use these technologies to inform them about their health, manage their health and to raise awareness about their health. However, participants would not use these technologies because they were deemed unnecessary. We see that all three sensors have a average score > 4, which would translate to participants saying they would probably to definitely use these technologies. We can thus conclude that these technologies overall were well received and will be appropriate for the frailty toolkit.

4.3 Usability assessment

4.3.1 Heuristics

The overall experience was questioned first, after which more specific questions were asked. Almost all participants found the toolkit easy to use. Questions were described as "simple and asked in a clear manner''. The toolkit's instructions were clear, but it was also questioned how difficult it would be to set up the toolkit.

There were a few main characteristics the participants liked about the toolkit; the toolkit was simple, gave quick responses and was easy to communicate with. Again, it was reported that the questions were asked in a clear manner. There was a variety of characteristics the participants disliked. Multiple participants responded that not everyone can wear a watch or wants to wear a watch. The questions seemed impersonal and would disturb the user during their daily routine. Someone said it would get bothersome if the questions were asked on a daily basis, and others did not want to keep busy with such measurements. Multiple participants expressed their concern on how the toolkit would breach their privacy, where one participant responded he did not like the "Big Brother'' feel.

When asked if older adults would be accepting of this toolkit in their home the answers were somewhat divided. About 68 % of the participants thought older adults would be accepting of the toolkit, where 16% expected the older adults to not accept the toolkit. Participants said they expected older adults to be accepting with the prerequisite that clear instructions were given beforehand and that privacy would be guaranteed. Others said they thought the toolkit would be too modern for older adults. It would be intrusive, bothersome and the toolkit would be too unpersonal. The need to have human contact was said to be important for older adults. Other participants did not give a straight answer as to if the toolkit would be accepted. They said it depended on the individual and the individual's age.

The next section of the usability assessment addressed more specific characteristics of the toolkit based on Nielsen's heuristics. Note that only a few of Nielsen's heuristics were questioned due to the experiment setup. The responses were tabulated, describing violations, recommendations and strengths (table 6).

1. *Visibility of system status*

About 30 % of the participants have said that they did not receive feedback on where the user was during their task, and if they completed their task correctly. It was recommended to give feedback by repeating what was said by the user as an answer to the system's questions, and to give feedback on the measurements itself. Also, it was said that more time might be needed when a user has to think about the past – e.g. their exhaustion during the week or what they had to eat during the day. Noted as a strength of the system was the quick feedback it produced.

Table 6

Violations, recommendations and strengths of the frailty toolkit.

Heuristics	Violations	Recommendations	Strengths
Visibility of system status	Did not give feedback on where user is in task	Repeat the reported answer as a confirmation Give more time for questions to be answered Give substantive feedback on someone's reported measures	Quick feedback
Match between the system and the real world	Smart speaker sounds like door bell Robot voice is bothersome	Use more laymen's terms Might be problematic for people with hearing issues	Clear questions and easy to understand System asks questions in logical order
User control and freedom	Cannot perform tasks when not at home	Needs to be more automated	
Aesthetic and minimalist design	Design is barely noticeable Overwhelming amount of technologies		Simple and uncluttered
Help and documentation	Not clear where to ask questions Did not inform what the system was doing with information		

2. Match between the system and the real world

Two violations were noted with the second heuristic. The first violation had to do with the sound of the smart speaker activating and preparing itself to interact with the user. This sound was received as sounding like a door bell, which could confuse the user as to where to direct their attention. The second violation was described as the artificial intelligent robot voice of the smart speaker, which was perceived as annoying and bothersome. Recommended was to use more laymen's terms; one participant stated that exhaustion (Dutch: uitgeput) could be changed to tired (Dutch: moe) as it could be difficult to understand.

Someone also raised the question of how the toolkit would work with people who have hearing disabilities and how it would adapt to these people. 96% of the participants responded that the questions were clear and easy to understand, while being asked in a logical order.

3. User control and freedom

While this heuristic also was not questioned in the survey, users did note that they would not be able to perform the tasks if they were not in their homes. Some said they would not want to have the toolkit ask questions while being outside, and asked whether it would interrupt them as their schedules vary from day to day. One user mentioned that they would like to see the system more automated.

4. Aesthetic and minimalistic design

The design of the toolkit was barely noticeable and blended in with the background too much. Too many technologies in the toolkit could also be too overwhelming for the user. It was recommended to provide different colours to make the toolkit more noticeable. A few participants said they would like to see an alternative for the smart watch. More than half of the participants did think the design of the toolkit was simple and uncluttered.

5. Help and documentation

It was not clear where and if the users could ask for help or ask questions about the frailty toolkit. Unclear was also what exactly was done with the collected information.

4.3.2 System usability scale (SUS)

The second half of usability assessment consisted of the system usability scale. SUS yields a single number representing a composite measure of the overall usability of the system being studied. The SUS score was calculated by the sum of the score contributions from each item. Each item's score contribution ranged from 0 to 4. For the positively stated items the score contribution was the scale position minus 1. For the negatively stated items the contribution was 5 minus the scale position. The sum of the contribution scores was then multiplied by 2.5 to obtain the overall value of SUS. The maximum score to be obtained was 100.

Table 7

Mean SUS score with standard deviations per nationality, gender and combined

Nationality	Female		Male		Total	
	M (n)	SD	M (n)	SD	M (n)	SD
Dutch	67.03 (32)	16.22	73.33 (18)	12.60	69.30 (50)	15.20
Canadian	84.11 (14)	14.30	81.09 (16)	12.18	82.50 (30)	13.07
Total	72.23 (46)	17.42	77.00 (34)	12.83	74.25 (80)	15.72

SUS score for Canadian participants was not normally distributed, as assessed by Shapiro-Wilk's test ($p = .031$). Therefore a Mann-Whitney U test was run to determine if there were differences in SUS score between Dutch and Canadian participants. Distributions of the SUS score were not similar, as assessed by visual inspection. SUS score for Canadian participants (mean rank = 52.22) were statistically significantly higher than for Dutch participants (mean rank = 33.47), $U = 1105.50$, $z = 3.50$, $p < .001$.

There were 34 male and 46 female participants. An independent-samples t-test was run to determine if there were differences in SUS score between males and females. There were no outliers in the data, as assessed by inspection of a boxplot. Appreciation scores for each level of gender were normally distributed, as assessed by Shapiro-Wilk's test ($p > .05$), and there was homogeneity of variances, as assessed by Levene's test for equality of variances ($p = .121$). There was no significant differences in SUS score between males and females, $t(78) = 1.35$, $p = .183$, despite the men's SUS score being higher than for female participants (table 7). This confirms Bangor et al. (2008) assumption that SUS score is not affected by gender.

The participants' age was recoded into five age groups (table 8). A one-way Welch ANOVA was conducted to determine if the SUS score was different for groups with different ages. There were no outliers, as assessed by boxplot; data was normally distributed for each group, as assessed by Shapiro-Wilk test ($p > .05$); but there was heterogeneity of variances, as assessed by Levene's test of homogeneity of variances ($p = .008$). There were no statistically significant differences between the SUS score of the age groups $F(4,30.97) = 1.43$, $p = .247$. This does not confirm the assumption that the SUS score decreases as age increases (Bangor et al., 2008)

Tabel 8

Mean SUS score with standard deviations per age group and education level

Age group (n)	M	SD
45 – 49 (9)	67.50	18.11
50 – 54 (21)	78.33	12.71
55 – 59 (23)	76.20	18.75
60 – 64 (15)	72.33	17.49
65 – 69 (12)	70.83	7.49

5. Discussion

5.1 Attitudes towards in-home monitors

The first half of this study examined older adult's perceptions on in home monitoring technologies. Results show that most of the older adults do not actively think about how their health can be measured outside of the clinician's office. The older adults do not seem to feel an urgent need to use most technologies, and are not necessarily interested in tracking their health measurements. This can be explained by the participant's health: most had reported to not have experienced any health issues in the past years. However, the need for technologies was recognized when it was prescribed as part of a specific programme or if the clinician would deem it to be necessary to track the patients' health. The perceived lack of need is one of the reasons for abandonment of AT's (Davenport et al., 2012; Petrie et al., 2018), and thus it is important to have the intended users known why the toolkit is needed.

A major concern with many of the technologies was the possible privacy violation from using the technologies. This concern refers to being identifiably recorded and to recorded while being unaware.

Information privacy is something which is much valued by patients (Goodwin et al., 2002) and therefore it is important to guarantee complete information security regarding personal information collected with such a system. Patient's concerns regarding medical data privacy can have harmful effects on their interaction with health care provider (Courtney et al., 2008). This can range from withholding of information to the avoidance of the health care system all together (Courtney et al., 2008).

5.2 Usability of the toolkit

The second half of this study researched the usability of the frailty toolkit. The average SUS score (74.25) represents the overall usability of the toolkit. Comparing this score with the University Grade Analog (Bangor et al., 2008) this toolkit would get rated with a "pass'' - an acceptable usability. However, having a SUS score on the border of acceptable / unacceptable is not considered ideal. Looking into the nationality differences we can establish that the average Dutch score is below this *passable* border, where the Canadian participants ends well above that threshold. It is therefore important to see where points of improvement can be found.

Nielsen states that "the system should keep the user informed about what is going on, through appropriate feedback within reasonable time'' (Nielsen, 1994). However, the participants did not feel like this toolkit gave them this appropriate feedback. They advised repeating the reported answer and to give more substantive feedback. Examples of substantive feedback could be encouraging or motivating statements on an individual's measurements.

The participants noted that the questions were unpersonal, could be disturbing the daily routine and could potentially get bothersome when asked every day. Comparing these results with the focus group, we can conclude that it is important for the user to have the freedom to decide when and how often the toolkit will communicate with them. The toolkit for example could be designed to prompt the user for information, or users can proactively "push'' information to their clinicians (Courtney, 2008). Users should also be able to personalize the notification sounds and voice commands. A concern was raised that not everyone can or wants to wear a watch on a daily basis. A different technology that could measure users' activity level and walking speed that would not be worn on the wrist for example could be a fitbit clip ("Fitbit Inspire Accessories,'' n.d.). As the design was described as simple and uncluttered, but also barely noticeable, we recommend to offer more colour variety. Again, the concern of privacy violation was raised, which corresponds to the focus group in this study but also to previously mentioned studies researching health monitoring devices (Demiris et al., 2004; Courtney et al., 2008).

The use of the toolkit was explained during the study, but it was still unclear why the system collected the information and what it was used for. Having something unfamiliar installed at the place that is most private to you, your home, can feel as a breach of privacy (Courtney et al., 2008). I believe that, apart from the technical aspects, one of the most important aspects of the success of this toolkit will be the instructions and explanation of why the toolkit is installed. When users do not know why their information is collected, and therefore might not see why the toolkit is useful and necessary, it may lead to abandonment (Lee & Coughlin, 2015)

Acceptance of the toolkit is important as it has major opportunities to aid in diagnosing frailty in older adults, where current practices fall short due to methods that prone to error due to human bias and reflect snapshots of someone’s wellbeing (Fried et al., 2001; Rockwood et al., 2005). Frailty is a dynamic condition and should be treated as such, and the toolkit has the capabilities to do so. Further development and testing however is needed, as we see that there are many points of improvement.

5.3 Limitations

This explorative research provides some insight in how a new technology for the assessment of frailty is appreciated and what improvements can be realised. The proposed recommendations can be used to iterate the toolkit, which will also have a positive effect on the SUS score. This score can then be benchmarked against other similar health monitoring technologies. The further development of the toolkit will hopefully result into a useful and valuable new method to assess frailty in older adults. However, this research also shows its limitations.

More technologies were presented in the second focus group. There was a third focus group lined up to enrich the already existing data. The sudden closing if all universities meant that the focus group data was more limited because the third focus group could not be carried out. It is important to still carry out this third focus group when this has become possible to confirm the conclusions drawn from the focus groups.

There are many ways to conduct a usability study, with every method having it’s pros and cons. There are expert-based inspection methods and user-based methods. A prominent user-based approach to gain deep insights in the problems user encounter in interaction with a system in usability assessment is the Think-Aloud method (Jaspers, 2009; Bastien, 2010b). Users are invited to do typical tasks with a product, or are asked to simply explore it freely, while their behaviours are observed and recorded in order to identify design flaws that cause errors or difficulties. The initial objective of this research was to research older adults carry out a usability test where they interacted freely with the technologies in the toolkit, after which they were questioned about their experience according to Nielsen's Heuristics (Nielsen, 1994). However, the COVID-19 pandemic hit the world and this method was not considered an option anymore. Therefore, a video was created to mimic the feeling of walking through a room and interacting with the toolkit. Nevertheless, a real interaction with the toolkit was not there. The participant did not have the ability to take their time and freely explore the toolkit, thinking-aloud while completing tasks. Analyses of these verbalisations provide detailed insights into usability problems actually encountered by end users. The current research gives us some insights participants opinions on the toolkit, but they did not necessarily encounter usability problems. Future work should therefore be carried out to assess the usability according to the think-aloud method to gain more deeper insights with encountered usability issues.

Participant were recruited through social media to assess the usability of the toolkit. Ideally older adults would have been recruited, but due to the online character of the survey this would have been problematic. The CBS reports that 40% of Dutch older adults aged 75 or older use social media (Roozen, 2020). We compared these numbers to the percentage of social media users in the age group 45 to 65 year (94.8% and 88.9% respectively), and determined that this group would be easier to reach through social media. This did result into a younger age group, which could have an effect of the results of this research. However, results suggest that there was no effect of age on the SUS score which counters this implication.

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Appendix A Technologies Focus Groups

Figure 2 *Wearable*

Figure 3 *Door sensor*

Figure 4: *Fridge sensor*

Figure 5 *Mat sensor*

Figure 6 *Camera*

Figure 7 *Depth camera*

Figure 8 *Dynamometer*

Figure 9 *Motion sensor*

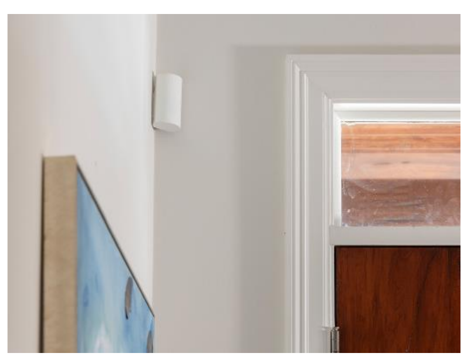

Figure 10 *Smart speaker*

Figure 11 *Weight scale*

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Appendix B Recruitment Flyer Focus Group

PARTICIPANTS NEEDED FOR

RESEARCH ON FRAILTY ASSESSMENT

We are looking for volunteers to take part in a study researching attitudes towards frailty monitoring technologies to develop a frailty monitoring toolkit. As a participant in this study, you would be asked to participate in a focus group to discuss technologies which can be used monitor frailty in older adults.

Your participation is **entirely voluntary** and would take up approximately 75 minutes. By participating in this study you will help us create a better understanding of how you would like these technologies to measure your health and help us develop a frailty monitoring toolkit which is accustomed to your wish and needs.

Your time will be compensated.

We are looking for volunteers who

- are aged **65 years or older**,
- are able to walk with or without assistance and
- are able to communicate fluently in English.

To learn more about this study, or to participate in this study, please contact:

Principal Investigators
Chao Bian & Anna Hoonakker
416-946-8573 or chao.bian@mail.utoronto.ca

This study is supervised by: Dr. Alex Mihailidis – alex.mihailidis@utoronto.ca
This study has been reviewed by the University of Toronto Research Ethics Board.

Appendix C Focus Group Guidelines

Below is a general guide to help moderators lead the focus group session, but flexibility will be exercised to facilitate discussion and creative brainstorming. Before the focus group begins, participants should provide informed consent be reminded that their participation will be recorded using a video recording device. During the complete session, two researchers will be present. One researcher will take field notes, while the other researcher will ask the question and facilitate the discussion between participants.

Introduction

1. Welcome the participants and introduce myself.

Welcome and thank you for volunteering to take part in this focus group. I am Anna Hoonakker and I am an international student from the Netherlands doing my research at the Intelligence Assistive Technology and System Lab. I'll be moderating our discussion today. It is important that you know and understand that you can withdraw from this research at any stage without penalty.

2. Explain the purpose of the study and its overall importance/significance.

Today we will be talking about how your health can be monitored by technologies. We are designing a toolkit to help monitor physical decline through monitoring physical health. This physical decline in clinical sense is called frailty. We will discuss health monitoring and review some technologies which can be used to measure your health. It is important for us to get your opinion on the monitoring of health by technologies because we want to include technologies in this toolkit which are appreciated by its intended users: you.

3. Explain the focus group session they will participate in

As I mentioned before, we will be discussing the topic of health monitoring with technologies. Firstly, we will try to think of technologies which can be used to do so. Later in the focus group I will show you a few technologies and I will ask you what you think of these technologies.

4. Explain the expectations for participants

The most important rule is that only one person speaks at a time. There may be a temptation to jump in when someone is talking but please wait until they have finished. We are interested in hearing your thoughts and points of view even if it is different from that which others express in the group. I want you to know that there are no right or wrong answers, and all opinions and views are equally important. This also means that you do not have to agree with the views of other people in the group.

Time commitment: I estimate this discussion group to last no longer than one hour. I am going to make every effort to keep the discussion focused and within our time frame. If too much time is being spent on one question or topic, I may park the conversation so that we can move on and cover all of the stages and also to ensure that all participants have a chance to give their input. If we have sufficient time, we will revisit parked thoughts in the order they were parked.

5. Address confidentiality

We will be audio-recording the discussion because we don't want to miss any comments. But we will only be using first names today and there will be no names attached to the final report. Therefore, you are assured of complete confidentiality. The tapes will be kept safely in a locked facility. As the discussion will be recorded it is best if one person speaks at a time.

6. Answer any questions from or address participant's concerns related to the study

Are there any questions or concerns regarding the study?

7. Reiterate the information on the consent form and ask if the participant has questions or requires any clarification

You have all received the consent form through email or post. I hope you all had the time to read this consent form thoroughly. Are there any questions regarding the consent form, or does anyone want me to clarify something about the consent form?

Review of technologies

We will start the focus group by asking the participants if they know someone in their direct environment who has trouble aging, and to describe that person. By asking for a description, the participants will most likely mention cognitive and physical decline of older adults. We want them to first describe measures for frailty themselves and come up with technologies which can be used to measure. Then, we will show them technologies which can be used and how they would feel using these technologies. This will be repeated until we have reviewed all technologies. The basis for this set-up is provided in a systematic overview in figure 12. Some measurements (muscle strength, report exhaustion level) are measured with only one technology, which means there will only be 1 technology presented. As some technologies can measure multiple frailty criteria's, some technologies will be discussed more than once.

1. *Think of someone in your environment who has trouble aging. How would you describe that person?*

a. If participants mention physical decline go to question 2

b. If participants do not mention physical decline, confirm this is indeed a sort of decline which pairs with getting older. Probe into mentioning physical decline instead of cognitive decline does the person also have trouble moving around?

2. *Pick out one of the frailty criteria (X) mentioned by the participants. I hear X has been mentioned a lot/you have mentioned X. How important is X to you?*

3. Can you think of a way to measure X? How?

Introduction to first technology (T1) by showing the participants the technology on paper while explaining what it is and how it works.

4. *How would you want to interact with T1?*

a. If participants do not want to interact with T1, introduce T2 and go to question 6.

5. *Would you feel comfortable having T1 monitoring your health? Why not?*

Introduction to first technology (T2) by showing the participants the technology on paper while explaining what it is and how it works.

6. *How would you want to use this technology?*

7. *How would you want to interact with T2?*

8. *Would you feel comfortable having T2 monitoring your health? Why not?*

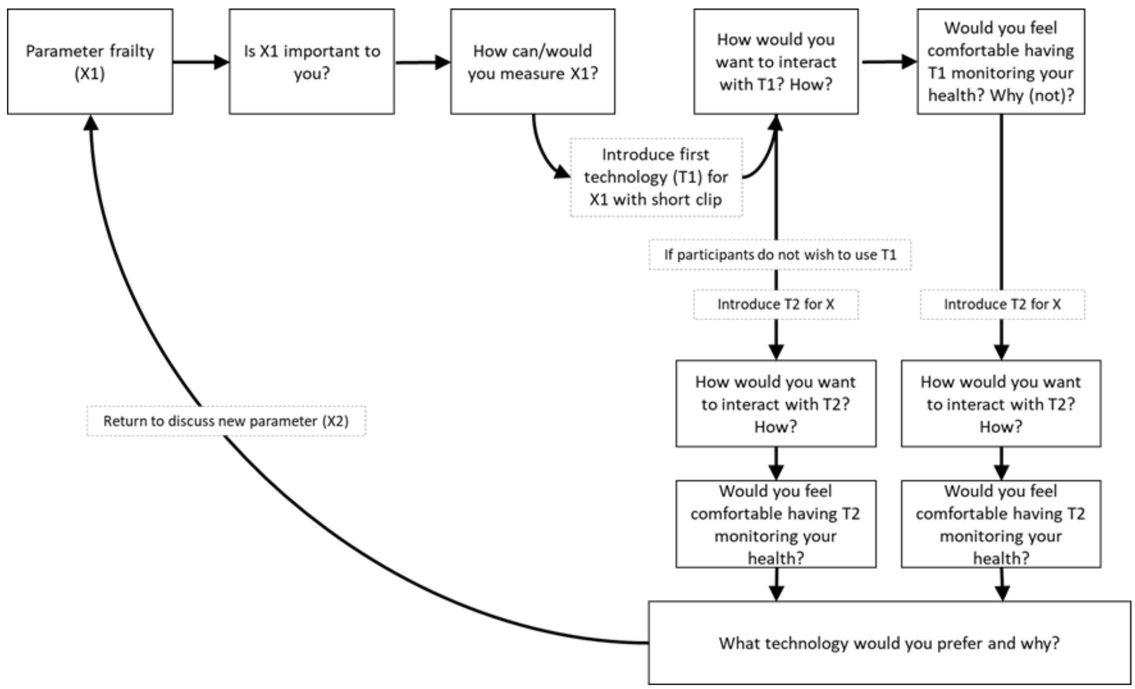
9. *We have just discussed a few technologies which can be used to measure X. What technologies would you prefer to monitor/measure that X? Why?*

Return to question 2 and mention another physical decline which appears in older adults and has been mentioned by the participants.

10. Conclude what technologies we have discussed and which technologies were more appreciated than others. See if the participants have any extra additional remarks about this.

Figure 12

Systematic overview guidelines focus group



Appendix D Introduction and Instructions Usability Assessment (EN)

Welcome!

First of all we want to thank you for participating in this survey. You are taking part in a study that researches a toolkit that can detect frailty in older adults. By older adults we mean people with an age of 65 and up. This toolkit is being developed to detect frailty in older adults which in turn can help them get the appropriate care. You will see a video with a number of technologies, which you will be asked a few questions about later. Collectively, these technologies form a toolkit that can detect frailty in older adults.

It is important to have your volume on and that you watch the video in a quiet environment. While watching the video and answering the questions, we ask you to empathize with the situation that is outlined in the video. Try to empathize with being an older adult. Finally, you will be asked to answer some questions about yourself. This data will only be visible to the researchers of this study and your personal data will not be published.

Thanks again and have fun!

<u>Scenario:</u> It is 2040. You are sitting on the sofa watching TV while wondering where the time has gone. It feels like yesterday when you were very active, walked daily and said, "40 is the new 30." "But if you're being honest, you're not the youngest anymore. You knee has been aching lately, which makes walking a bit more difficult. This also means that you now enjoy sitting on the sofa at home a bit more, watching TV and having a drink or a bite to eat.

When you went to the doctor for a check-up last week, he spoke about a new system that could detect frailty in older adults. This toolkit consists of different technologies. He told you it was still in it's testing phase and asked if you would like to test the system. You told him that while you wouldn't categorize yourself as frail, you would have no problem testing the thing. The doctor told you that the system will communicate with you and request that you perform certain actions. '' Exciting '' you thought, as you started the first testing phase of the toolkit ...

Video https://youtu.be/D4qCDOTHMKA (EN) https://youtu.be/nfapsaFPLiU (NL)

Thank you for watching the video. We will now ask you a few questions. We would like to ask you to still imagine as if you actually interacted with the sensors in the video.

Survey usability assessment (Appendix E)

Thank you for answering the open questions. We now continue a short questionnaire about your experience with the toolkit. Here you choose which answer is most applicable to you. You can choose between the following answers:

1 = Strongly Disagree

2 = Disagree

3 = Neither Disagree nor Agree

4 = Agree

5 = Strongly Agree

Again, you are requested to imagine that you are still 20 years older than your current age.

SUS questionnaire (Appendix F)

Finally, a few more questions about yourself..

a. What is your age?

b. What is your nationality?

c. What gender do you identify with?

- Male
- Female
- Other

d. What is your highest level of education?

- Primary education
- Secondary education
- College
- Bachelors degree
- Masters degree
- PhD or higher

e. Do you have any comments about this study?

This is the end of the survey. We would like to thank you for participating in this study.

Would you like to receive the research report or do you have questions about this study? Please contact Anna Hoonakker at a.e.hoonakker@students.uu.nl

Appendix E Survey Usability Assessment

(adapted from Nielsen, 1994)

1. Overall, how was your experience using the frailty toolkit?

   - Was it easy or difficult to use? What was easy / difficult about it?

2. What did you like about the toolkit? What did you not like?
3. By providing a tool like this, do you think older adult would be likely to accept such a frailty measuring tool into their homes?
4. We will now proceed to ask you for more specific questions about your experience using the toolkit. In your responses, feel free to offer recommendations on how we can redesign the toolkit to resolve any specific issues you had.

   a) **Visibility of system status**: Did you feel that the toolkit..

      i. ... kept you informed of where you were in your task?

      i.. ... kept you informed of what the system was doing (i.e. status)?

      iii. ... provided appropriate feedback within a reasonable amount of time?

   b) **Match between system and real world**: Did you find the words and phrases used in the toolkit were..

      i. ... familiar and easy to understand (vs. too technical)?

      ii. ... appeared in natural, logical order?

   c) **Aesthetics and minimalist design**: How did you find the design of the technologies used in this toolkit? Was it simple and uncluttered?

Appendix F SUS Questionnaire

(adapted from Brooke, 1996)

1 = Strongly Disagree

2 = Disagree

3 = Neither Disagree nor Agree

4 = Agree

5 = Strongly Agree

1. **I think I would like to use this toolkit frequently**

   Strongly Disagree 1 2 3 4 5 Strongly Agree

2. **I found the toolkit unnecessarily complex**

   Strongly Disagree 1 2 3 4 5 Strongly Agree

3. **I thought the toolkit was easy to use**

   Strongly Disagree 1 2 3 4 5 Strongly Agree

4. **I think that I would need the support of a technical person to be able to use the toolkit**

   Strongly Disagree 1 2 3 4 5 Strongly Agree

5. I found the various functions in this toolkit were well integrated

Strongly Disagree 1 2 3 4 5 Strongly Agree

6. I thought there was too much inconsistency in this toolkit

Strongly Disagree 1 2 3 4 5 Strongly Agree

7. I would imagine that most people would learn to use this toolkit very quickly

Strongly Disagree 1 2 3 4 5 Strongly Agree

8. I found the toolkit very cumbersome to use

Strongly Disagree 1 2 3 4 5 Strongly Agree

9. I felt very confident using the toolkit

Strongly Disagree 1 2 3 4 5 Strongly Agree

10. I needed to learn a lot of things before I could get going with this toolkit

Strongly Disagree 1 2 3 4 5 Strongly Agree