EMOTIONS AROUND EMERGENCY ALARM USE:

A FIELD STUDY WITH OLDER ADULTS

Report for Smart Services CRC Personalisation Project H5

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Contents

Introduction

This document reports on the outcomes of two studies which investigated the use of domestic technologies and more specifically emergency alarms by older people. This research aims to generate a better understanding of the emotions, challenges, benefits, and opportunities that are encountered when elderly people use emergency alarms in the domestic space. First, twelve semi-structured interviews were conducted in the field with users of emergency alarms, relatives of emergency alarm users and older people that do not use an alarm. Interviews involved questions about their general expectations and feelings around domestic technology use (labelled in the report as non-users). Although older people often have specific concerns (e.g., mobility and health problems), their need for social connection and meaningful activities around technologies are similar to those of the general population despite them being quite often less engaged in technology use. A second field study explored the opportunity for a prototype, developed by the emotions discussed in the interviews.

Technology has the potential to support older people in their everyday lives, but only if it addresses their needs. Many existing technologies for the elderly fail because they do not address the emotional requirements of older people, such as the fear of new technology (Lorence and Park, 2006). This project is part of a larger research program on creating modern emergency alarms that aims to address the emotional needs of technology users via a novel combination of ethnography and motivational goal modelling. Emergency systems are an example of technology that has high impact potential, but does not address the emotional needs of older people. Emergency systems typically have two features: (1) an emergency alarm: the user can raise an alarm if they require emergency attention; e.g. via pushing a button on a pendant worn around the user's neck; and (2) a wellbeing check: the user informs the service provider that they are fine, on a daily basis; e.g. via a button on a base station connected to a telephone line. If no indication of wellbeing is received during a specified period, the service provider initiates checks on the user.

While these emergency systems offer valuable services to older people and their families, they often suffer from usage problems. One major reason for this is that they do not consider many of the emotional needs and contextual conditions of the older people using them.

For example, our field interviews of study one revealed that older people view these emergency alarm pendants as "cowbells" forced onto them. The emergency systems suffer from many problems, including:

1/
The emergency alarm pendants worn around the owner's neck are viewed by the owner as having a "stigma" attached to them, which indicates that they are no longer independent and cannot care for themselves.

2/
The emergency alarms offer only limited mobility, in that the alarms will typically only work in the owner's house, meaning that they might be hesitant to leave the house.

3/
The wellbeing check requires the user to remember to push a button each day. When they forget, the service provider calls to check, which leads many older people to feel they are a burden, despite paying for the service, and to feel that they are perceived by their families as suffering from memory loss. The reason is that the pressing of the button does not convey any meaning to them and it is therefore forgotten.

4/
Many of the properties of the emergency system are not easily configurable, such as the time period in which the wellbeing button is pushed, or the people that will be notified if it is not, leaving the users feeling that they are not in control of the system.

In addition to these problems is the issue of cost: the hardware plus the cost of monitoring the system is so extensive that many users cannot afford the service (Vergados et al., 2008). Many local councils in Australia that subsidise the service are only able to offer it for the most needing people, meaning that many people miss out. Another consequence of this is that emergency services are usually introduced in a critical period of a traumatic event such after a fall, the bereavement of a partner or when the first time the discussion comes up to move to a nursing home. A lot of older people feel overwhelmed in these situations to adopt a routine around a new technology.

Of particular importance of these systems is that they address the functional and emotional needs of the older people using them, such as allowing them to feel independent, giving them control, and integrating them into their individual lifestyle (to feel 'non-disruptive'). At the same time, the emotional needs of other concerned parties such as families, friends, and other carers must be considered.

The results of this first study provide a basis for designing, implementing, and evaluating a mobile emergency system (study two) that considers the major emotional goals of older people such as feeling safe, mobile and independent, but still cared about. Our focus is on innovative ideas around emergency alarm systems without the stigma of feeling monitored, controlled and dependent on others. We hope to enable older people in a situation that might require emergency action. Allowing this them to remain at home and to make choices about the remainder of their life.

TECHNOLOGIES FOR OLDER PEOPLE (CURRENT RESEARCH)

In recent years there has been a growing interest in the design of technologies for older people (Birnholtz & Jones-Rounds, 2010; Waycott et al. 2012, Vutborg et al. 2011; Wherton & Prendergast, 2009). Much of this literature has focused on health and safety issues, such as the design of technologies for monitoring health and providing support in the context of failing health and increasing frailty (Birnholtz & Jones-Rounds, 2010; Blythe, et al., 2005). While these concerns are important for older people, we propose that the feelings of older people and their interests and independence have been neglected. We aim to design technologies that convey older people with positive feelings when used and to give them a strong voice in the development. In this way, we will adopt a positive design approach, using technology to create "new opportunities for activity" (Carroll, et al. 2012, p. 7). They argued that there are benefits in designing technology that aim to enhance the strengths of older users, or that provide new opportunities for older people to exhibit and build on their strengths. Others have also argued that it is important for designers to take into account the particular communication preferences, needs, and strengths of older users when developing technologies for elderly people (Lindley, et al. 2009). Technology for older adults is likely to fail unless it can be used effortlessly and it serves a clear and meaningful purpose (Lindley, et al., 2009). A main concern for our project was to effectively meet these challenges and to make recommendations for an emergency alarm that would be useful, usable, and ideally surround them with positive feelings - even provide an opportunity for elderly people to engage in meaningful social activities. Below, we describe some of the issues that formed the background to our field study and recommendations for the development of a second generation of emergency alarms.

SOCIO-TECHNICAL SYSTEMS REQUIRE AN UNDERSTANDING OF CONTEXT

It is important to recognise that while emergency alarms offer particular opportunities to older people's feelings of safety and comfort, these emotional goals cannot be achieved by technology alone. Therefore, although this project focussed on how emergency alarms are used within the domestic setting, it was also crucial to consider contextual conditions such as initiation of the service, set up and living circumstances. In this way, the field study involved an investigation of the whole socio-technical system consisting of relatives in the role of carers, the home environment, attitudes and feelings of the user around interaction with the device, rather than the mere use of the emergency alarm by the older person. It was deemed important to a) interview relatives, and b) provide participants with the opportunity to talk more generally about technology use, their background and their interests. This issue was highlighted by former studies (Pedell et al., 2010; Vetere et al., 2009) that showed that meaningful interactions of older people with domestic technologies depend always on the larger life context. One of the key findings from participant interviews in this study again confirms that users can feel very different about the emergency technology depending on their life history and family situation resulting in unproblematic use or refusal to use the emergency alarm.

“Technology for older adults is likely to fail unless it can be used effortlessly and it serves a clear and meaningful purpose.”

(Lindley, et al., 2009)

Emotional goals in technology development

GOAL MODELLING

An innovation in our current work is the explicit use of emotional goals in software engineering during both requirements elicitation and design. Emotional goals are different from functional goals, which address the functional intent of users, and form quality goals, which detail the qualities of the functional goals (e.g. "secure", "usable", or "fun"). Emotional goals address how the user feels about a system rather than the properties of a system. This distinction resonates with people as they grapple to effectively use new technology. We are demonstrating the importance of exploring emotional goals of users, and how to carry those goals through to the concept phase. We aim to revisit the model during design, implementation, and evaluation of the development of a personal emergency system.

INTEGRATION OF FIELD DATA INTO SOFTWARE DEVELOPMENT

A growing appreciation can be found in literature that existing software engineering methods are limited by not taking into consideration the social objectives (e.g. Baxter and Sommerville, 2010). One proposed way of addressing social objectives is through ethnographic studies of human-centred activity. Ethnographic data can be used to inform system models, and to help define socially-oriented requirements and consequently to help bridge the gap between the output of field studies and to the input for system designs.

Traditional ethnographic data does not translate directly into requirements, and informing system engineering with ethnographic data is problematic. Today, integrating ethnographic methods and software engineering methods is still in its infancy. This view is echoed by Baxter and Sommerville (2010) in their comprehensive review of design methods for socio-technical systems:

> "Modelling and abstraction is fundamental to software engineering, with models of different types being used by engineers to communicate. The practical use of socio-technical approaches has to acknowledge this by providing a means of modelling, and by integrating with existing approaches. […] The abstractions currently used in technical system modelling (e.g., use-cases, objects, etc.) do not seem to us to be sufficient to represent socio-technical considerations" (p.3).

In our previous work (Miller et al. 2012; Pedell et al. 2013), we demonstrated the suitability of the agent-oriented paradigm for modelling the social domain, exploiting the capacity of agent models to represent the goals and motivations of roles and individuals. We conducted cultural probes (Gaver et al., 1999) and applied the results to agent-oriented models. These models allow us to represent human activities as well as software system behaviour. One novel outcome was the use of quality goals to represent socially-oriented requirements such as having fun and being playful.

Our current work improves on our previous work by considering emotional goals (represented by) as well as quality goals (clouds) besides functional goals (parallelograms). Emotional goals have been conceptualised and suggested by Marshall (2014). Considering emotion as part of requirements is not a new concept (Bentley et al. 2002), and has been considered mostly in the gaming community (e.g. Callele 2006), however, methods and techniques for connecting these with the greater software engineering process have not been suitably addressed. Our previous work on considering social objectives via agent-oriented modelling is a first step towards this.

In our application domain of emergency alarms for the elderly, there are several bodies of work looking at improved detection of emergencies. Most recent work analyses the use of wireless sensor networks throughout the house and on the body of people to monitor their well-being (e.g. Peeters 2000; Yan et al. 2010). While these approaches offer considerable potential beyond traditional emergency alarms, there is a lack of work exploring the suitability of these for fitting into older people's lives, or the acceptance of these systems by older people (Steele et al. 2009). Further, despite wireless sensors becoming cheaper, the cost of wireless sensor-based solutions is likely to be higher than existing systems due to additional hardware, and thus are more costly to set up for older people, their families, and bodies who fund these systems and services.

Initial goal model

We started with an initial goal model based on our knowledge of older adults' technology use. This model helped use to formulate our assumptions and the questions for the interview guideline.

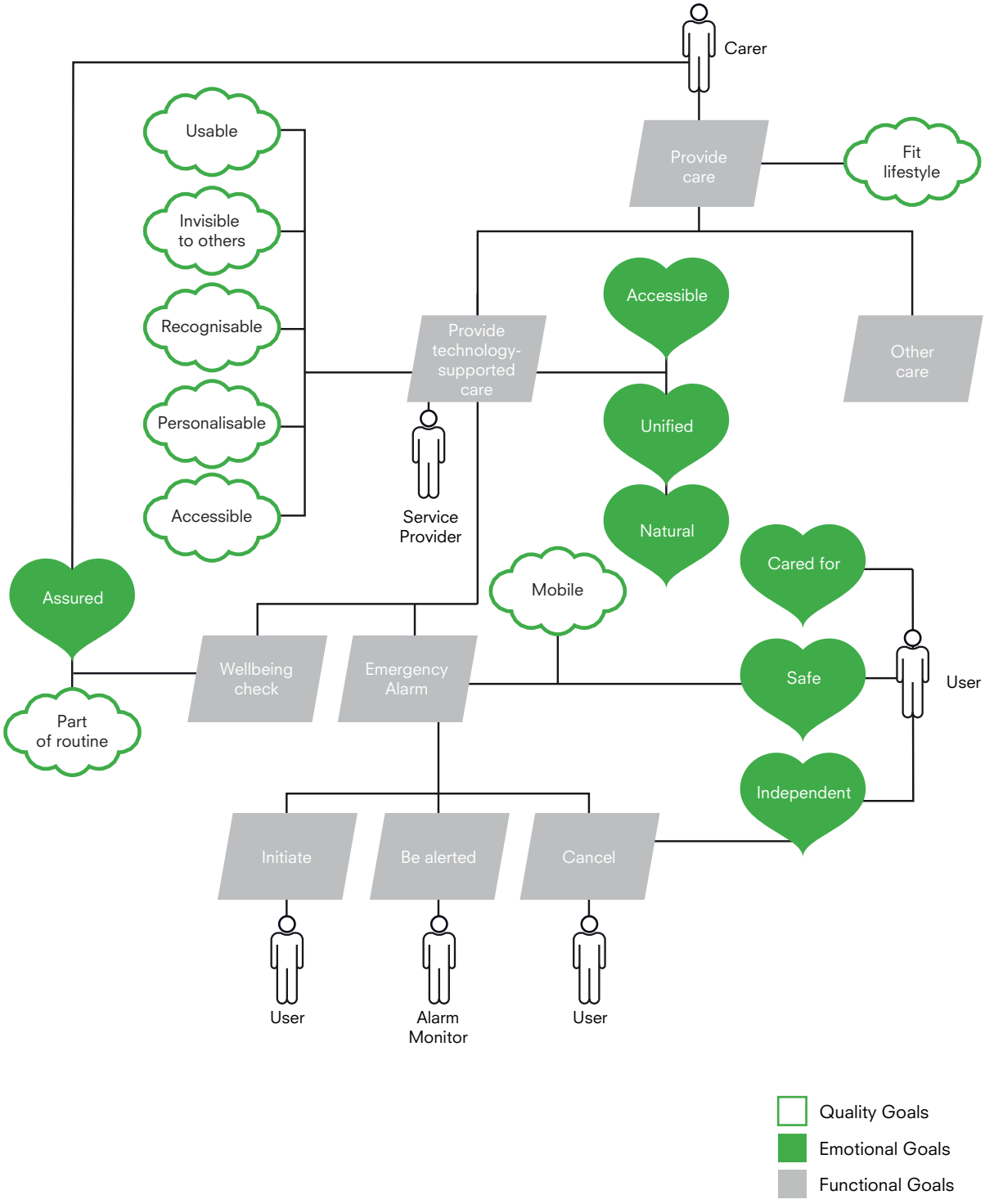


Figure 1. Initial goal model for emergency alarm use

Field study one (interviews)

We started with an initial goal model based on our knowledge of older adults' technology use. This model helped use to formulate our assumptions and the questions for the interview guideline.

This research comprises an in-depth interview approach to systems development common in User-Centred Design (UCD) (Rosson and Carroll 2002). UCD has human requirements as the constant focus throughout the development process and uses a range of established research methods such as usability evaluation, ethnographic field studies and iterative prototyping. This project is particularly challenging, as it must fulfil hard-to-define needs such as "feeling comfortable" around a technology with the main purpose to detect and communicate emergencies.

Our approach ensures that the primary focus remains on the feelings and needs of the users and their care takers — giving them a strong voice. This is important, as we do not merely evaluate the usability of the technology via concrete traditional and measurable tasks, but its ability to empower older adults living at home on their own considering the complex nature of emotions around technology use. We have received ethics approval from the Swinburne University Research Ethics Committee to conduct this research.

While we provide a lot of rich data that helps with understanding the emotional problems around emergency alarm technology use and its context, it is not to be understood as statistical data. We are not reporting on the likelihood of certain buttons being pressed or not pressed. Our sample is too small to make these kinds of statements compared to the overall number of emergency alarm users in Australia. Our study follows an approach that blends ethnographic analysis and goal modelling for social requirements elicitation.

STUDY PARTICIPANTS

We conducted the field study with twelve participants (eight older people and four relatives of emergency alarm users).

Older people

The field trial consisted of eight older people aged between 66 and 91. The participants were all living in Melbourne. The research team had planned for more participants, but it was hard to recruit more in the given time frame as some went to hospital. With one exception all emergency alarm users lived on their own.

Six of the participants were using the MEPAC system, one participant was using the Tunstall system and Vital Call. Most participants had received the emergency alarm via the council, the recommendation of an aged care provider, or Vet affairs. Older adults receiving the service at no costs needed to:

/ Have had an assessment
/ Be identified to be eligible for low care services
/ Be living in their own home (i.e. not those in residential care)
/ Living on their own

There was quite some frustration mentioned in the interviews about the rigid process that usually would have to be tackled in a situation of crisis (acute health problem, bereavement of partner) and the amount of time it took after the order to receive a personal alarm (for more details refer to Appendix B).

Table 1 provides an overview of the participants. Personal details such as names and locations have been changed in order to protect anonymity.

Relatives

The relatives of emergency alarm users were interested in participating as they also were very much emotionally involved in their older relatives' lives and proofed to be a good source to understand the decision making process around emergency alarms. Otherwise there were no specific criteria for them to be chosen. In many cases the relatives instigate the installation of an alarm in their older relatives home.

	INTERVIEWEE	AGE	LIFE SITUATION	TECHNOLOGY USE (ALARM)
USER	**Jane**	**85**	Lives on a large block of land with husband in their home for many decades (five children). Alarm was set up when husband was in care for four months.	Wellbeing-check and alarm (Mepacs). Overall relieved and 'religiously' used. Never used alarm. One false alarm.
USER	**Gary**	**90**	Lives with his dog, his wife of 60 years has passed away three years ago. He has some services coming in to support him with cleaning, shopping and meals. He loves his garden and family.	Wellbeing-check and alarm (Mepacs). Overall impartial and needs support with daily use. Does not like to talk about the alarm.
USER	**Liam**	**86**	Lives on his own. Has one daughter who lives overseas; wife died two years ago. His three brothers are all deceased. He regards himself as very independent. He has not much social contact.	Wellbeing-check and alarm (Mepacs). Uses a landline telephone; has a new computer but has difficulties using it; uses Skype to talk to his daughter. Overall not proud to need one, but tries very forcefully to not forget. Used alarm in one instance
USER	**Claus**	**91**	Claus has lived in Australia all his life. A war veteran. Spent six years in the Navy, from the age of 18, suffering from post-traumatic stress syndrome as a result. His wife died four years ago after a marriage of 65 years. Main carer is his son.	Alarm pendant only (Tunstall) as result of VET affairs audit. Use for over 24 months prior to moving to an aged facility in October 2012. Overall satisfied and no problems with use. Never used alarm. Used to enjoy watching TV and radio — did not bring any personal items when he moved to nursing home.
RELATIVE	**David**	**-**	Father 91 has an alarm. David was not feeling responsible for the installation of the system as he followed recommendation. From his point of view everything worked well and he was very glad about it.	Alarm pendant only (Tunstall). His knowledge of the alarm systems was minimal. Only that he was aware his father had it, and knew that he was required to press the button once a month for testing purposes.
RELATIVE	**Christine**	**-**	Mother 85. Felt quite overwhelmed about required care assessment.	Wellbeing-check and alarm (Mepacs). Great relief for the family.
RELATIVE	**Lucas**	**-**	Mother 88. Considered alarm necessary for his mother to stay at home.	Wellbeing-check and alarm (Mepacs). Used alarm for approx. one month before wellbeing check was turned off because it was causing stress. The emergency button was still in force.
RELATIVE	**Joe**	**-**	Auntie 84-88. Joe's aunt was in the health care discipline and was therefore familiar with procedures in assistive care. Experiences with two different emergency alarm systems; firstly at the home, where she lived alone, and then in the retirement home.	Alarm pendant only (VitaCall). She was not happy or willing to use the system. An agreement was made whereby she only could stay at home alone if she would utilise it along with other safely procedures. Had two falls and was not wearing the pendant. Would only be compliant when other people around.
NON-USER	**Greg**	**66**	IT staff (working full time), wears a hearing aid.	Tech savvy, not prepared to learn technology when not easy and useful for him; sets up family meetings via smart phone.
NON-USER	**Martin**	**71**	Active researcher and professor, tech savvy with strong opinions on technology development for the ageing.	Angry about infantilism & stereotype of older people not able to make technology choices and the slow development of adequate technologies.
NON-USER	**Sharon**	**79**	Mother, nine siblings. Lives in the countryside with her 83 year old husband.	Has taught herself the use of the computer with the help of friends in her community. Many interests.
NON-USER	**Marie**	**69**	Mother of three, former nurse, very clear about her wish to make her own choices about health and death.	Uses the computer for email and information access.

Table 1. Summary of participants

DATA COLLECTION

Twelve semi-structured interviews were conducted with users of emergency alarms, relatives of emergency alarm users and older people that do not use an alarm. The thirty minute to one hour interview took place at a location of convenience for the interviewees, most commonly in their homes. This gave us a good insight into the living conditions and the setup of the emergency alarms. The focus of the interviews was on emotions, around using the emergency technology and technology in general. Additionally, we were interested in its challenges and benefits for participants. Some of the interview questions we used were "How was the decision made to sign up for the emergency alarm service?", "How do you feel about using this system?", "Could you describe what actions the emergency alarm system requires?" and "What other technologies are you using?". We also conducted interviews with relatives in order to receive complementary data and a second perspective on the impact of the emergency alarm technology on the life of the older relatives. Some participants were contacted for follow-up questions.

All but one interview was recorded. In one case a care person asked if we had received permission by the children to interview the father. Additionally collected data was photographs of the emergency alarms and sketches of the home and where the system was setup. All interviewees were very open and pleased about the fact that their opinion and feelings were taken into consideration for a development project. No one refused to answer any of the questions, but one user clearly preferred talking about something else as he was not very interested in his personal alarm.

DATA ANALYSIS

The interview transcripts were examined and key themes were identified through content analysis. In a first round of analysis at least two researchers would independently summarise important themes of the interview and then discuss them regarding their consistency until they reached agreement. The initial detailed summary of the data was subjected to further thematic analysis in the group, resulting in the main themes that are described in these four main categories. This analysis focused on identifying emotions around emergency technology use (1), qualities technologies should have (2), common challenges that participants experienced when using the alarm technology as well as the key benefits (3), and context conditions surrounding the emergency service including the initial set up and training (4).

This analysis focused on

1 Identifying emotions around emergency technology use
2 Qualities technologies should have
3 Common challenges that participants experienced when using the alarm technology as well as the key benefits
4 Context conditions surrounding the emergency service including the initial set up & training

Results

The results presented below describe firstly, a summary of the most important insights. This is followed by a more detailed discussion of the key themes that have emerged from analysis of the interview data. The themes illustrate how the emergency alarm was used and the emotional impact it had on the participants. The themes are grouped into "emotional aspects", "qualities", "challenges", and "contextual conditions" associated with using the emergency alarm system.

EMOTIONS OF EMERGENCY ALARM USERS

This section describes themes that have emerged from the data analysis that highlight the emotional aspects of the emergency alarm and other technical use. These are aspects of use that extended from functionality and technical use to how people felt this service impacted on their everyday lives. Emergency alarm systems have a high level of technical reliability. It is important to understand better the interactions of the user with the device and resulting emotions in order to improve overall reliability of the system in emergency situations. These emotions were both positive and negative. Our data show that participants for whom the alarm service works well and appear to provide benefits to the user have positive feelings towards the alarm, participants who have problems with the interaction mostly have negative feelings. For this reason we give quite detailed explanations about the reasoning behind the different emotions around use. We also look into the emotions of relatives as they are often involved in the decision to acquire an emergency alarm and play a crucial role being a main point of contact in case of an emergency. Finally, we look into emotions that older people (non-users) have with technologies they appreciate or emotions that they would like to experience when using technology.

The main themes to emerge concerning emotions of older people using emergency alarms are: a) feeling independent; b) feeling cared for; c) feeling in control; d) feeling safe; e) feeling competent; and f) feeling in contact/touch.

Feeling independent

The theme of independence was one of the strongest, but also one of the most varied and complex ones. While to feel independent was a major goal in all of the participants' lives, the alarm is seen by the users as either threatening or supporting their independence. This perception is dependent on their living conditions and highly influenced by the situation that had led to signing up for the service.

The interview with Joe in particular provided insight into the emotional attitudes associated with the emergency alarm system, by both the carer and the user. Although the initial purchase of the system did provide the carer with assurance of his aunt's wellbeing, it did not provide the user with support as she did not feel comfortable using the system. She felt negative connotations with the alarm as she was required to wear it around her neck. Joe spoke of the negative fashion in which his aunt and her peers would discuss such devices. Stating that he understood those who are required to wear the system feeling that it represents a lack of independence, as it stigmatised them as being old and having to rely on others for help. For Joe's aunt also, the visibility of this dependence via the pendant was a large problem. Her nephew described her feelings as:

> "It threatened her independence and made her- externally she felt that it branded in a way that made her less independent." [Feelings of his aunt as described by Joe]

However this feeling was not only in the company of others, but something she would not like to admit to herself. In this regard she would even wear the pendant less when no one was around, as she admitted after her 2nd fall, during which she was not wearing the pendant.

> "… part of that was to do with what it looked like. The fact that it wasn't aesthetically pleasing but it, far more importantly was the psychology of the device and what it meant for her and the fact that she didn't just not wear it in public but choose to not wear it alone whilst inside the house I think it's much more an internal thing more than what it looked like or what it said. You know for her it was about the psychology, what it meant to her." [Feelings of his aunt as described by Joe]

Similarly other users Joe knew (friends of his aunt) would not want to be perceived as dependant and the visibility caused the major problem.

> "Its the badging of that so visually you have this thing where you have to have something and if its accessible then its visible. That visibility marks you in a particular way." [Joe]

One relative described the feelings of his mother in a similar way:

> "She always would joke about her cowbell, and complain about it. "Look at what my kids are making me do," kind of comment. A slight resentfulness about it. And it was kind of an area against her independence. She'd occasionally make comments about, "Look what I'm resorted to," comments about it." [feelings of his mother described by Lucas]

This comment highlights how some users feel about the emergency alarm forced upon them.

As outlined above the theme of feeling independent around emergency alarm use stretches from feeling a threat to independence, to a need of wanting to be perceived as more independent and not in need of care or, even stronger, the stigma of being old and frail. While there are these strong negative associations, one user felt more independent because of the pendant.

> "And, you know, she wasn't at all anti it. She liked it because it gave her a little bit of independence, and we loved it because we felt, well, we know she's safe. And if she has fallen, then there will be a few calls, but she is not going to be laying on the floor for hours and hours or a day until somebody comes to the house." [feelings of her mother described by Christine]

> "I think she felt that she'd got her independence back. I can stay here by myself because I've actually now got something that if something happens to me, she is not going to fret. Like "How am I gonna get to the phone?" It was certainly like a safety... I don't know how to explain. Gave her a level of comfort that she didn't have before." [feelings of her mother described by Christine]

Emotions of emergency alarm users. **Feeling**:

/ independent
/ cared for
/ in control
/ competent
/ in contact/touch
/ safe/comfortable

On the other hand the pendant also helped to preserve independence and was used for negotiation between user and relative:

> "And my aunt, she you know understood and this was you know something she expected that and again it was a bargaining thing where that preserved her independence. By not, by giving up that and having to comply with those things it was worth it because you know she retained her independence." [Joe]

However this would merely result in some superficial compliance in using the pendant. This resulted in this particular case that Joe's aunt would wear the device primarily when he was visiting.

Feeling cared about

The second strong emotion was a desire to feel cared for. This is closely connected to the previous theme and is only positively received if the care is not felt as something that is patronising or taking away choices. It also needs to be carefully distinguished from 'receiving care'. In particular two older women who worked in care all their lives were feeling very strongly in not wanting to receive care, but making their own choices. This brought in particular Joe's aunt into a dilemma as she was able to perceive the real concern about her, but was very opposed to the alarm use as something for old and frail people.

> "She worked for disability services all her life. Um and this transition was very difficult for her, because she went from being the carer form being someone who didn't want to be cared for. And there was, and she understood the systems that were in place. And she knew how bad assistive care could be and she had employed people and done all these things through the 60's, 70's and 80's and this was, you know she found herself then on the receiving end of that stuff that was a really difficult transition for her." [Joe]

Despite these strong feelings she tried to comply to a certain degree to please her nephew's efforts.

> "She didn't want to upset me and she didn't want me, to feel like she wasn't cooperating with me." [Joe]

Similarly the technology set up originated from a deep concern by relatives which was not seen or felt by this user as something positive and even had a negative impact on the relationship.

> "In a sense, on the whole, it failed expectations. Just that we had to turn it off, because it wasn't a good thing to do. And did it increase the relationship with my mother? No, it didn't, actually. She didn't view it in a kindly way."[Lucas]

Feeling in control

It was important for users to feel in control - else the feeling would turn into stress around the technology use:

> "And quite honestly, at the end, we actually turned off the service at the end of the month, because we were not happy with it. It was stressing my mother, it was stressing me, getting calls at different times, and it wasn't actually helping her in order to do it. So we decided... By that stage, I was visiting my mother daily, and that was actually a more reliable check of how she was doing than the service." [Lucas]

In some families it worked better as calling in daily as the control was at the older person's end and was more flexible in this regard.

> "We were ringing every day, but that was actually a hassle too. You know, I've got to get the phone. It might have been she was having a shower and they're going to ring. So this way we know that she gets up and she has her routine." [Christine]

Making choices is also an important aspect of feeling in control. This quote illustrates this in a clear way.

> "Mum goes [shopping] and it's an outing. And she goes up and down the aisle. "That's nice. I might try some of that." And they do get meals. It's called Choice meals. But they do like to... Dad still likes to try to cook a little bit, but he's... But it's just, again, by them shopping and choosing their own food, they've still got control of their life. You can imagine if you send someone to the shop to get milk and bread and cheese, you'd think, oh, it's not really the cheese I like, or I really didn't want full-cream, I want skinny. It takes all these choices out of your life. You may as well be, you know, you're kind of in a prison cell then, and someone's just bringing you in the food." [Christine]

Older people who are signed up for an emergency alarms without any choice. Marie was quite forceful about the importance of being in control of her own life and the choices she wants to make.

> "With the emergency alarm take up there are in my opinion other issues. It is about the end. I am not miserable about it. Life is wonderful, but we are all dying one day. People have to have the right to make a decision when they want to leave. […] One reason I wouldn't want to be monitored is that if something happens I want to be left alone. I don't want to go in a nursing home. We talk about it a bit among my friends when we meet. Quite a few have a bottle ready in the bathroom. Most wouldn't even take it, but they want the assurance that if they want to they can. My best friend has terminal cancer since three years. She has no illusions about that things will only get worse and more painful from now on. I think our generation is a bit more in control. The last generation – in particular women – stayed at home and brought up children. I have two medical attorneys – both are nurses in their 50's and I spoke to them and they know what I want. I wouldn't asked my children – they are too emotional to make the decision I want in the end." [Marie]

Feeling competent

The resistance of some older adults to using emergency alarms is closely connected to a feeling of being incompetent if they are not able to use it as instructed. They feel embarrassed, annoyed about themselves when they forget to press the button or even worse feel overwhelmed by the use of the system. As there is only one style of emergency alarm around it does not cater for different levels of understanding technology. Therefore an emergency alarm should be able to build on different levels of knowledge and metaphors to convey a good understanding resulting in the competence to use it correctly.

> "And no matter what system I try [claps with hand on his knee in frustration and enforcement several times] I still manage out of 10 days that I miss out 2 or 3 times by completely forgetting and that is what annoys [emphasis] me." [Liam].

The amount of questions the researchers were asked about the correct use of the system was surprising considering how important the correct use is. People seemed to be reluctant to gather the missing information from the service provider. One reason might be that they did not want to be perceived to be incompetent.

Feeling in contact/touch

Older adults like to be in contact with other people. They highly appreciate any friendly human contact and the emergency alarm was perceived as a small contact point to the outside world in some cases when people were living alone, but also they wished that the personal alarm use was more intimate. Both aspects (the feeling of being less isolated and the need for more human contact is expressed by the following two user quotes:

> "Very comforting that you've got that contact, uh, otherwise you're on your own. You know, you've got no one." [Jane]

> "If it were a real voice, it would be even more re-assuring than a recorded voice". [Husband of Jane about the reminder of the wellbeing check]

Claus did mention more than once how courteous the people were he dealt with. This included the installation staff and the staff he dealt with during maintenance checks once a month. When questioned as to why he found them to be courteous, he said they were nice to speak to.

When the service was set up by some trusted body or person then this seemed to rub off on the perception of the alarm system.

> "So, well if you've set this up I trust that what you've got me is the best thing that's there…" [Joe quoting his aunt when setting up the second personal alarm]

Extending on this topic is the notion of sharing and how crucial it is for older people. The opportunities to share information, knowledge and experiences with loved ones seem to be crucial for their wellbeing. The lack of being able to do so can result in boredom and disinterest in their own life which impacts on the perceived relevance to use an alarm to extend their life.

Claus mentioned he previously enjoyed watching the television or doing the crosswords, but now that he is in the home it is of no interest. He also no longer cared for ornaments he used to care for saying if there is no one to share the memories of the objects with, they are no longer of value.

> "Because your hearing starts to go, and your sight goes. You just grow old. And you really lose interest. And it's very hard to find something to occupy yourself. Here today... I used to do the cryptic crossword puzzles in The Age. And when my wife died, I just didn't. I didn't in years. I haven't read a newspaper since. [...] And I've been married for 64 years. […] When you're living by yourself, it's no barrel of laughs. It's one of the prices of growing old. And, you know, you're used to sharing everything, things like ornaments that you shared. When you're divided, they're of no consequence. They don't have the meaning they had." [Claus]

This is supported by Christine's description of the feelings of her mother who is integrated in family life having brought up five children.

> "Like every Christmas, I'm picking Mum and Dad up for Christmas, and Mum said, "What can I get?" And I said, could you get the plum pudding and some custard? So she's got that task to do when she goes shopping. Makes her feel like she is still contributing. When she's out with this lady shopping, "Yes, I'm going out for lunch at Christmas. I'm still part of things." [Christine]

Feeling safe/comfortable

Feeling safe is closely related to the feeling of comfort. If users were not comfortable with the use of the device then it would not convey a feeling of security and safety either. This feeling of safety was particularly strong with Jane who expressed this several times during the interview as did her daughter.

> "It gives me confidence and security." And "…but basically because I've got this mepac, I've got confidence when I'm on my own." [Jane]

> "And I think she actually was quite comfortable. She wants to stay in her own home, you know, she was quite happy to be there. But it did give her a bit of comfort, knowing that she wasn't totally isolated, and if something happened, she just had that... And she wore it. She's not wearing it now because Dad's home. But she wore it religiously. It was really very much like a safety thing that you would wear all the time." [Christine]

The next quote outlines well that technical reliability is not enough to convey a feeling of safety to some users.

> "OK, it worked, but she wasn't really comfortable. And it was immediately a source of stress. Would she be able to do it at the right time? She was having some degree of confusion from various stages, and one of the things, time started to become confusing for her." [Lucas about his mother]

Whether a level of comfort is reached relies heavily on the user being able to achieve a routine that felt natural and integrated into their life.

> "And I got called several times. I certainly remember going at 11 o'clock at night one time. The service had actually called me, saying, "Your mother sounds confused," or whatever else. And I went over there and she wasn't so confident about the time, and was stressed about what she was doing or not. It never became a routine for what they did. And if the alarm service was concerned that she wasn't actually doing it, they called me." [Lucas]

> "It was a great comfort. And I was conscious of it all the time. And they were always most courteous. I didn't need to call them. […] It wasn't an issue because I never ever needed it" [Claus]

Participants were concerned that the alarm would cause too many changes in the home environment. Some of the users felt disrupted and needed to get used to the phone being in a different spot and the fact that a technician was moving things. Undesired changes were perceived by some older people as quite invasive.

When safety practices were in place relatives and often the users themselves tried to keep them up as they knew that it was quite difficult to establish them in the first place.

> "The alarm wasn't intended to replace anything else but to augment that stuff. So we didn't change any of the other practices. And also the idea of the habit forming stuff. I did really want her to continue those security kind of habits that she had been doing, and not change anything. So the idea was that the pendant, ahhh was an extra." [Joe]

Some users wished for more assurance that everything worked all right and they did the correct things while others were satisfied as long they did not get contradictive messages:

> "It seemed to work very, very well. And I'd had no reason to call them." [Claus]

EMOTIONS OF RELATIVES OF EMERGENCY ALARM USERS

The main emotions of relatives of older people using emergency alarms surround these themes: a) feeling assured; b) feel freed up; and c) feeling in control.

Feeling assured

The overarching theme was a feeling of relief and assurance that some system was in place that would support them with the care of their relative. The burden of checking and worrying seemed to be lessened and they felt they could assume that the older person was safe as long as they did not hear from the service provider. This was true for most relatives at least at the beginning when the service was set up.

> "We just felt we'd be more comfortable, because she was living by herself, that if she had a fall or something happened to her, that there wasn't somebody calling in every day, that we would at least know that she was OK." [Christine daughter of Jane]

> "No. No, nothing happened [incident that required an alarm]. Apart from, I guess, the fact that you'd call and you think, "Well, she hasn't answered. Is she at home or has she fallen?" […] "I loved it [the alarm]. It was a huge relief, a huge weight off my shoulders, going to sleep at night thinking if something has happened. Or didn't have to think, I haven't heard from Mum. Is she OK? I just knew that there were somebody else helping with that caring, if you like." [Christine]

> "No, I thought it was great. I was very pleased that he had no trouble with it, because when I'd go to visit, he'd say, "Yeah, it's fine."[David – Claus' son]

> "He was comfortable with that very quickly. Weren't you? You learned it very quickly, you know, what you had to do." [David]

Some underestimated or didn't consider factors that might hinder the use of the device as intended. As one relative noted, it was difficult to guarantee that the system was used as intended:

> "And I naively thought 'of course this is the first thing that's going to happen. Unless she's unconscious it's going to get pressed and it's all going to happen really quickly. Um that's, as I'm sure you've found doesn't always happen. But that was my approach to it initially. That it was about an immediate reaction. That it would get from you know trained professional would come, and assist them." And "You know, I had done what I can do but there were a lot of unknowns." [Joe]

Feeling freed up

One relative felt the alarm and other services helped them to focus on more relevant and fun things to do.

> "Like where we can actually offload some of that work that's a bit more mundane and a bit more not so personal, get other people in to do it. So having the monitoring, we're not having to do that extra little piece of work." [Christine]

The opposite extreme was when the service would cause extra work and repetitive phone calls throughout the day as it was the case with Lucas and his mother.

EMOTIONS OF NON-USERS REGARDING TECHNOLOGY USE

In asking non-users how domestic technologies in general and alarm technology specifically should feel, the list includes more positive attributes (such as informed, welcoming, friendly, in control, sensible, trustworthy, helpful, non-threatening) with expectations of the technology to feel supportive, friendly and flexible. They did not have many negative feelings around technology they were using. This might be partly due to the fact that this group of interviewed people is considerably younger (in their late 60's and 70's) and has made positive experiences with modern technology and are not in a situation they do have to use any technology. A common assumption is that a non-technology-savvy older generation is dying out and with the coming generations there won't be problems in technology use. Others say, as technology will progress rapidly some members of the older generation will continue to have problems to keep up. However, based on our data and previous studies our prediction is that while people get more technology savvy they also have higher expectations and will make their own choices around technology. They won't choose technology they are not comfortable with as they have experienced how technology can be supportive, user-friendly and seamlessly integrate into their life style. If anything they will place higher demands on their technology use and raise question the current user group won't with regard to ownership of data and storage.

Both Greg and Martin promoted technology as something that should enable people and stated that if technology would not work for them they do not use it.

> "My hearing aids are a massive enabler […]. Technology is an enabler. […].So, like there's one that does work for me really well an app on the iPhone, I've got diabetes, and what it does is logs blood readings for me and it also transfers them to a webpage that my GP can look up. So, that's one that does work. But if it doesn't work for me I very quickly sideline it. […] If it's a badly written app or it isn't intuitive to use, well then… I just don't bother persisting with." [Greg]

> "Oh, absolutely, absolutely I do feel supported by technology, wouldn't be using them if I didn't. It's a thought that comes to mind occasionally, just how did we manage? Like, even just organising the family [...] And how long does it take to organise something today? Ten minutes, you find out who's available, who's going and where it is." [Greg]

Others like Sharon took a bit longer to adopt modern technology, but once they got over a certain hurdle they were clear about what they wanted to get out of the technology and enjoyed its use.

> "I was petrified of the computer when I first got it, absolutely petrified! And it would come up, you've done an illegal transaction, and I'd be looking behind me to see if there was a policeman nearly – you know what I mean? […] I was determined I was going to be able to do only what I want to do though, not business, just emailing and those simple things.[…] "I enjoy it. I enjoy keeping in contact with people. Perhaps that more so than anything else, and I enjoy doing things on the computer like birthdays and all the Christmas emails, I'm into that, I'm very into pretty things on the computer." [Sharon]

When Martin was asked what he thought about existing alarm systems he got really upset and emotional.

> "Yeah. This is one where, I think, that most of the systems are shocking. They require people to move around, they have silly attitudes towards what elderly people will do, what they will deal with. For example, I've seen four warning systems that have a big red button. For god sake, 80 per cent of the population is carrying accelerometers these days, they're called smartphones. I mean, really! There are small plug-ins you can put on the backend of an iPhone that will keep your ECG going. Why are we not getting this stuff? You can set up perfectly sensible algorithms to do this, so why don't we get on with it instead of doing this dated, prehistoric stuff? I really am quite annoyed about it. […]It's designed for the infantilist view of the elderly. It's as if early onset Alzheimer's is universally applicable. Great design placed in appropriate hands is very bad design. If I fall and I have a big red button over there, I'm not going to hit the button am I? I can't get to it. If I'm carrying a device that will press the button. Why? – I'm carrying a smartphone, which is cheaper than the pair of devices. So what are you playing at – do you see the point? […] I'm just thinking of the simplified phones. The simplified phones are, again, an infantilism. What you actually need is a voice detection that will just do it. I didn't say Siri was great, but Dragon Dictate isn't bad at all. Given a limited vocabulary you can get very high performance out of it so why would you bother to have a phone with anything on it? […] You've always got smartphones, almost everybody has smartphones. You know, iPads are being used by 90-year olds on ships now, right? So, they contain accelerometers, they contain location based services. They contain all of the stuff that you need and you really don't need very much. I mean, I've got a little thing like this, which is a hotspot generator, so when I go overseas I just buy a sim card, shove it in there and use the hotspot for my phone, my iPad, my computer. […] Within two years they will be getting complaints from the 80 and 90-year olds that there's not enough bandwidth for their iPads. Appropriate design and delivery is the only barrier."

QUALITY GOALS

We also explored the qualities or characteristics emergency alarms and other domestic technologies should have.

User

There were not many comments from users on the qualities of their personal alarm system. Either the alarm would work for them and this was usually expressed in terms of positive feelings or it would not work for them and then it was expressed with strong negative feelings. This is an indication that the use of the alarm is indeed an emotional and highly relevant topic for the users, it having a potentially large impact on their lives (as often, living in their own home was under threat). Also, the set up and choice of the alarm is often wrapped up in family discussions touching on sensitive relations between children and their parents. Users with a pendant only were less emotional about it as the use affected their daily life far less ("well it is working – no problem"). Satisfied as well as dissatisfied users spoke in quality goal terms, mostly when they were describing the problems they had with their use. This is not surprising as problems can be described much easier than the working attributes of technologies. This has been expressed in literature as "good design is invisible". Therefore the users' comments on qualities that are important for them in personal emergency alarm use can be found in the following section.

Relative

The relatives had ideas about some of the qualities that they predominantly had in mind when the alarm was set up such as immediacy of the help service. They saw alarms far more from a technical point of view, focussing on what they should accomplish.

> "The immediacy of it. Um, because if she had a fall inside that house. Which is this big rambling kind of place. Let's say if she fell down in the kitchen, or hurt herself in another way in the kitchen. It could be hours before that was noticeable. That's why I liked the idea behind the alarm was the immediacy of it." [Joe]

Non-user

Non-users had quite a distant view but were able to describe some relevant characteristics of technology. Key qualities of domestic technology listed by non-users were the following. In their opinion technology should be private, trustworthy, supportive, intuitive, an enabler, learnable, flexible, low cost, usable, informative, social, convenient, and interesting. While the qualities of enabling, social, private and flexible were the dominant ones. Some said they are simply a necessity. This younger generation, as already outlined in the emotional section above, has high expectations of technology and will not put up with anything that does not meet their quality criteria. They also will have higher demands on issues such as privacy of data and 'lifestyle fit'. Their opinion is that the technology has to fit and that they do not need to put the effort in. Martin, being very familiar with technology use, expressed this very strongly several times during the interview:

> "So, when communications are needed and when technology can help, I just use it." [Martin]

> "Technology should provide you with the ability of offsetting things where you don't need to make the decisions in the monitoring." And "It should enable me to do things I can't otherwise do. It should not be an instrument of control or surveillance." [Martin]

> "… I will not have a monitoring system in my home unless I have the data being fed into my computer. I want to know what you're getting and I can set my own neural networks up to adapt, thank you." [Martin]

> "And quite honestly, at the end, we turned off the service at the end of the month, because we were not happy with it. It was stressing my mother, it was stressing me, getting calls at different times, and it wasn't actually helping her in order to do it. So we decided... By that stage, I was visiting my mother daily, and that was actually a more reliable check of how she was doing than the service."
>
> [**Lucas**]

“We were actually clear on the objectives of why we were doing it. And, again, that was not an easy message, saying, “Look, we’re not here to alarm, but we’re doing it because we care.”

[Lucas]

PROBLEMS AROUND EMERGENCY ALARM USE

Overall, the users were clear about the aim of the system which was to support them in case of emergency. However, the interviews identified a number of problems that the elderly users experienced.

The use of the alarm pendant was more straightforward and better understood than the wellbeing check. However, as the alarm was not used on a daily basis it is also more difficult to establish what problems a user might face pressing the alarm or how well understood it really is.

The main problems with the alarm involved the range--restricting mobility, that usage was often not well integrated into lifestyle, and that the emergency alarm system was not well understood due to missing feedback of the system.

One main problem was that some relatives did focus on the functionality and their expectations and became only aware at the time of the emotional response of the user to visibility, feeling of dependency and free choice regarding how to live their life. This was beautifully expressed by Joe who chaperoned his aunt's emergency alarm use for four years:

> "…it was a really good learning exercise for me, so I really underestimated the um - my assumption was that the functionality of it really far outweighted the aesthetic concerns. But also that because the use is so simple and so direct, this intervention is so direct, that this will just work. (mimics explanation) "Because you just go you need to do this and this and this", and that it will work. And I really didn't appreciate the nuances, and that there were so many different ways to use it." [Joe]

Visibility

The visibility of the pendant caused massive problems as in some cases it would result in the pendant not being worn. As already described in the section on emotions in particular Joe's aunt did not like the fact that it pointed out their need for this kind of service.

> "Because of the visibility it was the scarlet letter. Kind of notion that it really branded the wearer as someone who, ahhh was not as independent as someone who didn't have that. And so I saw lots of strategies when I started to look for them, 'oh it's in my handbag' or 'I don't carry it on Tuesdays because I'm meeting up with some friends'. Lots and lots of different strategies people would employ to minimise the visibility of the device. I didn't find anyone in her peer group that had anything positive to say about them. Sometimes it was a necessary evil and that was about as positive as it became." [Joe]

Poor integration

Some users struggled to remember to press the wellbeing check despite having developed daily routines. The problems that Liam encountered were also experienced by other participants.

> "All right, but out of 10 times at least three times I forget. It doesn't matter how – what situation I try to take on – I forget. Then the poor girl – she has to phone me after 12. But I have tried to put myself into a system: So get out of bed point 1, go to the toilet point 2, then I have a signal here I have to push – this one here I press." [Liam]

Emphasis is put on how Liam has tried many different routines to remember to push the wellbeing check button, however always manages to forget. Liam feels disappointed with himself and upset as he considers forgetting to push the button to be a personal failing.

> "I walk pass again and again and still I manage to forget to push the bloody button" [Liam]

Even with the Mepac system in a visible area Liam still forgets to push the wellbeing button. The device is not visible even when it is purposefully positioned in a visible area.

> "If you walk to your car you need to have an ignition key to start the bloody thing. You don't have to think of it, it is just a matter of you can't… there is no comparison there" [Liam]

The reason why there is no comparison in this car metaphor is that you want to go somewhere and without a key it is not possible – with the wellbeing check it is easy to forget as there is no need to do this and no immediate goal behind).
The underlying problem seems to be that the activity of pressing the button is not in itself meaningful to some users. The users do know that they are ok and in this regard it does not provide any additional benefit or any new interesting information to them. For some users it is an obligation to remember it at the right time with an extra value to their life. When the feeling of obligation outweighed the perceived benefit then users became sincerely stressed:

> "The biggest problem is it didn't get integrated into my mother's life and part of the routines that she had. If I use jargon, she didn't ever really appropriate the technology. It didn't become part of her life. And she never really viewed it positively. So again, it was kind of a necessity. It was kind of something you put up with and it only ever remained something you put up with. And in fact a bit worse than that. It was a source of stress and we turned it off". [Lucas]

Claus did not have difficulty in the monthly maintenance check-up of the machine. He had a calendar which marked the fifth of every month whcih was when the call was made. He mentioned that it became part of his routine. Stickers provided by Tunstall he put in his calendar for the whole year helped him with this routine.

Often the well-being check was compared with taking tablets and the strategies of remembering it. Some of the older people would regularly forget, others had large reminder notes hanging in their homes and others achieved a real integration. Marie had a very strict routine about when to take her tablets to a degree it has become second nature to her. The interview with Marie stopped once as she had to take her pills to lower her high blood pressure. She has to take them three times a day and says it nearly works for her on a subconscious level:

> "I thought – it must be time soon for my tablet and see it was 12 pm exactly. I somehow know. It is the same in the morning. I wake up at 6 o'clock. It has become a routine for me." [Marie]

Missing feedback

Some interviewees commented on how there was a lack of feedback with the device. This extends to three situations: They did not know if they had pressed the wellbeing check (i), if they were within range of the base station (ii) and they also did not know what kind of feedback they would receive once the alarm was initiated (iii). The missing feedback of the wellbeing check was mentioned the most out of the three.

> "…well normally its my job to push the button, and that's it, then there is no confusion. […] but what I am saying is, we wouldn't know who has pushed it, whether it has been pushed or not. [Jane]

The fact that some users were not really aware of the procedure once the alarm was pressed caused unnecessary fear. They were not aware that someone would speak to them, before anything else would be initiated. Jane seemed to have grown confident and knowledgeable about the use over time having experienced several forgotten wellbeing checks, monthly checks and one false alarm without anybody being reproachful, but always friendly. She saw the emergency alarm button as a contact to speak to someone to initiate help:

> "So its independent of any landline, you know, our own phone. Something quite separate. I mean, if I push the button and I want to speak to her about something I can do that." [Jane]

Lack of understanding & information display (control)

The problems summarised in this section hinder the user to gain full control over the system. Users varied greatly in how well they understood the system or the information given. The information that is given on the display of the Mepacs system for example did not help users. Either they did not understand the information or they did not make use of it. The display seems pointless to Liam for example. This leads to the assumption that the wrong information is displayed on the screen and could be used in a better way.

> "That is the time. I never have a look at it." [Liam]

> "I don't know what the display is for." [Glen]

Glen also noted that he was unsure of what the function of particular buttons on the Mepacs base station was. He tells us he doesn't really know how the Mepacs works and that he doesn't care for it and rarely uses it. He then refers to his caretakers stating that they are using the system for him. When asked what the coloured buttons do, Glen wasn't too sure on their function. He responded that he has to press the red button to talk, but was not sure what the green button does.

> "The green button? The green button is for silly questions – actually I have no idea." [Glen]

The display was particularly unhelpful for older users that do not have a regular day-and-night rhythm as they get no indication if the time is "am or "pm".

> "She wasn't sure when was day and when was night. So we tried to install a clock for her with big numbers so she could read where the time was. But what was day and what was night was a bit confusing. So actually saying it's between 6 and 11 in the morning wasn't so easy. […] this was kind of May-June, so it was kind of dark a whole range of time. And she tended to keep curtains drawn, so the normal cues of what was day or night didn't happen easily either together with it. So the notion of when she would need to do it was difficult". [Lucas about his mother]

Joe went through a lot of effort to ensure that his aunt would understand the use of the system.

> "…we did a few tests so we did one when it was installed and we did one week later, and then at intervals we did a couple of tests. And to just make her really comfortable that this is what this means, this is what will happen. […] I would ask her to go over the rehearsal of that, (mimic's scenario) "ok so this would be what would happen, you press this and this is a test, and you know if this wasn't a test you know, you know, what do you think will happen now? And how long do you think that may take? Um so thats - and she was very clear about that. And look for her I think, one it was a reasonably simple thing to understand. And two that she had been someone who had been working with, in the field - say I have maybe called an ambulance say two maybe three times in my life, you know she is someone who has dealt with hospitals and dealt with ambulances on a weekly basis. And so that for her - she understood, there was something she could bring to that understanding with the system. That whole idea of the severity of it and what that would mean and she understood with that, if that phone wasn't answered, the assumption would be that this is a high priority call. And that an ambulance would attend really quickly rather than wait and seek more information." [Joe]

Still there was only a rudimentary understanding of the technical aspects of the alarm. Either it was not explained to the users at all or the language was used that they would not really comprehend the overall system based on the knowledge they have.

> "…the base station was installed. And it was tucked away, she really saw and her understanding of the technology was she pressed the pendant and then all the stuff happened. She didn't make the connection to, between that as a satellite, back to the base station, and the phone line and all these other things." [Joe]

> "So we did have the discussion and essentially she sort of admitted that she didn't want to wear it and she didn't think that she should and she understood the risks and she was prepared to take the risks and that she didn't want to upset me and she didn't want me, to feel like she wasn't cooperating with me. And so she said [mimicked aunts voice] 'so at least I wore it some of the time'. You know so these times when she wasn't wearing and when someone was there and she didn't really need it. But for her, that was her compromise."
>
> [Description of non-use and family discussion – **Joe**]

Non-use of the system

A big problem was the non-use of the system. The two main reasons were that the situation was not judged serious enough to raise an alarm or the pendant was not in reach. The high threshold might be connected to the idea of some users that it is only used in a very serious emergency. Otherwise it would disturb people. Lucas' mother did not raise the alarm and in one instance she fell and could not get up herself.

> "I didn't want to bother you. I was OK. I figured you would come and get me at some stage." So where she used the alarm wasn't... It just didn't ever become part of her life that she felt comfortable with." [Mother quoted by Lucas]

Acquaintances of Sharon would have a similar attitude and not use the emergency alarms when needed:

> "Some of them are very silly they feel, 'oh no, I won't press it, I'm not… I think my hearts getting better', 'oh, it's the middle of the night, I don't want to disturb them'. There's a few like that, which will sit it out till its daylight." [Sharon]

Glen would not even use the wellbeing check. Glen was far removed from the Mepacs system. There are people who come in and push the wellbeing check button for him. This really removes the need to even have a wellbeing check button in Glen's scenario. The base station functions as a stand for his various family photos. Throughout the interview he beckoned us to look at these family pictures and others located all over his windowsills.

> "Next to it here are all the photos of my grandkids – they are the most important thing in my life. I will see them all on Christmas and I am looking forward to this"

Claus stated he always wore the pendant, however he did take it off to go to bed, where he left in on the bedside table, and to shower. In this instance he left it on the corner of the basin. He mentioned that it was always within arm's reach. Interesting to note here is that Claus felt the need to mention this, even though it does appear to be unrealistic that any person would be capable of reaching the corner of the basin from inside their shower.

> "I wore it all the time, all day every day. But at night time, I would put it on the little bedside table. That was at the same height as me. It was so far away from me [shows distance with his hands]. But I had it with me all the time. I thought if I wore it during the night, I might push it during the night or something and just make a pest of myself. […] I never ever wet it. I had the idea that... I had it there with me. It was always within reaching distance, whatever I was doing. […] It'd be the edge of the wash basin. The shower is here, so I'm standing there. Like from here to there." [Claus]

The system did not fulfil the requirements of Joe (as the carer) or his aunt (as the user). The alarm was not activated in necessary situations, for example incidents whereby Joe's aunt did require emergency assistance she was not wearing the alarm.

> "…there were a number of times when she should have. One when she broke her wrist and she was outside at the time. Another one in which she fell very heavily and bruised her hip. Um and needed hospitalisation for internal bleeding and other things that happened. In all cases she didn't have the alarm with her." [Joe]

Mobility

One of the most common questions of users were the range of the device. They all had an idea about the approximate reach, but were not sure what this meant in their home environment.

> "…but I wanted to try and work out exactly what this range was and I couldn't get a straight answer really from the company, it was a little kind of, cause you know these are old houses with solid double brick walls, it was a double brick building. There was a whole range of you know those kinds of things going on. I know that it covered the range of her property. […] I ended up doing some tests. Because I started becoming anxious about 'well what happens if she's in', you know the back corner. So I actually did call the company. I said I'm going to test this. Now it's going to be pressed in a couple of minutes. [imitates speaking to alarm administration] We don't need a response, blah blah blah, and so we went to one of the corners of the property and tested it. So I don't know how much further than that in terms of going to the street, or chatting to a neighbour or you know seeing someone out who might have come to visit, going to their car or something. I don't know how much further it would have gone, but I knew that it covered the property range." [Joe]

Most service providers ensure that the indoor space of the home is covered during the set up. However, users do not want to be restricted to the indoors as their mobility is often quite restricted anyway as many do not drive cars anymore.

> "And again, that was one thing we used to worry about, because their letterbox is a long walk. It wouldn't get the range to the letterbox. But I guess at the moment now, because there's two there... And again, my brother would pick the mail up for them. And they don't really use a clothesline. They'll just put clothes on an inside horse. They don't actually use a clothesline as much. But it's not much of a range." [Christine]

> "The only possible disadvantage is if you had to go any distance from the house the contact is not as good. I haven't had to try that out but I don't think, it would be useful, if you were, in our house, in our garden, its an acre, and if I was down the end of the garden and fell and hurt myself, I'm not too sure if they'd get the recording of my button." [Jane]

In Jane's case the use of another device has been appropriated and as they spend time together she is not too restricted to the house. However, this is different to most other users who live on their own and wish for a more mobile alarm extending the current range.

> "Well the positive aspects of having it are, um, going to help you while you are within the house and maybe a short distance from the house, but further than that it isn't going to be useful because the, you are too far away to make contact and therefore you need to carry a mobile phone with you. Well John does that too, he has his phone in his pocket and he can ring me if he, something happens. But normally we go out together." [Jane]

“Next to it here are all the photos of my grandkids – they are the most important thing in my life. I will see them all on Christmas and I am looking forward to this”

(Participant’s comment regarding the basestation, — **Glen**)

Lack of choice

The current systems offer no choice to the user. This exacerbates flexible use and as a consequence is difficult to integrate the system into their life. Only one relative looked around comparing different systems as he was paying for the service himself. He was surprised about the small range of options that was on offer.

> "The first system. ahhh and most of the things that I found was they were very similar. So in terms of function and in terms of physical appearance, and weight and battery and all of those things were quite similar and there was a lot of that stuff that was being rebadged and re-marketed, and there was this kind of grey market stuff, all there was a whole range of things. But they all essentially, I couldn't, ahh in my limited knowledge of that stuff, I couldn't really differentiate in terms of the functionality of the product they all seemed to operate in a very similar way. Ummm and so I made a decision based on availability and price." [Joe].

It is a common situation that either a relative choose the device or the council provides a certain type and it is often the case that actual users are not involved in decision process.

> "Yes but the convincing happened after that, I made a commitment to the product and then tried to convince her because I... If it was abstracted I didn't think I was going to be successful and I was kind of very keen to have her able to stay in her own home. And this was one of the things that you know, and we didn't get to that negotiation point, but it was really for me, Look really she can't stay there unless she has this and some other things in place. Because she was becoming frail and had a couple of incidents, you know the usual… " [Joe]

This again is not contributing positively to the seamless adoption of a system as users feel they are presented with something they had no choice in.

> "I wore it all the time, all day every day. But at night time, I would put it on the little bedside table. That was at the same height as me. It was so far away from me [shows distance with his hands]. But I had it with me all the time. I thought if I wore it during the night, I might push it during the night or something and just make a pest of myself."
>
> [**Claus**]

Impersonal (not social)

For many older adults social contact is important. They are not used to and they do not desire to interact with technology for social purposes — what should not be misunderstood as not being able, willing or interested in communicating through technology.

> "I was going to ask you a question. When the, if we are a bit late in pressing the before, say before nine o'clock and get a phone call to say haven't pressed your button yet, is that voice a real voice, or is it a recorded voice? […] The reason I asked, it would give greater, um, what was I going to say, intimacy, but something of a word like that to it if the relationship between the machine and the user. If it were a real voice, it would be even more re-assuring than a recorded voice." [Janes' Husband]

Greg in particular appreciated his hearing aids that enable him to have normal conversations. He even has a loop to use when he is talking on the phone.

> "I think the most amazing technology that really affects me is my hearing aids. What they are able to do, because Audiology are just around the corner and I'm their client, they are able to do some fantastic things and it's meant an amazing difference to me, because I'd be in a meeting and everyone would burst out laughing, I think they're probably laughing at the old bloke who can't hear (chuckles), which was off putting, but no, they've had a major impact on my ability just to converse. Mind you, the family considers that they aren't efficient enough, because I miss a lot or that's sometimes called selective hearing." [Greg]

Lucas' mother did not have a problem to use technology to communicate. If she would have been able to get to know the alarm as a device to communicate it would have been easier to integrate it into her life.

> And again, in her position, say, with the nurses that visited, "Oh, she was such a lovely person." And we had a conversation. My mother liked talking. She was a big talker, and that was kind of part of what she did. And that was always a challenge with phone conversations you couldn't get off the phone when you wanted to do things. The alarm system was kind of outside. It was in one of the things that she said, "That's helping taking care of me." She understood why it was there. It worked technically, but other than that, not. […] It started off on the wrong foot at some level, because a technical person gave it to her. The technical person didn't connect with my mother, in terms of doing it. So it worked technically, but it didn't actually develop it. [Lucas]

PROBLEMS & UNDERLYING EMOTIONS

A lot of the problems seem mostly triggered by two conditions. How it came about the decision for signing up for the service and if users were signed up for the alarm only, or alarm and wellbeing check. The confidence Claus had in the system appeared to be dependent on the provider, VET affairs. He mentioned what a good job they did and presented a strong previous relationship with the organisation. The more deliberately the service was embraced the less problems and negative emotions were developed around use. That there were far less problems experienced by the pendant only users can be at least partly attributed to the fact that there is simply less opportunity to make mistakes.

CONTEXT CONDITIONS AROUND USE

Other problems not directly related to the use concerned the a) installation; b) the long lead up time; c) lack of ongoing training d) desire to remain in the own home.

Installation

The installation itself went in most cases smoothly. Despite this some users experienced it as intrusive and didn't like the fact that the telephone had to be moved.

> "I think the trickiest bit was actually getting it installed. And again, having some sort of new person, stranger, tradesman come to the house. Then it was like, well, we're gonna have to move the phone, and that's a bit, oh, OK. Anything that's a bit sort of...changes, they don't cope with it that well. […] And that was actually a little bit of a... You know, trying to find the right place to put the central part. Because I think it relies on your telephone line. And so they actually had to move her telephone into sort of a different room so that this monitoring base was closer to the telephone line or something. I don't know." [Christine]

It was hard to tell if the problems encountered by Joe's aunt were indeed technical problems.

> "Yeah I was. It was a number of years ago. But yeah, so there was a box, you know that was installed at the main phone point in the house. And I think I also brought a line filter to help. There were some issues with a false alarm, so I brought a line filter to help with that." [Joe]

Long lead up

There are sometimes long lead up discussions before alarms are set up. In some of the cases families would have discussions around setting up an alarm up to several years, but usually it was installed when some acute incident occurred or the service was recommended by some official body.

> "The idea really came... I know I'd mentioned it to Dad probably about a year before you got one. I think I'd mentioned the idea to you. But it was Vet Affairs who actually suggested it, didn't they? And they organised it" [David]

But also when the council was getting involved it sometimes took up to six weeks from the first contact to the installation (see also Appendix B for more information on aged care assessment).

Training opportunities & ongoing support

Users were not proactive in getting in touch with the personal alarm providers despite having many questions about the details of use. The manual did not give enough details for a comprehensive understanding of the whole system. The installation and training combined in one session is quite overwhelming for older people not familiar with technology.

Non-users as well as users feel a strong need for more support and tailored training for the technologies they want to use. Training offers either did not exist or were not tailored enough.

> "The mobile phone, we still haven't learnt how to text or retrieve messages and that. In a small community you haven't got, sort of, anybody much that you, like you buy a mobile phone and they say, yeah this is what you do, and you go home and you think, now, what was that I was supposed to do. We haven't got much help in that line. If something goes wrong things have to go to town to be fixed, there's nothing in the small community to help you out." [Sharon]

> "Put it in simple terms what it means. Like, as you said, with the phones and texting and all that. If there was just somebody you could go to and they'd say, 'now you hit button A'. This is what I do, I write it down. First step, 'hit button A'. Next one, something else. That's what I did with the computer. I've got all these sheets of paper with my way of doing it." [Marie]

> "Somebody to help the older people out. […] How can I put it? You need people that can help older people with learning to text on the phone. And help you with things you want help with – do you know what I mean? Where, I guess, in the city you can get it, I'm not sure on that?" [Sharon]

Urge to stay at home

Older people want to stay in their home as long as possible. It became clear in the interviews that in some of the cases there was merely the emergency alarm preventing relatives from having to pressure older people move into a nursing home. Being aware of what is at stake in the perception of the users is important to understand their needs, but also the massive pressure and emotions this causes for all people involved.

> "And where she lives, she actually is... They live on an acre of land with no houses close. You'll see when you go there, it's like totally the wrong place for them to be living. They should have moved about 10 years ago. But when all this happened, we spoke to Dad's GP, and he just said you can't move them now. They're too old to move. That sounds awful, but they just don't cope with the move, with the change. He said that if you're going to move, it would be if they were going to go into assisted living. He said don't move from there, and then a year later, then they're going to have to move to assisted living. So we're now trying to get the best out of where they are. And Dad, after being in aged care, said he never wants to go back again. He actually said he'd rather stand in front of a train than go back to aged care. So that was interesting. And it wasn't such a bad place, he just wanted to be home. [Christine]"

Updated goal model

After the thematic analysis of all twelve interviews, the initial goal model was revisited and refined according to the main emotional and quality goals found in the data. Goals that could not be confirmed by the data as relevant for the user were deleted, some goals renamed and new goals introduced. It should be noted that some general goals that apply to any kind of software are seen as given and not explicitly integrated in the model such as ease of use, usability and reliability of the system. Main changes to the first goal model involved the need for better feedback and possibilities to communicate the state of wellbeing. The pressing of the button is for some users at times hard to remember; it ties them to a routine and the action has no reward or meaning to them. The desire for a more social interaction with the device poses demands for at least one person in their network not to leave and outsource the monitoring purely to a service, but on a daily basis being part of the personal wellbeing check and ongoing support. This would meet several of the emotional goals of older users. It would not only check on their well-being, but potentially increase their overall well-being and lower the risk of social isolation. This would also touch on the goal of the service feeling better integrated into their daily life.

The goal model summarises the most important goals of the users with a strong focus on their emotions. Existing ideas and concepts can be viewed in how much they match this goal model and predictions can be made as to how well it will be accepted by the user. This lightweight evaluation can be used at all stages of development and has been proven useful in other large scale software development projects (e.g. Multi Player Online Games involving 80 students and 20,000 hours of programming time within the Faculty of Design). Also, different current market solutions can be viewed, compared and evaluated using the goal model. Below we present and analyse some of the providers of personal alarms and sketch out some concepts illustrating promising directions for an innovative and enabling emergency alarm for older users.

Our overall results confirm the position of Lindley et al. (2009) that technology for older adults is likely to fail unless it can be used effortlessly while serving a clear and meaningful purpose. The technology must also convincingly address emotions and fit the individual lifestyle. Meeting these challenges is essential to our project. In the next sections we provide recommendations based on the results of the field study.

Updated goal model

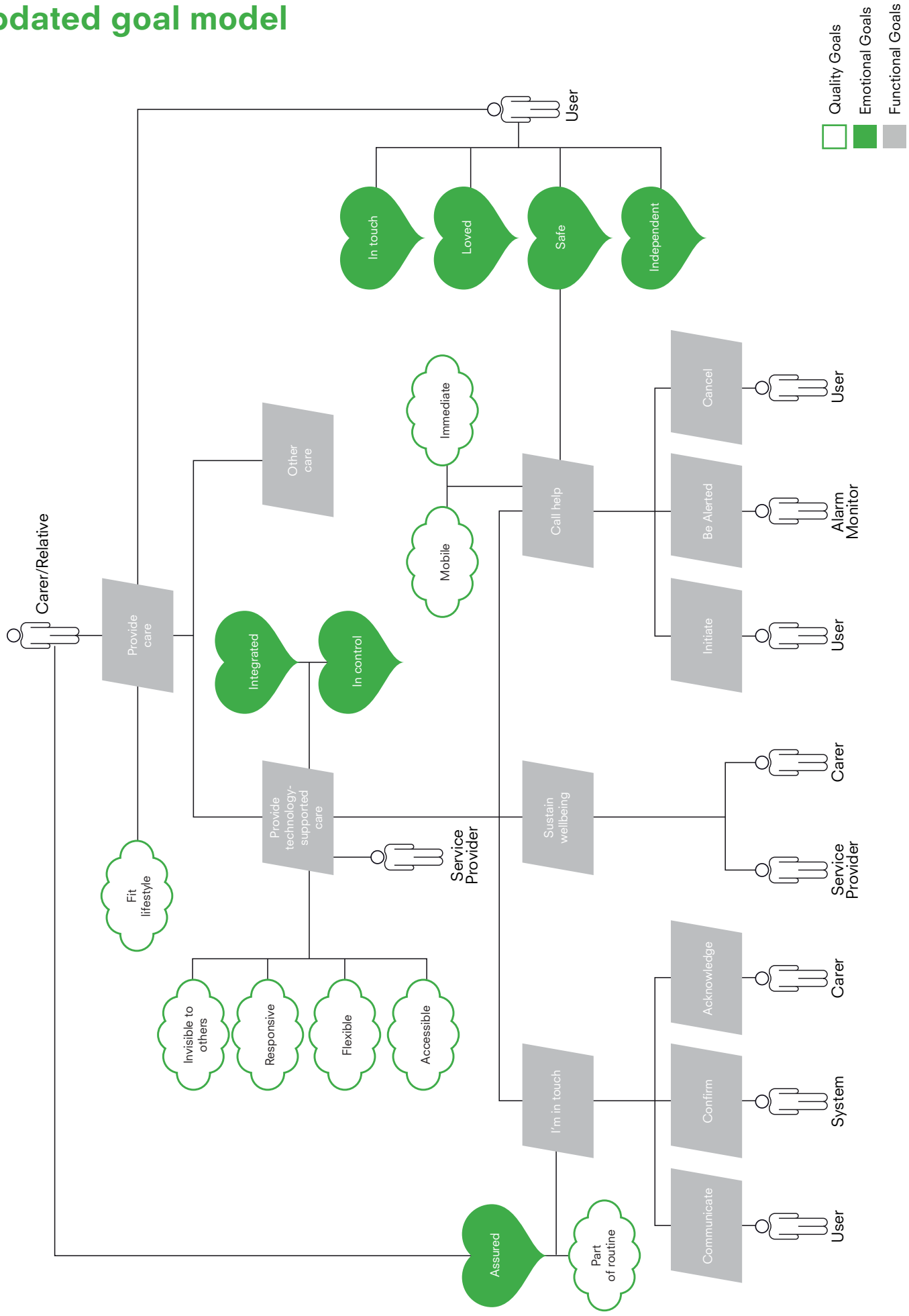


Figure 2. Updated goal model for emergency alarm use based on field study data

Recommendations

In this section we make recommendations based on the functional goals, quality goals and emotional goals derived from the data. This distinction is useful as quality goals are properties of the technology, and they do not differ greatly between individual users. Emotional goals are the effect that the technology has on how the user feels, and will differ significantly depending on the individual user. Therefore, following the logic of the goal model, the recommendations are split in three sections: What an emergency alarm technology should do (functions), how it should be (qualities) and how it should feel (emotions).

FUNCTIONAL RECOMMENDATIONS

Emergency alarms provide two main functions the alarm and the wellbeing check. We suggest three functional goals that are described below.

I'm in touch

Many participants stated the importance of communication.

> "For me personally, I think technology is a support system and an information system, and a contact system." [Marie]

Therefore we recommend for the wellbeing check a more social interaction. With sending "I'm in touch" the user is letting carers, relatives or significant others know that they are ok. We deem it crucial that they do receive some sort of confirmation as any communication expects a response. This does not have to be a verbal response.

Sustain wellbeing

"Sustain wellbeing" is the greater goal of helping the user maintain their wellbeing, including emotional and social wellbeing. This poses a higher demand on the service provider and/or the relative to get engaged with the individual user and not merely to confirm that the older person is "still alive". This suggestion is in alignment with a recent shift of more person-centred care that is pursued by aged care providers and the government.

One possible solution could be the service provider visiting or calling to see how the user is feeling rather than just calling to see that the equipment is still working. This is well supported by our data that shows that it is important to build up and reinforce positive relationships and experiences for successful technology use. As exemplified here;

> "Whereas the nurses, the nurses immediately connected, had a rapport about positive areas. And it occurred to me, why was not the person that had a rapport with my mother actually explaining to her how the thing works, rather than the technical person? That seemed to me an additional person who didn't add value. If that could have been integrated in the service, or someone who had a rapport with my mother explaining it, I think it would have been better." [Lucas]

If this was the case his mother probably would have been able to see the technology as part of her routine and daily care instead of a completely new external challenge.

Call help

With a trusted relationship (and this could differ from user to user) fears and barriers could be lowered to use the alarms in case of emergency. This is the functionality that requires the least changes from a users' point of view. None of the users questioned whether the alarm itself works when initiated. Improvements concern range and an assurance of immediate action when needed.

> "Should do what it needs to do and why anything else." [Glen]

"Whereas the nurses, the nurses immediately connected, had a rapport about positive areas. And it occurred to me, why was not the person that had a rapport with my mother actually explaining to her how the thing works, rather than the technical person? That seemed to me an additional person who didn't add value. If that could have been integrated in the service, or someone who had a rapport with my mother explaining it, I think it would have been better." [**Lucas**]

QUALITY RECOMMENDATIONS

The whole system as well as the single components should adhere to the universal principles of design (Appendix A). In effect, quality goals are concerned with the additional properties of the technology and can be considered to understand how we may assist with the way the technology is accepted and to what degree.

Fit life-style

Overall the system requires a better integration into the daily life of the user as well as the carer. We see opportunities for the role of relatives, friends and carers to naturally integrate the technology. If this role was considered to be part of the social network it can create an awareness of the well-being of the older person. This does not need to be the responsibility of a single point of contact. A main contact only needs to be informed when no one in the network was in touch in a defined timeframe.

The device should fit the lifestyle and be part of a routine: Several users mentioned a break in routine and forgot to push the notification button. Luckily, in one particular instance the user was able to answer the response phone call from the service provider before she left and confirmed everything was okay.

Invisible to others

A nicer designed device would make a big difference to some users. Even more importantly it should be invisible, being integrated in some other device or masked as an accessory. As discussed with Joe his auntie was not proud to have the device.

> "It wasn't really something they wanted to talk about (whispers this to gesture uncomfortable topic), I only suggested it to her because I then realised this was a possibility. For me this was like great this is fantastic you know, this is another way I could monitor her,….. And I became aware only through its use of how much negatively was surrounded by a number of people that had them. " [Joe]

Responsive

Every user interaction (no matter if with the base station or the pendant) should be responded to, to allow for human error. Feedback should be given to the user with every interaction made between the user and the pendant. The feedback could be tactile (vibrations), auditory, or visual. Importantly, the user should be alerted very clearly to the fact that the button has been pushed to reduce the likelihood of emergency procedures being initiated when the user did not intend this. Such situations cause significant embarrassment to users.

If the pendant is accidentally pushed, there should be a short period of time (5-10 seconds) where the user can deactivate the call for help either on the pendant or the base station.

The button should be designed in a way that accidental activation is minimised during daily activities. Perhaps the button could be concave or shielded with a raised lip.

The base station display should communicate information that is relevant to the users' interactions. For instance, the station should acknowledge that a button has been pressed and that the notification has been received.

Ideally the design is self-explanatory and there is no labelling needed, also in consideration of non-English speaking users.

One user stated that she once triggered the alarm on accident without realizing she had done so. She had to immediately confirm she was ok when the service provider rang her. As she did not realize she had triggered the alarm, she could not cancel it.

Unsure if the other user had already pushed the button, the user and her partner regarding the well-being button expressed concern as to what would happen if they pushed the button at different times of the day.

Flexible

As the pendant is worn at all times during the day it should be able to adapt to the user during different daily activities. The necktie should be easily adjustable and made of a material that does not 'grip' to the skin.

The pendant should be able to be worn on different areas of the body such as neck, brooch, pocket or wrist. Accordingly, the size of the pendant should ergonomically suit the desired area of the body it will be worn on. For instance, it would look aesthetically unpleasing if it were worn on the wrist and was large and bulky. The base station should be designed in a way that it can be installed in flexible locations within the house, in order to not disrupt the current layout of the user's home, but still be accessible. Users should not be locked into a set time frame, on any day.

Accessible

If the pendant is worn underneath clothing, the form should be designed in a way that it can be easily removed without getting hinged or snagged on buttons or collars. The button on the pendant should be easy to reach and activate. The pendant should have a speaker to communicate with the service provider in the event of an emergency.

Immediate

An emergency call needs to be responded to very quickly. This includes not only the emergency response but all responses. There should be a balance between false alarms and quick response.

Mobile

The range of the emergency alarm should be improved. Sharon noted that she does not take the pendant with her when she is out, as the range does not cover the grounds on her journeys. When she is at the far end of their property she would carry a mobile phone with her, as the range is better.

Part of routine

It is important that the routine feels natural and integrated with everyday life. Ad hoc set up routines did not work well. Also, routine should not necessarily be understood as something that is the same every day or able to be easily adapted. There should be possibilities to tailor the service to individual routines and changing routines.

EMOTIONAL RECOMMENDATIONS

We identified seven emotions (feeling in touch, cared for, safe, independent, in control, integrated and assured) that were crucial for all users and that need to be accomplished to guarantee that the user feels comfortable using the system and consequently uses it. However, as a focus on emotions is not common in system development it is challenging to give straight forward recommendations on how to fulfil these users' emotions.

Integrated

The alarm system should be integrated into older people's lives. Alarm system should be marketed and offered to younger users. Often users are in crisis circumstances when the system is introduced, creating a stressful atmosphere to learn of new technology. The earlier users start the better the chance it will be integrated in their lives. Integration can also be achieved by making use of existing devices such as mobile phones, touch tables and computers. Other care services should be integrated with the emergency alarm.

In control

Users are more likely to feel in control when a system is easy for them to use. To achieve this every button on the base station should only have a fixed function, and that function should be easy to interpret.

Button colour schemes should be easy to interpret and not break traditional conventions that users may be familiar with. For instance, traffic light colours are a convention and something that people understand.

Assured

Relatives need to feel assured that the users are indeed well. This will be short lived if they are not fully integrated in the process.

There should be choices in the process for the user, giving them confidence in the technology as they have had input and an opportunity to understand and comprehend the process prior to installation.

Additionally to this the individual who instigates the alarm system needs to be considered. The person who introduces the system can have effects on the response of the user. Claus for example received his alarm system via an audit of an independent organisation he had previously had close associations with. Claus was particularly deliberate to express his positive response to the system.

The following four emotions are in particular relevant to the user. These emotions are not tied to emergency alarms and cannot be implemented, but should be enforced by the interaction with the technology.

In touch

Most older people love to communicate and be in touch with other people. Some positive 'human' feedback should be sent and received by the user in order to feel 'in touch'. Technologies that aimed to increase a feeling of human contact are presented in the sections 'prototypes in literature' and "concept idea section".

Cared for

The feeling to be cared for is closely connected to a desire to be in touch with loved ones. Caring is strongly connected with spending time together and investing time. As time is often an issue ways are needed to be in touch over a distance and in non-time consuming ways. The current alarm is not balanced in this regard. It is built on the concept to assure the relative, but does not satisfy the feeling to be cared for. Again prototypes from HCI projects demonstrate subtle and time efficient solutions that are reciprocal and address this felt need. However, as the other emotions this cannot be implemented into the technology itself, but based on existing relationships. For such systems to work a shift in perception of some relatives is needed. A "if I don't hear from her I know she is all right" — attitude only is not enough.

Safe

It is important that an emergency alarm is not only reliably functioning, but also that the user feels safe and comfortable with it. As one relative stated:

> "the reliability of the device is so dependent on the way it's used […] I think that unpacking why it is the button is not pressed is a very complex thing. Not insurmountable but I think there are many dimensions to it." [Joe]

A solution should be more flexible to individual needs and possibilities. Older adults are very different. The demographic of emergency alarm users varies widely in regard to abilities, age and health. Instead of a "one-fits-all-solution" this should be accounted for. We recommend also introducing a new emergency alarm system when the user is not in a crisis situation. In stressful situations and in a rush it is hard to achieve a feeling of safety.

Independent

Some systems try to achieve reliability in reducing the degrees of freedom or agency for the user. Our results show that only when users are comfortable and willing to cooperate with the purpose of the emergency alarm can be fulfilled. Users always will find ways to not use a technology if they do not want to. We recommend to increase their feeling of independence and not try to force them into compliant use.

> "And that by giving the user agency in their use of it you create a whole set of other concerns whereby the reliability of the device is so dependent on the way it is used. As soon as you - the more agency you give someone, or the more independence you give them, the less effective the device is. And it took me a while to get to that point. So that was the learning curve for me. But I couldn't see - while the agency was still there I couldn't see how the device could be made more - apart from altering the visual appearance of it — I couldn't see how you could make it more efficient." [Joe]

As a consequence she tried to be compliant:

> "…she was trying to, you know her… [pause], her way of trying to respect what I was trying to do, was whenever I was there she would put it on. Or if someone she knew that I knew was there she would have it on. She really kind of worked through a whole lot of layers of connections between people to make sure that was ok." [Joe]

The next section looks into existing alarms and their advantages and disadvantages followed by some concept ideas.

"I think that unpacking why it is the button is not pressed is a very complex thing. Not insurmountable but I think there are many dimensions to it."

[Description of non-use and family discussion — **Joe**]

Competitor analysis

There is a range of personal medical alarms on the market offering peace of mind to those living at home. While most alarms offer this peace of mind, it can be difficult to choose between the products listed on the market, especially given the physical and functional likeness they all share. This section of the report aims to distinguish between the variety of products available and how each product shares or separates itself from competitors within the market from a functional perspective. This includes how the pendants work, the aesthetics of the products, the operable range from the base stations and special features, the leaders within the field, finishing with a short review on the emotions users associate with these products.

PENDANTS

All medical emergency alarms contain a base station and a pendant. Pendants usually have a necklace allowing the user to wear the pendant under their clothing around their neck, as is the case with the Safety Link VCI MK9 series. However, this could pose a problem if the pendant becomes tangled under the users clothing making it difficult to remove the pendant to access the push button. Other products offer the user a little more flexibility when it comes to wearing the pendants. Some are designed in a way to retrofit to a pre-designed wristband or clip attachment to be worn on the clothes like a brooch (Tunstall Personal radio Triggers). From a functional perspective, Tunstall offer the user greater flexibility in deciding how to use their pendant and greater accessibility if the user needs to push the emergency button. However, it is common practice within the market to see pendants only having a single sided face to which the user can press the button, again making it difficult if the pendant twists under the users clothing. Aesthetically, the pendants on the market all look alike. A white shell encasing a contrasting red button often with a small LED to indicate the button has been pressed. Phillips however have shifted away from this aesthetic creating a pendant that is softer, with no contrasting colours. The button is concave allowing the thumb or finger to find its way, while also minimizing the chances of accidentally pressing it. The Philips AutoAlert pendant also features an adjustable water proof strap that can be lengthened or shortened according to user preference; again removing itself from current fixed length ties.

Figure 3. Pendants from Tunstall, Phillips and Medi Pendant

In the event of an emergency, a user would only communicate through the base station making it difficult if the base station is far removed from the user. Medi Pendant recognizes this as a major issue and has designed a pendant that they claim to be the only pendant allowing the user to communicate without needing the base station. The pendant features a small in-built speaker that when activated allows the user to communicate directly with the service provider. Considering most pendants on the market only offer 50-70 meters of coverage from the base station, the Medi Pendant provides an additional level of security operating within 600+ feet to the base station.

Emotions

The literature surrounding pendant designs are varied. However, some articles do discuss that the personal medical alarms do reduce anxiety about falling and have little negative experiences associated towards using the alarms (Migual, K & Lewin, G. 2008, p. 104). From a functional perspective Migual and Lewin (2008) found that users prefer not to wear the pendant in the shower because the wet cord is uncomfortable on their skin and prefer not to wear it during sleep as they are afraid they will press the emergency button. The necklace pendant is also seen as a nuisance in some articles with one participant commenting on how it dangles around the neck during gardening:

> "The alarm lives in my bedroom. You really need a small one on your wrist or something. It dangles.... If I go out to do something in the garden I don't want it flapping around in front of me. Too big to sort of hang off my wrist." (Johnston et al, 2010, p. 234).

Discussion

The common features identified for pendants include a single button and some form of feedback light. What does differ however are the smaller features such as adjustable neck ties and in-built communication systems. While the literature addresses some emotional benefits, such as reducing anxiety and making the user feel confident, there are many functional issues with the pendant itself that do need addressing to ensure the user needs are met. These include addressing accidentally pressing the emergency button, the impact it has on daily routines and ensuring the pendant itself is comfortable to wear.

BASE STATIONS

Base stations are the hubs of the service for personal medical alarms (figure 4). A typical base station would feature a speaker, usually activated when the pendant is pushed, a button that works to call help in need of an emergency and a cancel button if the emergency button on the pendant is pushed. In some cases, a base station may also have three buttons; a button to call for help, a wellbeing check button and a cancel button. This section of the report will focus on the independent features of existing base stations, in particular the functions of each feature and how they compare to each other. To capture how each feature functions, product semantics will be used as the framework.

Figure 4: Mepacs, Tunstall and Phillips lifeline device (in this order)

Buttons

All base stations have some form of button. The Mepacs base station has a raised red button, and a raised green button. The red button serves two purposes. The first is the wellbeing check, while the second function is 'call for help'. The green button is a wellbeing check. From a product semantic point of view, the functions of each button could be said to not relate to the design and colour of the particular button. That is, does red represent that everything is OK and green to cancel? What the Mepacs base station does do well is the placement and size of the button in accordance with the Universal Principles of design (see Appendix A).
The buttons are appropriately separated from each to avoid accidentally pushing both at once, they are easily recognizable to serve independent functions from each other, they are accessible and they do not obstruct any other details from the base station itself. A large speaker on the front represents that the base station is to communicate with or listen to.

Tunstall is another brand of base station with an appropriate pendant. It is important to note that the Tunstall base station operates on the National Broadband Network. This is important because 'the National Broadband Network will ultimately replace the copper network and all other public fixed-line telecommunications networks in Australia' (Tunstall, 2013). Current alarm providers on the market only operate on the current copper line system. The Tunstall base station is an example of a three-buttoned base station however it is unclear of the function what the green and yellow buttons do. The red button however is a call for help.

The Phillips lifeline base station is aesthetically different to all others. It only has one visible button, which is to call for help. Its' red contrasting colour makes it easily identifiable and easy to interpret its function. The reset button is used to test if your base station is working as intended. When it is pressed, the unit will say 'thank you' confirming the base station is in working order.

Discussion

While base stations do vary in design and button placement, colour and form, they all function in a very similar way. All base stations serve the primary purpose which is to communicate with a third party in the event of an emergency. It is interesting however that all of these products have titles on their features to indicate what they do. It would be interesting to determine how a base station would be designed so as the function of the device and its features communicate their function without the need for an explanation.

Also refer to link with list of relevant Australian services: http://www.persa.com.au/aboutus.htm The Personal Emergency Response Services Association (PERSA) is a self-governing body that represents manufacturers, service providers, and consumers of Personal Emergency Response Systems (PERS).

All base stations serve the primary purpose to communicate with a third party in the event of an emergency. [...] It would be interesting to determine how a base station would be designed so as the function of the device and its features communicate their function without the need for an explanation.

INTERACTION PROTOTYPES FROM RESEARCH

Several prototypes have been developed and ideas of adoption explored in a multitude of HCI projects that used ethnographic field studies to facilitate subtle interactions between family members (Hoog, Keller, & Stappers, 2004; Vetere, Davis, Gibbs, & Howard, 2009), in some cases explicitly to support older people to stay longer in their homes (Mynatt, Rowan, Craighill, & Jacobs, 2001). These prototypes, promoting subtle interactions of family members to be in touch, correspond well with the aims of our projects on addressing emotional needs of older users at home using emergency alarms.

Electronic picture frames (Mynatt et al., 2001)

Mynatt et al. (2001) created a picture frame that constitutes a surrogate support system that transmits informal daily communication. According to the authors a surrogate support system is a form of mediated awareness intended to re-establish certain aspects of the naturally occurring social support that is disrupted, in this case, by the introduction of geographic distance into an extended family. Their goal is to leverage emotional connections with close family members and friends by augmenting a common household object that is typically associated with the family and the role that portraits already play in decorating the home. This is in strong alignment with the aims of our project making use of existing social structures and routines that are significant and familiar to older adults.

Collage (Vetere et al., 2009)

In a similar fashion 'Collage' (Vetere et al., 2009) is a shared domestic display using mobile camera-phones as an input device and a touch screen for synchronous interaction between family members with a focus on grandparents and grandchildren. Via the phones, photographs and text messages are sent to the touch screens simultaneously. The photographs and messages provide a constant presence, flowing down continuously on the screen (older pictures are smaller than new pictures and shown less frequently), much like a waterfall. These shared objects can be stopped, moved around, enlarged and arranged. Collage enables a sharing of subtle and often serendipitous interactions without being intrusive. Collage facilitates particular simple forms of playful interaction and communication via the shared touch screen. When communicating via moving pictures or sending photos and texts simultaneously the implicit message sent to family members is 'I am ok' without putting a strong emphasis on this aspect of the interaction. The constant presence of the screen with family related content reminder of loved ones and consequently created a feeling of being less alone for some of the older people (Pedell et al., 2014).

The Gustbowl (van der Hoog, et al., 2004)

The 'Gustbowl' (Hoog et al., 2004) is an ethnographic research product that enables parents and children who have left their parents' house to bring back the feeling of coming home. The Gustbowl is described as a system allowing for low threshold, uncomplicated communication through using an aesthetically pleasing product. Technology is used to reconnect a parent and grown-up child by anchoring communication in routine daily actions. Importantly the Gustbowl is an example of a product that doesn't require people to change their daily routine but that incorporates everyday rituals to be used casually to be in touch. This connection would be a more subtle and non-intrusive way to communicate with a primary carer than an explicit monitoring system.

These three examples show how domestic prototypes have been developed to cater for meaningful but subtle interactions with family members, including their needs, routines, emotions and interests. Hassenzahl et al. (2012) point out that, from a psychological point of view, the exchange of seemingly trivial 'information' about mundane day-to-day events is crucial to the feeling of being involved in the loved one's life. That this can be technologically mediated was shown by Dey and de Guzman (2006). They developed a series of presence display concepts (e.g., PictureFrame, AugmentedMirror).

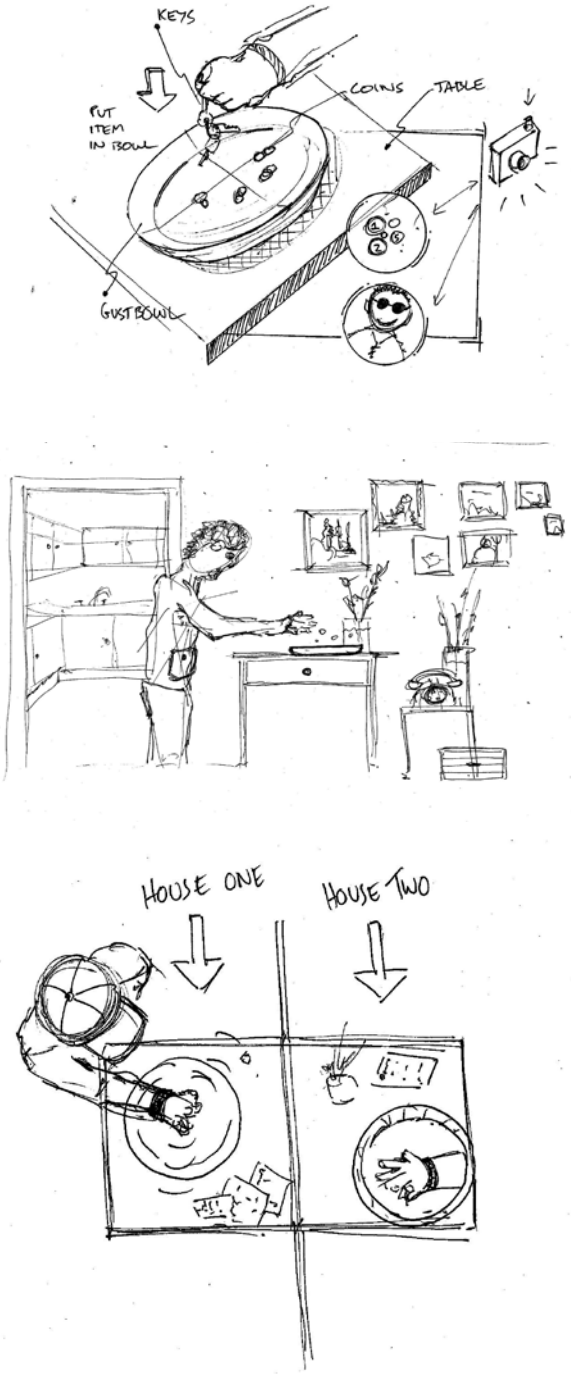


Figure 5. Objects are dropped into the Gustbowl. Images recorded by the bowl are sent to a second household.

Concept ideas

This section describes some concept ideas from the user's point of view. The following concepts were developed in a parallel project as part of the Swinburne Summer Scholarship program. They illustrate how some of the issues around emergency alarm use could be addressed and can be used to develop ideas. These designs are not a direct development of the collected data and do not represent a holistic design solution. IP of these concepts remain with Swinburne University.

DEVIATION OF THE PENDANT

This conceptual model of a pendant takes the best features of current designs and addresses some of the more functional problems (see Figure 6). Current pendant designs are only single sided and often concealed under the user's attire. If an emergency would occur and the pendant has twisted under the clothing of the user, it may be difficult to turn the pendant around and push the emergency button. Having a double-sided button adds a little re-assurance that if it has twisted under your attire, the pendant can still be pushed. It is slim to avoid getting caught in button holes, collars. Further to this, the pendant has a built in microphone allowing the user to speak through the pendant rather than through the base station in the event of a fall. Feedback is also given when the pendant is pushed in multiple ways. The pendant lights up, may vibrate and also makes a noise indicating you have pushed the button. The pendant can be worn around the neck using a waterproof plastic coated tie, or detached, worn in the user's pockets. Most services that offer pendants also ask the user to leave a spare key outside in a safe box. This pendant design offers an automatic door lock, that when pushed, unlocks the doors allowing medical staff entry into the house.

As a concept, it still would need more work to address some of the higher emotional level goals discovered by this research. This concept mainly addresses some of the functional goals.

CULTURE AND DESIGN

A major demographic of emergency alarms are females living on their own. In some cases, especially in some European cultures, it is customary to wear all black if you are a widow. In these cases, the current pendant does not adhere to these traditions with its white shell and vibrant red button. This design takes the pendant and rethinks it as black jewellery. The pendant itself can be transferred from one form to the other watch, necklace, brooch (see Figure 7) for flexibility. When the pendent is pushed, the black stone lights up indicating the device has been activated.

From our point of view this jewellery addresses well a specific part of the user demographic. However, the concept idea is not developed to a point where it has universal applications such as male, female, younger, old etc. The concept provides room for more work through and could become an innovative re-think of existing pendant designs as it is culturally sensitive, more appealing and less stigmatising.

Figure 6. Updated concepts for current pendant design

Figure 7. Concepts for culturally considered pendant

MOBILE PHONE APPLICATION

A software-based solution on a mobile device will enhance mobility and flexibility, while significantly decreasing cost as the take-up of tablet PCs and smart phones among the elderly is increasing.

While most pendants have a range of 50-70 meters, travelling around a large property can make it difficult to use the pendant in the case of an emergency. In one interview, the participant told us that he would often carry his mobile phone when he goes outside so that he could call someone in such an event. The mobile phone application (see Figure 8) takes the current pendent and base station features and combines them into a digital platform. A well-being check can be pressed, as well as nominating particular times of the day. Further to this, the user can assign from his/her contact list who should be notified in an emergency and who should be notified that the well-being check has been activated. This application also has the capabilities to add daily reminders with the in built alarm clock service on most phones.

The contact list shows who the user has been in touch with. This open approach has the advantage that not necessarily only one contact or care person is in charge, but as long as there has been contact once a day (or defined by the user more often) to one of the network participants the user is well. This approach easily integrates younger as well as older people and criteria such as the older person needs to live on their own and be in the need of care , become less relevant to sign up for the service. Data still could be monitored for the older users only and if no message exchange has taken place a check is initiated. The idea of a stigma associated with a service for older people could be lowered by increased social networking with existing significant contacts. Also these contacts do not need to be in proximity of the user as checks are only initiated in the case of no contact.

Trust and Privacy

Many older people mistrust others on the Internet and do not believe that sharing information about themselves will lead to a good outcome (Lenhart, 2000). Privacy concerns are therefore important to consider in the design of social technologies for elderly users. One way to mitigate this concern is to create a closed platform. Therefore, in contrast to social networking sites (e.g. Facebook, MySpace) we recommend the development of a platform that is not open to the public and closed to the caregivers and participants in the network. Transparency and control over data are also important aspects found in our data.

Touch screens

Touch-screen technologies have been identified as potentially well-suited to older users because they offer ease-of-use and suitability as both an input and output device (Doyle, et al., 2010; Kobayashi et al., 2011). Touch tablets enable direct input via touch-based gestures in contrast to indirect input devices such as a mouse. It is known that direct input devices are easier to use for the elderly (McLaughlin, et al. 2009). It is also known that larger screens enable the elderly to achieve the same or better accuracy in executing gestures compared to younger adults (Stößel, et al., 2010). Touch-screen devices such as the iPad offer numerous possibilities for making technologies more accessible to older users. There is a trade-off between size and portability that has to be well considered when making use of either a smart phone or a touch tablet.

Figure 8. Mobile phone application as a personal alarm

ONLINE WEBPAGE

A theme consistent with both the literature and the interviews was the notion of flexibility. Users who have current personal medical alarm systems installed in their house often noted that the service was great, but lacked flexibility. This conceptual rethink of a typical service would allow the user to sit down prior to purchasing their system and proceed through a series of personalising their system (see Figure 9). These stages are allocate, designate, voice and extra. The user would first define the colour of their pendant then proceed through to allocating suitable times throughout the day to which they would push the wellbeing check button. The user would then designate their nominees, while also having the flexibility to log back into the site and change or re-assign new nominees when required. The "voice" stage allows the user to decide things such as language services removing the need for the user to go through various telephone prompts to select their required language. Lastly, the user is given the option to add extra features to their new service. Extras could include necklace styles and automatic door unlocking when the pendant is activated. If the user needs change, a simple log on and update of their service can be changed from here. This conceptual rethink of a service touches upon how a user can take control of their service. Most of the literature that discusses how fall sensors etc. could be used and integrated conceptually in a home only focus on the technology of the system, but none speak of how the user would or does feel within this scenario.

Figure 9. Online webpage, considers how a user can take control of their service

CONCEPT IDEAS AROUND MONITORING

Usage monitors with a twist. The Jamy Toaster (see Figure 10) being connected to the internet, could be transformed to send a more personal message such as a smile or a 'good morning' to family members.

Figure 10. Jamy Toaster showing current weather

Less meaningful, but well integrated in the daily routine: the alarm clock could be combined with the wellbeing check (see Figure 11).

Figure 11. Making use of existing devices

PICTURE FRAME CONCEPT

In the home of one user the base station was used to lean his personal photographs on. It became obvious that his family is the most important aspect in his life while the emergency alarm was meaningless and he did not know how to use it.

Every user had plenty of picture frames of loved ones in the living area (presented in Figure 12). This would be a good point to start in order to develop some well-being check that could be combined with a meaningful interaction. This idea is closely related to Mynatt et al's (2001) digital picture frames. At the core of this idea is a video recording/picture frame where relatives/friends ask their loved one to check in for the wellbeing check.

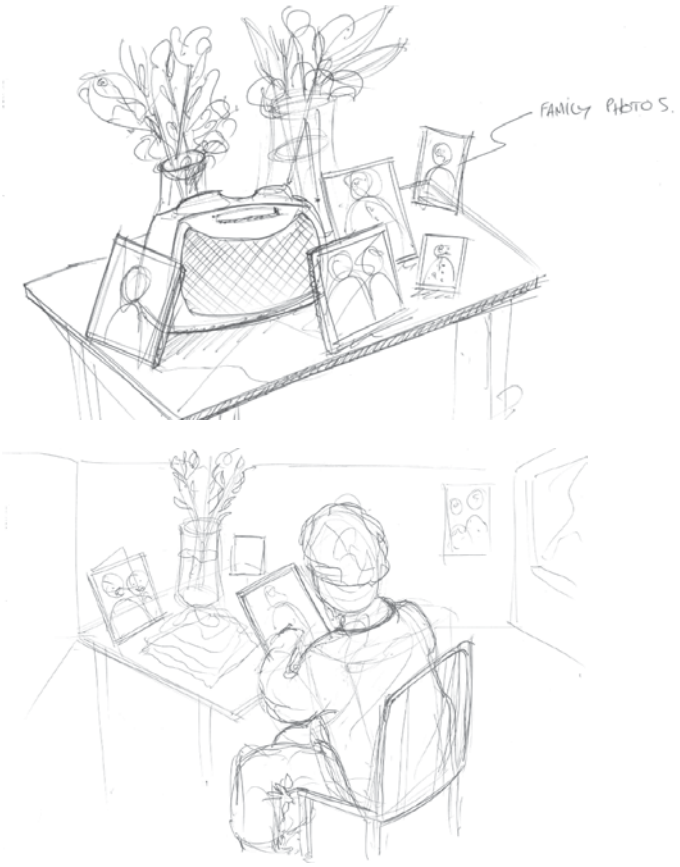
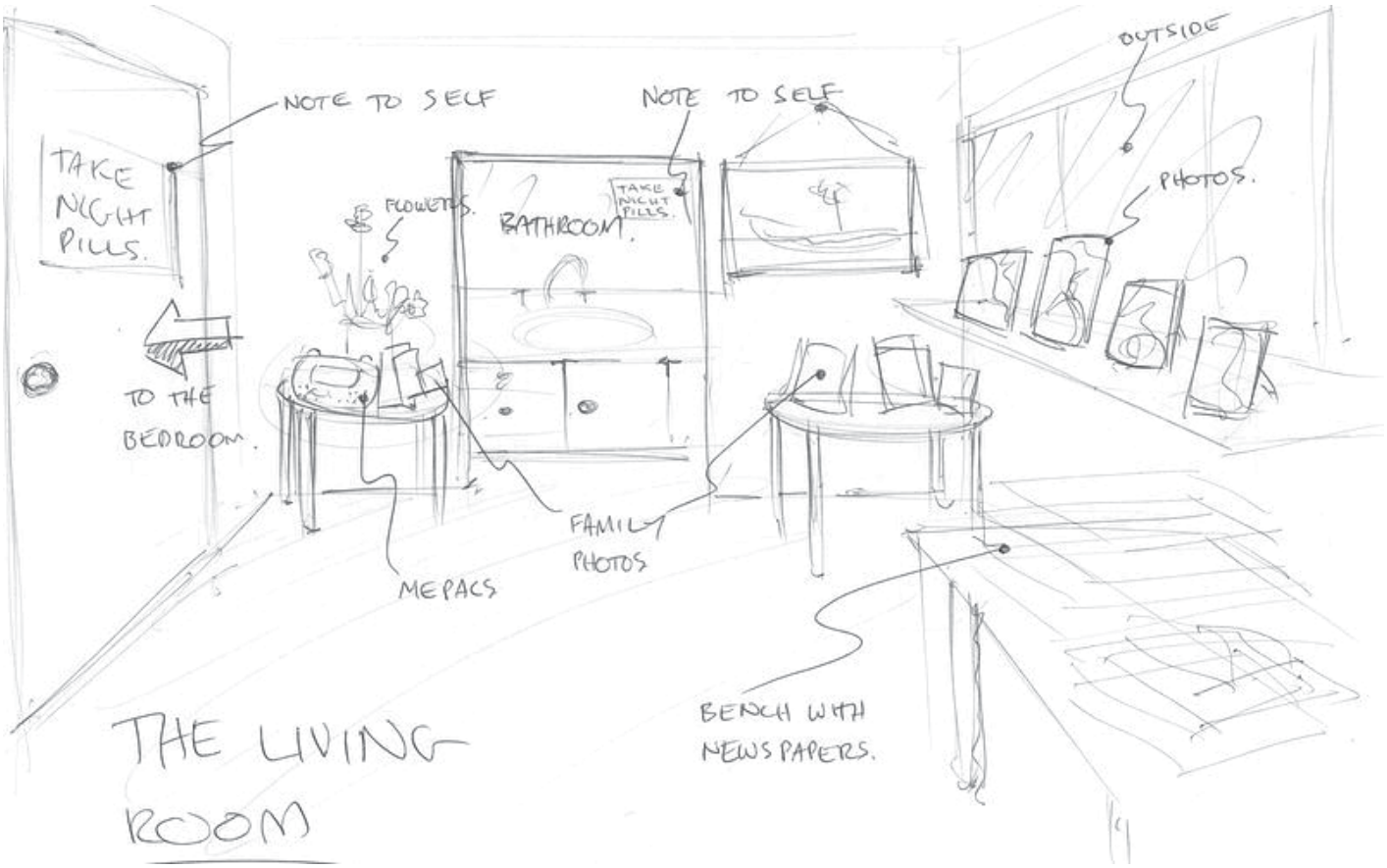


Figure 12. Considering the living context and investigating the role of family photographs (Sketches by Alen Keirnan.)



Prototype development

The prototype built is a picture frame application which focuses on a particular functional goal 'I am in touch', and its associated qualities and emotions. We have entitled this prototype 'picture frame' to distinguish it from existing photo frame applications, and because the term 'picture frame' best resonates with our client group (older people). This system is meant to replace the current base station used for the daily well-being check. The main aim of the picture frame is to balance the complex relationship between the well-being of the older person and the communication of this state to relatives, with an additional focus on the emotions of both stakeholders.

OVERVIEW

The system aims to gauge the well-being of an elderly person, by having them interact with a picture frame — which receives messages and photos from their contacts (family and friends). The picture frame (an application presented on an ipad) runs on a tablet installed in an older person's home. It can be supported on any web browser.

For each picture frame, an allocated period of time (usually within 24 hours) is designated as a check-in period, during which the elderly person should check-in (by touching the 'I am ok', or the 'message' button). If the person fails to check-in during the specified period an investigation message is triggered . If the person interacts with the picture frame then this is registered and a 'formal' check-in is not necessary.

The application consists of two main areas:

/ Researchers (Administration Section)

/ Picture frame (User Section)

The system aims to gauge the well-being of an elderly person, by having them interact with a picture frame — which receives messages and photos from their contacts (family and friends)

Agile development

The prototype technology was developed in an agile development process. One of the researchers of the team was in daily contact with the programmers for a period of two months to provide feedback and reflect on how progress matched with the goals defined in the motivational model. The prototype was developed with the emotional goals as a starting point. The functions and their qualities were discussed between the researcher and the developers, including an emphasis on how well they satisfy the emotional goals. In the following section the picture frame prototype is described with a lens on how the system is expected to address the emotions of the older user.

RESEARCHERS (ADMINISTRATION SECTION)

Setting up an installation

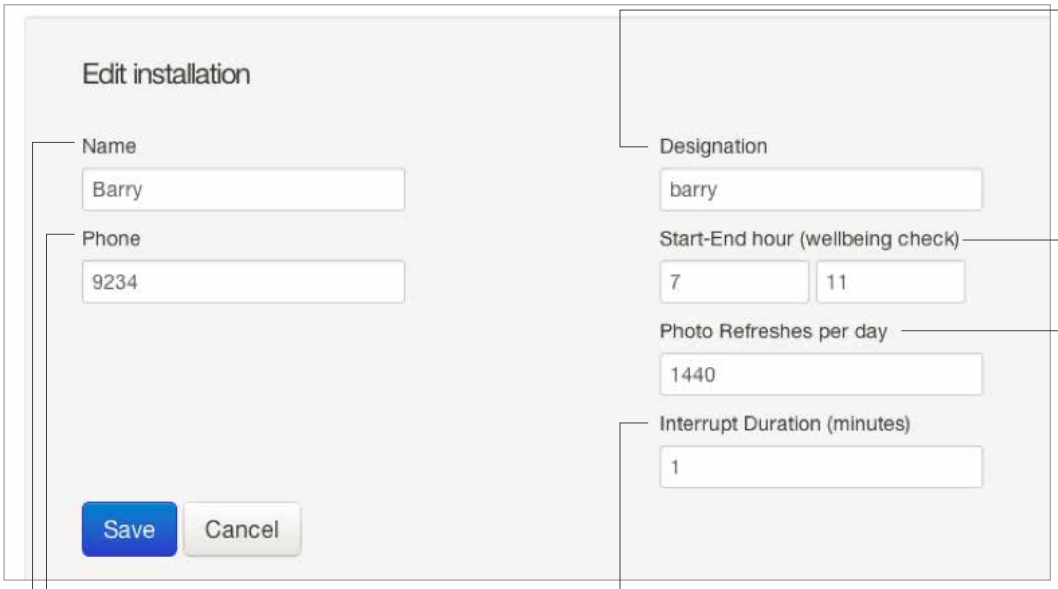
A single installation is a location (or person hereafter called user) that is using the system. Currently this is only for the purposes of the picture frame tablet but in the future this may include linking to home sensors.

An installation sends a series of events, that is interpreted to determine when any alerts need to be issued (see Figure 12).

Once a user has been setup — the picture frame can receive emails (from any email address) and will display those messages and pictures in the picture frame. The email address currently dedicated to the system is: smartserviceslean+<designation>@gmail.com i.e. smartserviceslean+alan@gmail.com.

“I just thought it’s great that he’s actually interacting with it, because it’s new technology for my father.”

[Daughter / Carer of **David**]



Designation

Used as part of the URL of the installation and is used as part of the email address that receives messages for that installation
The designation must be unique. It also must be alphanumeric with underscores only

Start-end hour (well-being check)

Integer that corresponds to a 24hr time that denotes the start time and end time for the check-in period
Valid range [0-23]

Photo refreshes (per day)

The number of times per day that the carousel will switch between photos in an installation i.e. 72 refreshes per day, means the frame will switch every (24 X 60) / 72 = 20 minutes
See Carousel behaviour (Appendix F)

Phone

Contact number of installation owner

Name

Name of installation owner (elderly person)

Interrupt duration

The length of time in minutes that an interrupt (new message received) will display on the carousel (at a minimum)
See Carousel behaviour (Appendix F)

Figure 12. The designation is a unique field that is entered as part of the installation setup.

Installation events (triggered by user)

Each field of the designation triggers events that are interpreted by the picture frame to determine whether any alerts need to be issued. Currently there are only 2 events:

Event 1
OK — The user has done something to confirm they are OK. Currently an OK event is triggered if the user:

a) Clicks the OK button (currently shown during the check-in period or when an investigation has been started)

b) Clicks the message button

Event 2
Help — this event can no longer be triggered from the picture frame, however it is still supported even though it was not part of the trial. Due to ethical considerations, the alarm could not be tested in the home environment with vulnerable people, without the backend setup being fully functional.

The installation events screen shows the details of the installation and lists the events in chronological order ((for screen examples refer to Appendix F). A note can be added by clicking on the note link (it will change to a darker version if it contains a note). The link 'Alerts' shows the alerts that have been triggered for this installation and the 'Send event' shows the picture frame. This function was exclusively set up for the test. A service provider would not be expected to see the actual messages or photos. This was relevant as it gave the researchers involved in the trial, insights into how the picture frame was used. For example, it was used instrumentally for short informative messages in order to organise events e.g. 'I will come around today' and for more personal messages about family issues 'look at your granddaughter – isn't she cute?'

Alerts

Based on the events triggered, the system creates alerts for users. Currently the following alerts exist:

Alert 1
Emergency — This can no longer be triggered in the system but is still supported.

Alert 2
Emergency Cancel — This can no longer be triggered in the system but is still supported. This is triggered if an OK event has been sent during an emergency period.

Alert 3
Investigation (Check-in mode) — Triggered if the user has not checked in during the required period.

Alert 4
Investigation Cancel — Triggered if an OK event has been received during an investigation period.

The same behaviour exists as per the events screen.

Based on the events triggered, the system will create alerts for participants (picture frame locations). These alerts are displayed in the administration part of the prototype. This part is intended to be used by a service provider. In the field study it was used for research data logging, in order to see when and how often users would use the system.

In the field trial only the two investigation modes were tested (described below). In addition the following data was collected: duration and times the picture frame was used (e.g. accelerometer data) and the times messages were sent.

Check-in mode

The check-in mode shows pictures/messages as per the carousel behaviour (Figure 13). The user can click the messages button to display messages related to this picture.

The system will pulse (lightening and darkening the background image) to show that it is currently during the check-in period. An OK button is displayed that when clicked will trigger an OK event and revert back to a sleeping state.

Figure 13. Example of picture frame at 'Check-In' Mode.

Investigation mode

The investigation mode shows pictures/messages as per the carousel behaviour. In addition there is an overlay over half the screen that alerts the user to the fact that an investigation has been started (Figure 14).

The user can click the messages button to display messages related to this picture or click the OK button, both of which will send an OK event and the system will then revert back to the sleeping mode.

Figure 14. Example of application in 'Investigation Mode'; the older person has not interacted with the picture frame in a while and an alert is generated.

Tablet movement (using accelerometer)

If viewing the picture frame on a tablet the system will display an image when it senses movement of the tablet above a certain threshold. The premise here is that in future iterations certain screen functions will only be shown once the tablet is moved (this is to encourage interaction with the tablet).

PICTURE FRAME (USER SECTION)

The picture frame displays images and messages and circulates them in a carousel like manner (Refer to Appendix F — Carousel Mode). The frame switches between photos. The revolutions of the photographs are based on input into the 'amount of photo refreshes' setting in the edit installation page. New photos are given priority over existing photographs. In addition the image displays a caption which is a truncation of the email subject (up to 255 characters). The picture frame also displays the contact person who sent the message.

When a new message is received it denotes the start of a conversation. The elderly person can reply to images/messages received with a message (Figure 15) and then the sender (usually a relative or researcher) can respond to the elderly person's replies in turn.

Thus conversations can be generated between sender and respondent. When a reply is received by the system, the picture frame switches to displaying the first picture that was received in relation to this conversation and it will display the new message as the caption. If a message without a picture is received the system will display a default background image with the message. The personal messages are intended to help the older person 'feel in touch' with other people instead of feeling that they are interacting with a system and merely pressing a button. The meaningfulness of the interaction is expected to add to a 'feeling of independence'. The recorded interaction can be leveraged by carers or service providers to ascertain that the older person is well supported e.g. by sending a personal message as well.

The personal messages are intended to help the older person '**feel in touch**' [...]. The meaningfulness of the interaction is expected to add to a '**feeling of independence**'.

Messages

The system shows the messages received from a contact in a lighter colour. The replies by the installation owner are shown in a darker colour. The system displays chronologically (with most recent towards the bottom) up to the last 10 messages. (Note: all messages are being stored)

Reply button

Any text entered in the text area are used to reply to the latest message that is showing (via email). The reply happens via email and shows as an email reply to the contact.

Back button

Returns to the picture frame screen.

Recent conversations with <contact name>

Contact name will be obtained from the email address that sent the messages.

Figure 15. Interaction concept of message screen

Field study two (prototype implementation)

This section describes the follow-up to the first field study to assess to what extent the older people considered their emotional needs addressed by the prototype.

STUDY PARTICIPANTS: RECRUITMENT

The study involved 9 primary participants, six women and three men, aged between 69 and 92 years, with an average age of 80. The participants were recruited through a variety of methods including:

a/ an advertisement located in and around Swinburne University

b/ pre-existing contacts of the researchers and their colleagues, and

c/ via a snowball method e.g. where a small pool of initial informants nominate through their social network, other participants who meet the eligibility criteria.

Our participants had a variety of backgrounds. They had a range of capabilities, and limitations commensurate with age including visual problems, arthritis, dementia, and mobility problems. Four of the primary participants had no obvious limitations at all. All of the participants lived in their own home either with a partner or alone. Some of the participants had used a personal alarm system before, and one (Erin) wore one throughout the project, although previous or current personal alarm use was not a pre-requisite for taking part in the study.

Each of the participants was asked to nominate a person or persons who could co-participate in the study by sending photographs to the picture frame.

PARTICIPANT	AGE	LIMITATIONS	TECHNOLOGY USE	CO-PARTICIPANT/S
Bruce	**72**	Epilepsy	Frequent	Researcher
Carol	**86**	Arthritis and visual impairment	Novice	Daughter and grand-daughter
Anna	**70**	-	Occasional	Son and researcher
Amanda	**69**	-	Frequent	Friend and researcher
Bridget	**84**	-	Occasional/ frequent	Daughter in law and researcher
Edgar	**78**	-	Novice	Researcher
Erin	**84**	Early dementia	Novice	Daughter and researcher
Tara	**92**	Significant visual impairment	Occasional	Niece and researcher
David	**85**	Early dementia	Novice	Daughter and researcher

Table 2. Summary of participants and co-participants (note: all names are pseudonyms)

The rationale for co-participation by family members or friends was that the photographic and message data would have more meaning, and emotional connection for participants than if it was sent by a stranger. Therefore, participants would be more likely to respond to this data.

Where participants were unable to secure co-participation from a friend or relative, a researcher acted as proxy and sent photos and messages instead. Due to time restrictions, most of the co-participants recruited to the study requested that the researchers also sent photographs to the participants, so there was at least one photograph per day sent to each participant.

The following table provides information about the participants and their co-participants. All the names are pseudonyms. The table includes participant age, gender and any disability or limitations. We also include an indicator of their level of technology use prior to the study. We use the following terms frequent, occasional and novice to indicate how often they use technologies. The relationship of the co-participants are cited. Note that most participants (7 out of 9) opted to receive photographs and messages from a researcher in addition to a family member or friend.

IMPLEMENTATION

All the picture frames served as an ongoing display in a central location of the home. We used prepaid 3G, and brought extension cords, easels and other items with us to each home, It was important we brought a complete setup with us, without relying on existing Internet services which may not be available in participants' homes.

While we suggested that the picture frames were located somewhere easily accessible for participants to reach, they were placed at a location of their choice, often where they spent most of their time. During set-up, care had to be taken to ensure that any extension cords were not obstructing the participant's path to the picture frame, particularly for participants with visual or mobility issues. All participants chose to use an easel to hold the picture frame, often removing it from the easel for interaction purposes.

Some, less mobile participants (e.g. Carol, Erin) chose to place the picture frames on their kitchen table (see Figure 16, below). Others (Bruce, Edgar) placed it on a side table near their computer or work station. Still other participants located it on a side table in the lounge room for visitors to see (e.g. Amanda), thus reflecting the aesthetic properties of the ipad (see Figure 17). No participants located the ipad in their bedrooms or other private areas of the home. All participants located the ipads at about waist height and often within easy reach of a chair.

Participants were encouraged to keep the picture frame running continuously in order to maximise the opportunities for interaction and the discovery of new messages and photographs.

DATA COLLECTION

There were a number of different types of data collection utilised in this study.

Semi-structured interviews

Semi-structured interviews were conducted with all the participants prior to, and immediately after use of the picture frame. All interviews were up to an hour in length and were audio-recorded, transcribed, and analysed.

Preliminary interviews included questions concerning the participants' background (demographic data, interests, daily routines), their technology use (what kind of technologies they use and how often, where the technology is located, and how they feel about technology etc.) and a discussion on which technologies might support them in the future.

Semi-structured interviews were conducted at the conclusion of the picture frame use. Each ipad was in use for approximately two weeks per participant. The second interview primarily focused on a discussion on the Ipad use. That is, questions related to expectations of use, usability, timing of use, and an in-depth discussion of particular features of the system e.g. the 'Are you ok' button. During the interview participants gave a practical demonstration of how they used the system and reflected upon the content of the photographs and messages. In particular the participants were asked to reflect upon any emotions they felt when receiving photographs or messages, or in connection with using the 'I am ok' button.

In addition, we compared and contrasted the use of the Ipad system with the pendant alarm with those participants who had experience with the latter. Finally we asked participants to imagine a technology which would best suit their needs in the event they were alone and required urgent support or attention. These ideas were generated to inform future design prototypes.

Above Figure 16. Below Figure 17. Examples of the locations of picture frames in participants homes.

A total of **560** messages were sent to and from the system. Some of these messages were sent in response to photographic content or message subject [...] Others such as a 'I am ok' message were instrumental responses sent to reassure co-participants that they were ok.

Co-participant's interviews

Semi-structured interviews were also conducted with relatives or friends who acted as co-participants for the Ipad use. Due to logistical difficulties, these interviews usually took place at the same time as the participant interview. These interviews focused on co-participants experiences of sending photographs and messages to participants. In particular we were interested in the co-participants experiences of choosing which photographs and deciding on what messages to send. Also of interest was the timing of interactions between co-participants and participants, and any feelings or emotions which arose as a consequence of using the system.

Researchers interviews

Finally, semi-structured interviews were conducted with the researchers who acted as proxy co-participants by sending photographs and messages to participants. These interviews served to debrief researchers who had been working with participants. This is common practice in qualitative research. Qualitative research embraces reflexivity, which is the idea of awareness, that researchers should be aware of the multiple influences they have on research processes and how the research process affects them.

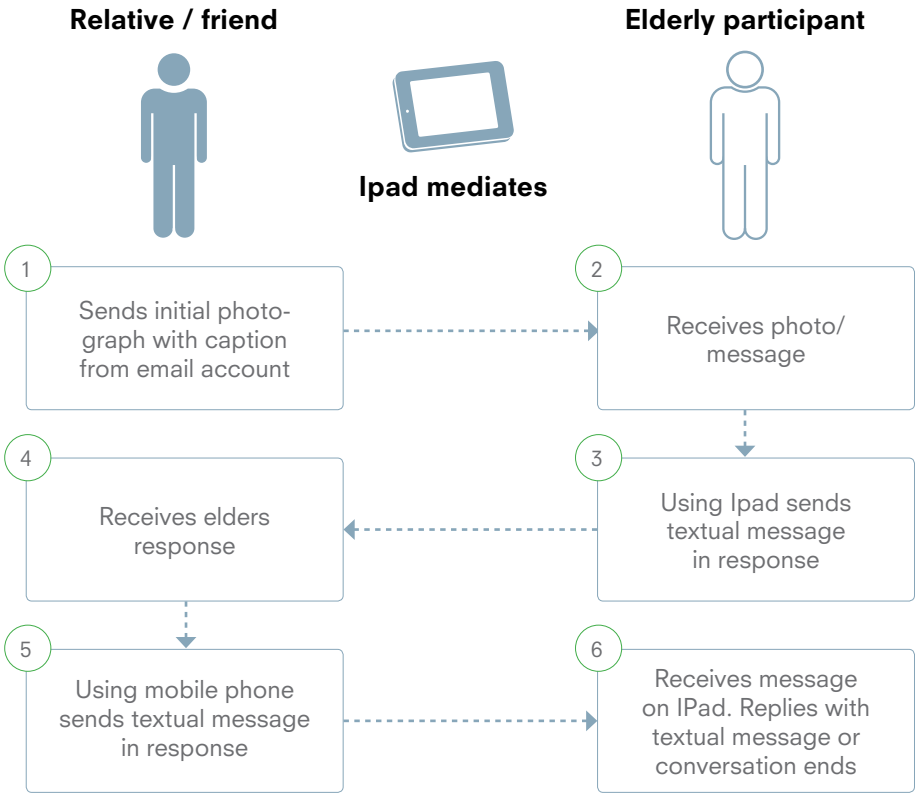


Figure 18. The relationship between participants and data mediated by the Ipad.

PHOTOGRAPHIC AND MESSAGE DATA

The picture frame was a two-way system in that both parties could send data to the other (as demonstrated in Figure 18 above). However only relatives, friends and researchers could initiate content. They could send photographic content with captions to the elderly participants. Elderly participants could reply using textual data in response. This design was chosen in order to simplify the interaction of the elderly participants. It was felt that it might be too difficult for elderly participants with a variety of physical or other issues to upload and send photographic content to relatives, as there are a number of steps to this process.

A total of 560 messages were sent to and from the system (e.g. family members or researchers to participants and participants responding). Almost all the initial photographs sent to elderly participants had a preliminary caption included with the photograph. Less than 10% of the initial content sent to participants were messages alone (i.e., they were not attached to a photograph).

The following sections are primarily concerned with the responses of elderly participants, as they are the primary focus of this research.

There were a range of replies to content sent to participants. Some participants primarily sent empty replies in response to content, which indicated that while they were engaged with the system, and wanted to respond to content sent by co-participants. However they had difficulty in doing so. This was particularly the case with Bruce and Tara — both of whom reported issues working with the ipad. Bruce's issues related to his unfamiliarity with the system, Tara's were relevant to her difficulties seeing pictures and text, due to visual impairment.

Other responses ranged from very short messages in response eg "Go lions".

Some of these messages were sent in response to photo-graphic content or message subject — such as a discussion of the families' favourite football team.
Others such as a 'I am ok' message were instrumental responses sent to reassure co-participants that they were ok, and sent independently of the OK button response.

Other participants (Bruce, Edgar, Amanda) engaged in much longer conversations. The longest of these conversations (excluding conversations with large numbers of empty replies) spanned 11 exchanges between participant (Edgar) and co-participant (researcher) originating on the subject of the Versailles palace in France, and going on to discuss history, graffiti and other subjects. The following excerpt comes from a conversation between Edgar and a researcher following photographic content sent of Siamese cats.

Edgar Sa I. Weeds ad

(unintelligible first attempt at sending message)

We have never had Siamese, however we once knew two Siamese who ate spaghetti in a most disgusting manner.

Researcher Some Siamese cats are obsessed with things — a friends chewed up wool. Nothing was safe — not even a jumper.

Edgar Ah! A geometric progression!

Researcher Yes indeed! My sister has two Siamese… my mother has two… I am the black sheep with a berman cat named Sebastian.

Edgar If you have a black sheep then you can knit yourself a Siamese! (sent twice)

Researcher Yes too true! Unfortunately I cannot knit. This is a skill I had as a kid… and if you were a Collingwood supporter then one could knit a magpie.

This excerpt reflects some of the common issues with using the technology. Edgars response was at first unintelligible, however his subsequent attempts worked well. This may be because he was still becoming used to the keypad, or because he was interrupted while writing the first message. Some messages were sent a number of times — this was a common occurrence for many participants. Often they resent messages, as they were unsure if it had been sent the first time, due to the time taken for the first message to be sent, and the size of the 'message sent' notice. It should also be noted that Edgar was healthier than some of the other participants, and he reported no visual or other limitations, therefore he was more able to make use of the ipad. This sequence is pertinent as it indicates some of the ways that able participants can share experiences with others, tell jokes, and engage with a seemingly random topics, such as Siamese cats.

LOGGED USAGE DATA

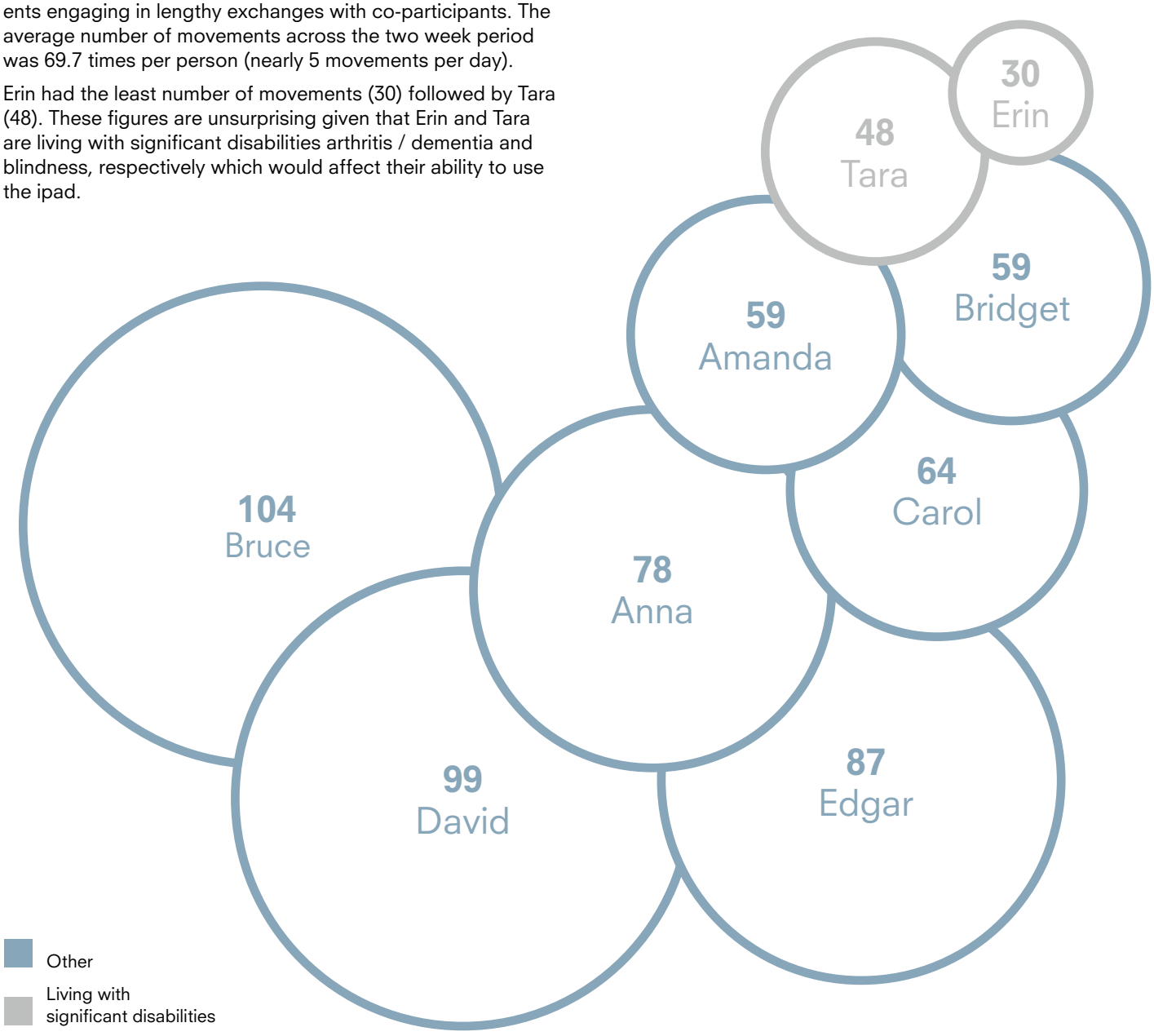
We logged the number of movements of the ipad per user (Figure 19). The largest number of movements was recorded for Bruce (104 over the two weeks) followed by David (99) and Edgar 87). It may be significant that the highest rates of movements are all recorded for the men taking part in the study. Bruce and Edgar, in particular, were very active respondents engaging in lengthy exchanges with co-participants. The average number of movements across the two week period was 69.7 times per person (nearly 5 movements per day).

Erin had the least number of movements (30) followed by Tara (48). These figures are unsurprising given that Erin and Tara are living with significant disabilities arthritis / dementia and blindness, respectively which would affect their ability to use the ipad.

DATA ANALYSIS

The interview data was analysed thematically through a close reading of the interview transcripts (Miles and Huberman, 1994). The analysis was an iterative process, following the approach recommended by Boulton and Hammersley (2006) which involves coding, reviewing, recording and interpreting the data. We were primarily interested in gaining an overall picture of participants experiences of using the Ipad application with an additional focus on understanding any emotional implications arising from sending and responding to content, and from interaction with the 'I am ok' button.

Figure 19. Number of movements per participant recorded by the accelerometer.



“...any message
is welcome…
I prefer voice,
but even pictures
(are welcome).

This is sort of
much easier to
use… than the
computer” [Bridget]

Results

All older participants were able to use the picture frame and most were comfortable using it. One of the participants (Bruce) had a strongly held position that he hated Apple and all its products and the study did not change this attitude. Despite this, the participant was one of the most prolific users of the picture frame. Notably, despite the view held by some relatives, that participants would not be capable of using the ipad, all participants to some degree, replied to photographs sent to them with commentary. This was the case even for more problematic users, participants who had physical or intellectual constraints (such as severe vision impairment due to macular degeneration, or the early stages of Alzheimer's disease). This is surprising considering that even some carers were doubtful that meaningful use and interaction between caring relative and participant was possible.

The relatives of participants seemed to welcome responses from participants, and may have underestimated the usability of the picture frame, or the motivation/capabilities of the participant. The following example highlights this:

> "No, I just thought it's great that he's actually interacting with it, because it's new technology for my father. He has seen an iPad because I've showed him lots of things on the iPad. On Facebook — his grand-daughters are in New Zealand - so when there's a picture of them on their Facebook page I will show him on the iPad, so he has seen the iPad but never interacted with it personally." [Son / Carer of David]

Thus, even participants with physical and intellectual issues, despite some initial difficulties using the picture frame, spoke about it generally in positive terms — using adjectives such as 'nice', 'cute' and 'fun'.

> "I mean it's nice — it's nice. It's, as I say, the advantage is it's easy to handle, easier to look at, and so on." [Tara]

> "Well it was fun, because its an ipad (proptotype) and you know, you can do that and that (demonstrating)... Everybody said an ipad is a lot of fun." [Bridget]

"Well it was fun, because its an ipad (prototype) and you know, you can do that and that [...] Everybody said an ipad is a lot of fun."

[Description from participant — **Bridget**]

Respondents such as Tara found innovative ways to better manage the Ipad (e.g. by using a magnifying glass in order to better see images) and welcomed the opportunity to receive and respond to messages.

> "..any message is welcome… I prefer voice, but even pictures (are welcome). This is sort of much easier to use… than the computer, and if I can't see it well, having it down like that (demonstrating), I can hold a glass over it, or hold my glass, and generally it's handy and it's easier than the computer." [Bridget]

The following comments below also provide evidence of positive feelings towards the device and the ease of use. This comment from the carer of the participant, points out how practical the device was to use. This relative was able to use her phone to send photographs and messages. Emphasising the need to facilitate the use of existing devices for the relatives to enable easy communication with the older person:

> "Yeah, that was fine, once I got that set up. Particularly doing it from my phone was good, because I've always got the phone with me, so in terms of doing it each day that was better for me..." [Carol's daughter, Jasmine]

"Yeah, that was fine, once I got that set up. Particularly doing it from my phone was good, because I've always got the phone with me, so in terms of doing it each day that was better for me..." [Carol's daughter, **Jasmine**]

This flexibility of use is important. Individual relatives, friends or researchers chose different times and methods of communicating with participants. For example, one of the researchers sent photographs and messages first thing in the morning prior to leaving for work so the participants would see content each morning prior to engaging the 'I am ok' bottom. The other researcher sent content through late at night (around midnight) realizing the participant would receive content regardless of how early they were awake in the morning. Some relatives (daughter of Carol) primarily sent through content when they knew relatives would be at home, so she might see and respond to photographs at that time. Another particularly busy carer (daughter of Erin) chose to send a group of photos to the researcher at one time, prior to deployment, so the researcher could act as her proxy and send them through on her behalf sporadically.

All of the senders carefully considered, what photographs to send (aligning them with topics they hoped would provoke the interest of participants). They also sought to provoke memories, and engage in conversation by sending and replying to elderly participant's messages.

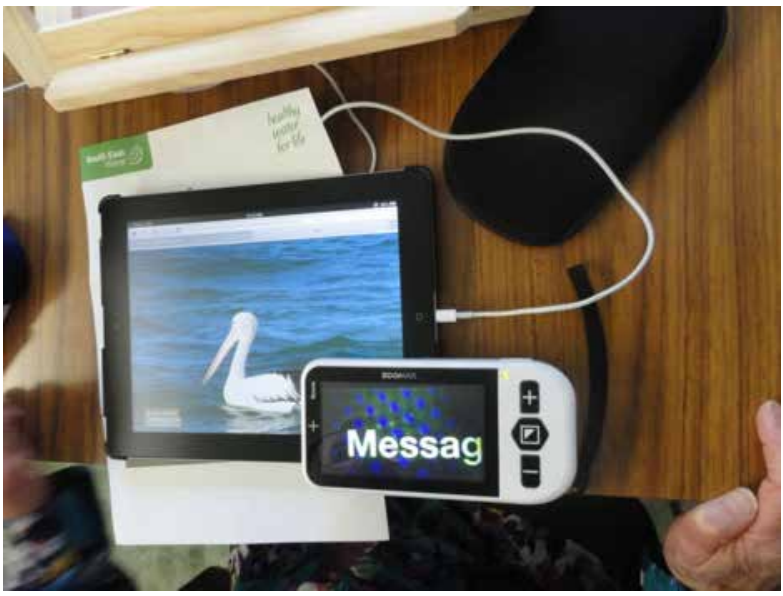


Figure 20. One of the participants with the picture frame and electronic magnifying glass used on the iPad.

“I think from one’s close family, it’s always lovely when they ring you or contact you in any way, again more so as we get older.”

[Participants perspective on communication with her family — **Anna**]

USERS VIEWPOINT

The following section outlines the usability aspects of the picture frame from the users (i.e., the elderly participants) viewpoint. We have used individual points here for clarity.

What worked well

/ Every single user could make use of the application to the best of their abilities.

/ The design of the application supported a wide range of abilities of use from individual users.

/ There was a range of use commensurate with the abilities / limitations of the users. Replies ranged from longer conversations to short one word replies. Some users pressed the ok button or sent empty replies in error. Despite the fact that we had not planned this, recording of empty replies was appreciated as we could see when users had attempted to send messages unsuccessfully.

/ Generally all users enjoyed receiving and looking at the photos or messages.

/ Users appeared to receive all the photos.

/ The white spinner (indicating the loading time works well and is indicative that the picture frame is working.)

/ The retina screen works well — even for people with problems with their vision.

/ Having the name of the sender with the photo is useful — particularly for users who have multiple senders.

/ The 'I am OK' button appears unproblematic for users.

/ Even the novice users enjoyed learning how to use a new piece of technology. In particular they enjoyed the fact that it was cutting edge technology which they could show/tell other people about.

What worked ok but could be improved

/ The scrolling function generally worked ok but the performance needs improvement (pictures saved on server at the moment)

/ It is difficult to discover new messages if they are not seen straight away. We suggest the creation of a badge which says 'New Messages' or something similar.

/ The contrast of text on background could be improved. Suggestion is that we do not use white on colour which is unclear and difficult for people with visual problems – e.g. use black on light colour (e.g. light blue).

/ Participants had difficulty seeing the 'Message sent' message. The 'Message sent' badge should be in a larger font and in a contrasting colour e.g. not green on green.

/ Reply button needs to say within the white field 'enter reply here' or 'type here to reply'. The reply button itself should say 'send' and is only activated when letters have been entered. The reply button should be larger for people with visual difficulties.

/ 'Recent conversations' should have the same font size as the rest of the text.

/ Overall performance needs improvement (e.g. currently quite slow)

/ Ideally the head of the browser should not be present (elderly people try to swipe the browser).

/ Some of the photos were distorted — in particular, there were problems with pictures in portrait format.

/ Could have extended message field to right hand side of page — and allow users to choose the text size. Thus allowing larger text for elders with vision problems.

/ A stand should be provided — this must be stable and ideally metal (i.e. does not move with pressure when users are typing). Some users may simply lie the ipad flat on a surface such as a table or benchtop to use (but then it is not like a picture frame and visible from further away).

What did not work well

/ Sometimes the messages became unattached from the photographs and they ended up on the default picture (appears to happen if the response is entered in the subject field).

/ Back should always take you back to the picture you were on when you entered "messages" no matter how much time has passed.

/ A couple of messages appeared to be duplicated and at least one appeared to disappear altogether (after receipt).

For consideration

/ Whether to have a delete function

/ Whether elders can send photos in response

/ Customize default picture

/ If a message is sent in the investigation period the 'OK button' should not come up

ISSUES WITH RELATIVES USE

The following section outlines issues with sending images and messages to the picture frame from the relatives and others (friends / proxy researchers) viewpoint.

/ Relatives carefully consider which images to select and send to elderly people, and what messages to generate. It would be useful to have a library of pre-selected images appropriate for this client group or smaller subsets identified for individual elderly participants.

/ Sending a picture once a day is a big commitment and unstainable for most relatives. It is useful to be able to load a number of photos at once and then they can be sent either automatically or manually, each day over a period of time.

/ Relatives should be able to send from mobile devices and other email accounts for better integration. They are currently restricted in that they can only send to the picture frame reliably via gmail and a desktop computer.

/ Relatives have to open their gmail account to see if there is a message in reply. It would be useful if there was an automatic notification of replies (as noted above).

MATCH WITH ESTABLISHED EMOTIONS

There were a range of feelings uncovered in the interview portion of the study that were confirmed as being important for the participants in the prototype study. These feelings included 'feeling safe' and the 'feeling of independence'. While these feelings are important for the concept of the prototype development and use, the idea of escalating the role of the picture frame beyond that of a device used only for social purposes, was not always welcomed. For example, one participant commented:

> "The way I feel at the moment, I wouldn't like that, because I still want to feel I can independently choose whether to get help or whether not to get help. I might change my mind if something really bad happens. I might think, "Help, I've changed my mind." But on that night (looking back) when I woke up and I knew I was in a lot of trouble, and my blood pressure was in stroke/heart attack zone when I took it, all I thought was, "Go back to bed, if you're here in the morning, fine, if you're not, you're not." [Anna]

In terms of integration of the picture frame prototype most elderly participants found that it became quickly established as part of their daily routine, something they would attend to first thing in the morning, and occasionally throughout the day if something (e.g. a new photograph or message) provoked their interest. The elderly participants reported non-use only happened if they were ill, away, too busy, or if the system was not working (e.g. if the internet expired).

> "It just became part of the days routine, like putting the kettle on and, you know, I just go and have a look, "Is there a message? Oh yeah, hmm," and reply to it, or look at the picture, see if there are any other pictures, and that's that, and it only (takes) a few minutes." [Anna]

Social — in touch

As previously mentioned, the elderly participants welcomed increased contact with family and friends. The picture frame application served as a unique way of establishing this contact, enabling families to be in touch in a light-weight manner on a daily basis without including the more onerous aspects of communication, from the carers viewpoint (e.g. such as long phone calls, attending to physical needs etc.).

> "I think from one's close family, it's always lovely when they ring you or contact you in any way, again more so as we get older. When children are little they want the approval of their parents; when parents get older they want the approval of their children." [Anna]

Sociability or feeling social can be considered to be an emotion associated with a level of communication. It has reference to both the frequency of contact and the number of people one may be in communication with. In this context the feeling of 'being social' was a popular theme amongst participants.

> "Oh, well yes. You know, if I wanted to say anything to the family, you know I could basically write them a little message." [Carol]

One carer highlighted the difference between the picture frame and a system he had previously used with his Aunt, arguing the benefits of the picture frame for sharing the responsibility for keeping in touch with the elderly person.

> "There is a sense that it's a one-to-many connection rather than just a one-to-one connection. So the system that I used with my Aunt had a primary emergency contact; a secondary emergency contact and really that was about it. Whereas this — you can build a network of support for a user and you can have different people checking in and one person certainly can be managing all of that, but it shares the exposure and the responsibility." [Previous Carer — Joe]

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[Previous Carer — **Joe**]

‘I’m in touch’ Goal model

This model is based on the ‘I’m in touch function’.

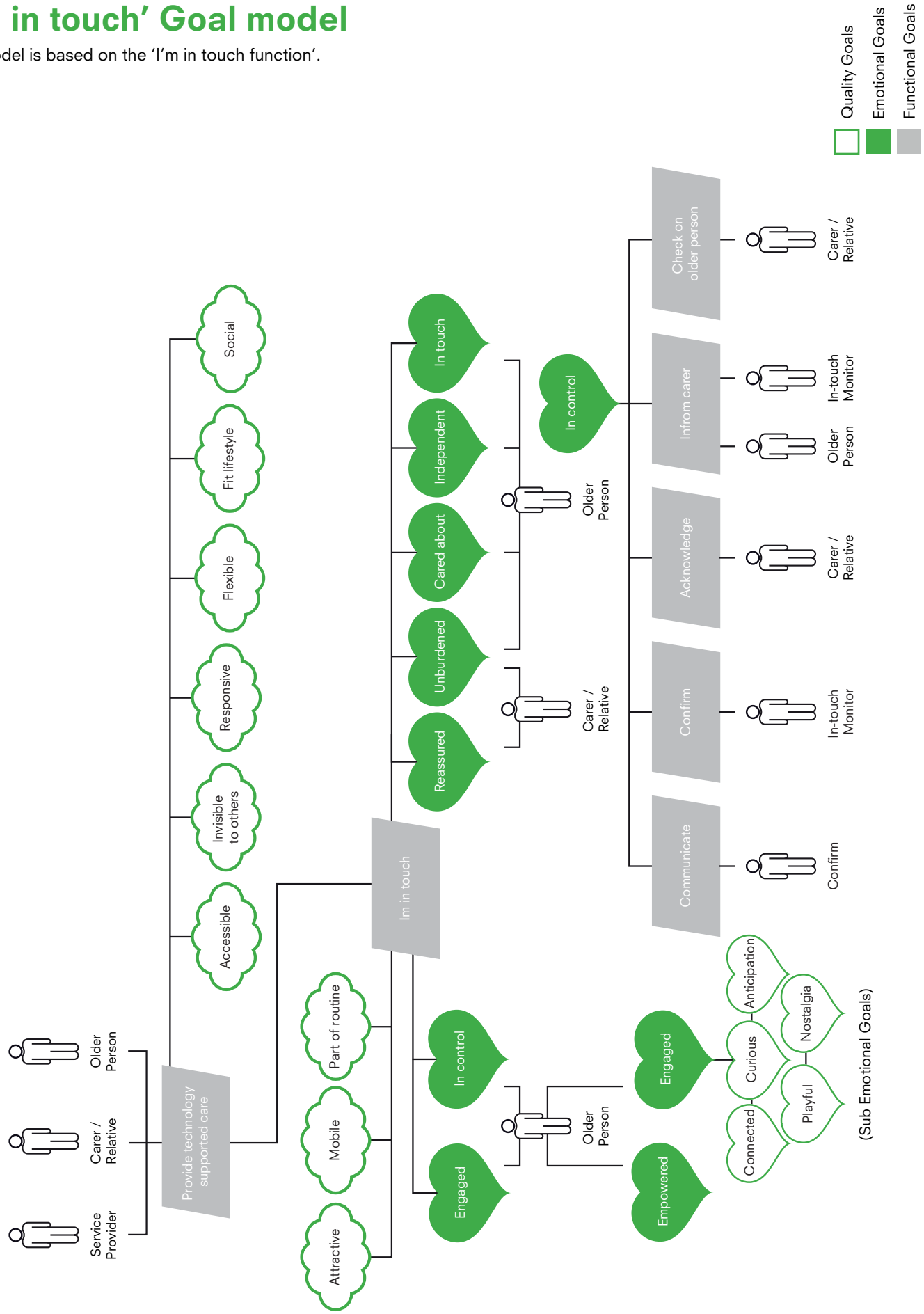

Figure 21. Updated goal model for emergency alarm use based on field study two data

NEW EMOTIONS (SYSTEM SPECIFIC)

The thematic analysis discovered new emotional goals. The main goal that emerged from the data was '**Engaged**'. This goal is very multifaceted and encompasses the emotions '**Curious**', '**Playful**', '**Anticipation**', '**Connected**' and '**Nostalgia**'.

Engaged

In the previous sections we have explored how the system enabled 'engagement' from the participants, in the sense that all the participants were able to engage with the picture frame, to varying degrees. At the most basic level, every participant was able to see and scroll through to view photos sent to them. This was even the case for Carol and Tara who had visual impairments. In addition, each participant used or attempted to use the technology on a daily basis, to respond to the 'Are you ok?' button and /or reply to content sent to them. While some messages were brief (e.g. nice to meet you) others were much longer and were part of whole conversations (e.g. particularly those from Edgar). Even Bruce who felt strongly that the picture frame prototype was not something he enjoyed, still made the effort to engage with it. So while he said that the "only thing which worked most of the time was to write a comment on the picture", he later added that "I don't like spontaneous comments. I only send comments when I'm reasonably sure" indicating that he carefully considered what commentary to make on each photograph, even when his replies appeared to be critical or negative.

These differing examples indicate that the picture frame reflects the level of engagement of the participant — participants with more severe impairments (e.g. Erin who has dementia, and Tara and Carol who have visual impairments) used it less than other participants. The healthiest participants engaged with it more. What is important is that all participants did engage with the prototype — no participant rejected the technology at the outset, or abandoned using it while they had it. All participants, apart from Bruce, enjoyed using it. We will now address some of the particulars of their use.

Curious

The system provoked curiosity amongst elderly participants. There were a range of facets to this curiosity — how do we use the ipad? How do I use the picture frame? Where do the photographs come from? What image will come through next? Why was that particular image chosen? What is the story behind that image and so on. This was even the case for our participants with dementia (particularly Erin) who while not understanding the system, or what its purpose was, (and in Erin's case could not remember who had sent the photographs) she was curious to see what image would be sent each day.

The relatives and others sending though the photos were aware of this curiosity and tried to select photographs which would provoke the curiosity of the elderly participants, even playing guessing games e.g. do you know which flower this is? Can you name this building? One carer commented that he was pleased the picture frame had provoked the curiosity of his father:

> "From my side, I was interested that Dad was actually using it and interacting with it and he knew how to get from no screen to press the photos, so that was good to remember what to press, so I was impressed. And then I could tell which picture you actually pressed messages on the most, so I think that gave me a clue more of his favourite photo, but I didn't count them all up but I kept them all."
> [Previous Carer — Joe]

Playful

The prototype was viewed as being playful by some participants. They could touch it, interact with it, and even play with it without having to worry that it might break. Although the unintended elements of the interface, such as the separation of photograph from conversation, were viewed as being 'stressful' for Bruce, for others they were seen as interesting or playful.

Amanda compared the picture frame to using a landline telephone used in the past whereby family members would pass it around to each other to hear a conversation. In this instance the Ipad can be passed from person to person and they can pick up the threads of the conversation from the pictures and messages:

> "So just to pass it round to everybody, rather than the next person speak on the phone, you know like the olden days, and you've got the picture, and the conversation, and everybody else can hear, it's just magic." [Amanda]

The picture frame was also playful in that it could be used in a playful, or humorous manner. This occurs both in the interaction with the device, and also in that the device facilitates playful interaction between co-participant and participant. For example, co-participants routinely sent participants content which was used for guessing games, storytelling and jokes. For example, one photo of a participant's son with a tiger had the accompanying message:

> "So I sent, 'Hi Amanda, I didn't know you had a cherub tiger. He's beautiful. Do you keep him in your garden? Who is the hunky guy?' (Laughs)." [Friend of participant, Amanda]

Anticipation

It was clear that the generation and sending of photographs and commentary provoked a sense of excitement or anticipation amongst participants, as the following quote implies.

> Respondent Oh, it was nice. Yeah, that was nice to have a new one every day, yeah.
>
> Interviewer Yeah? Were you curious about to look if there was a new one?
>
> Respondent When I came and I saw a new one, so I was pleased, yeah.
>
> [Bridget]

This sense of anticipation was sometimes felt by the people sending the photographs and messages. This was particularly the case for the researcher working with Edgar. His responses were often humorous and thought-provoking. Some of the more obscure topics he discussed such as graffiti made by Oscar Wilde on a windowpane at Oxford University — provoked the researcher to investigate further, in order to continue and contribute to the discussion. It is likely this was a conscious strategy on his part to keep the conversation going. In contrast, the researcher working with Bruce found it difficult to feel any excitement or anticipation about his messages which were primarily critical of the photographs and messages sent because he considered himself an experienced photographer e.g. "the bird is cute, yet shown too small, too much irrelevant background". Therefore he did not respond positively to many of the images sent. For example, a photograph of a chicken was 'ugly, silly, neurotic', a seascape was 'boring', and in reference to a photo of a dog he wrote 'I grossly dislike dogs'. Some photographs however, such as one of Venetian costumes received more positive response 'terrific' and 'a pleasure to view'. The researcher came to treasure these more positive comments.

Connected

While participants did not specifically articulate the need or desire to be more closely connected to co-participants (either family members, friends or researchers) many felt that there were benefits which arose from this. Usually participants did not want to 'bother' busy family or friends unless there was a real need. However the picture frame gave participants an opportunity to interact with family members and others across a distance in a lightweight and novel way.

Due to Erin's dementia, Erin's daughter and carer also viewed and used the picture frame when they were together in Erin's home:

> "It was more like a photo album to her (Erin) Well we usually looked (at it) together when I came (to visit)."
> [Daughter / Carer of Erin]

Nostalgia

The picture frame content and interactions provoked a sense of nostalgia in the participants. For Carol, this arose from using a keyboard for the first time in years. For many of the participants some of the images sent using the picture frame evoked feelings of nostalgia. Some of these feelings were very positive:

> "It was nice to see my wife. Very nice." [David]

> "The idea of sending an image, and that image being received and you having feedback that that image has been received – there is a beautiful… I think there is just a great intimacy to that..." [Previous Carer – Joe]

Other content provoked feelings which were not as welcome. Bruce found that a photograph of a caravan reminded him of travel he wanted to do with his ex-partner, and which would not now happen. A photograph of a restaurant reminded him of a similar restaurant where he was asked to leave. Similarly, while some participants welcomed photographs of places they had travelled to earlier in their lives (e.g. Amanda, Edgar) others found it sad that they would not revisit those places again or that they could not remember the details of those visits. For Erin, photos of family events and gatherings were a source of comfort as she could still recognise and name many of the family members in the photographs.

SUMMARY OF RESULTS (REGARDING EMOTIONAL GOALS)

The study reinforced that the prototype catered for important emotional goals and that a system like this addresses the social needs of older people. At the same time there were very strong personal preferences regarding how these needs should be met. There is a tension between the desire of the relatives to feel reassured and unburdened, and the older person to have full control over their lives. Any automatic response triggered by the system is felt by some as not feeling fully in control. There is a very fine line between monitoring people for care and interacting with them in a social manner. While the current system tries to find a balance between the two, for some participants it is not social enough and still too much of a monitoring system for others.

New emotions:
/ engaged
/ curious
/ playful
/ anticipation
/ connected
/ nostalgia

Conclusion and future work

Overall the prototype was better accepted than classic Emergency Alarm Systems that include a daily well-being check. In particular the photos from relatives were more meaningful for participants. Older people felt comfortable using the technology. It was easy to use and all participants replied to messages even with participants who were living with significant health issues (such a severe vision impairments, early Alzheimers). The prototype was well received even when carers were initially doubtful that the picture frame could be of benefit. From a development perspective the questions about feelings lead to identifying hidden requirements.

Our research explored, trialled and evaluated the concept of personal alarm systems specifically designed for older adults living by themselves. Our research showed that the emotions of this user group are not usually taken into consideration when designing, choosing or implementing these devices. Focusing on the feelings of the end-user — the older person — helped us to discover the underlying strong emotions triggered by expectations on family members and personal life style affecting intended personal alarm use. This approach helped us to develop a new system prototype addressing some of these emotions. With a picture frame prototype we were able to leverage the benefits of social communication for transferring information of 'well-being' to service providers and carers.

Overall, we suggest that our method is a systematic, repeatable, and a useful way of capturing emotional goals of system stakeholders and representing them throughout system design. Further, we believe that the notion of capturing emotions to inform system conceptualisation and design is an important step in improving healthcare systems. We can do no better in summarising our intentions than the following quote from a relative of an emergency system user:

> "I think that that's the conflict because for me as a relative and a carer, the assuredness was related to the functional aspects of the device, whereas for the user, their assurance isn't related to that at all. Their assurance is much more around the emotional ideas and that idea around the connectivity. And I think that in my situation that was the kind of the clash, is in that what I emotionally needed was very different to what my aunt emotionally needed. What's great to hear in terms of this plan is that this idea that you're addressing both of those things – that the emotional thing isn't just about how you feel about it; it also does relate directly to the functionality of it, because if you have a relative or carer who is really happy and on board with that, that's also obviously going to help emotionally the user and so that link is really important" [Previous Carer – Joe]

NEXT STEPS

In order to investigate the emotions associated with system use a longer trial is necessary. The two week trial was too short to explore feelings such as 'cared for' as it establishes over time. The next trial will run an improved system for one year.

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Acknowledgement of Figures

Figure 3.

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Figure 5.

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Figure 10.

The JAMY Toaster Retrieved from www.legrandours.com/3924/647021/gallery/jamy-smart-toaster

Concepts and Design
Concept by Alen Keirnan.

Images
All images have been authorised by participants.

Report Layout
Gretchen Dobson

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Appendix A.

Universal Principles

/ The design is useful and marketable to people with diverse abilities.
/ The design accommodates a wide range of individual preferences and abilities.
/ Use of the design is easy to understand, regardless of the user's experience, knowledge, language skills, or current concentration level.
/ The design communicates necessary information effectively to the user, regardless of ambient conditions or the user's / sensory abilities.
/ The design minimizes hazards and the adverse consequences of accidental or unintended actions.
/ The design can be used efficiently and comfortably and with a minimum of fatigue.
/ Appropriate size and space is provided for approach, reach, manipulation, and use regardless of user's body size, posture, or mobility.

Appendix B

Transcript on aged care system

/ This interview transcript sums up the challenges and problems that are relatives and older people faced when entering the aged care system. This is relevant as background information as only older adults assessed being eligible for care receive the emergency alarm service for free.

"It's what I was saying before. It's a shame you have to sort of get... Like all the services that we got for Mum only came about because she was living by herself. And I think there's enough trauma... They've been married 50-something, maybe getting close to 60, years. There's enough trauma being separated without actually having to add learning a new system and getting someone coming in. There was a lot of things happening at that time, as well as Dad not being well. So I can imagine if something happened and someone had died, now you're all of a sudden by yourself. There's a lot to cope with without actually adding that on.

So would you suggest it would be good getting more support also for couples in this regard?

Yes.

But it seems like these services are not that easily initiated when you are living as a couple.

No. Well, first of all, Mum and Dad actually... I don't know whether you know much about the whole aged care thing. Before you can get anything, you have to be what's called assessed. And I had a very steep learning curve with it all. But mum had had a stroke seven or eight years ago. And so when they come out of hospital, they actually have someone come out and they give you an assessment. So Mum had an assessment that she could get some care if needed. And she could get a certain amount of respite per year, which she never took up.

And then something happened to Dad. I can't remember what he had wrong with him. But he then got assessed. So they had these... I wouldn't say get-out-of-jail-free cards, but they had, like in the Monopoly Community Chest, these two cards that they had been both assessed, that they could get some sort of respite.

Now, when Dad went into hospital, the nurse in there said he is so lucky he's had that assessment because we could then go straight from hospital to aged care, because he has actually been assessed as being able to get a certain amount of respite. And your respite can go up to 60 days or something like that. You get a certain amount of respite without...

Because what happens is then you go into aged care and you have to hand over all your pension, basically, like whatever the cost is. And you have to fill in the forms and all that sort of thing that have to be filled in. So Dad had one day left of respite, if you like. And we had to have it reassessed and a special condition to see if he will get better in another two weeks.

Then you get to a point where they say, right, we can't have you as a respite person anymore, you have to become permanent. And we were like on the cusp. So the family brought him home, but my sister actually organised the district nurses to come, and they were coming every day to help him. Because he'd been in hospital for so long, he was able to then get that service.

What I'm saying is those services are all out there, but everybody's doing different things and it's not easy to get to. And a lot of the cases, you need it now. Like if Dad hadn't have had that respite, we don't know what would have happened to him from hospital. Like they couldn't have sent him home, but he wasn't sick to be in hospital, he just was incapacitated. He couldn't move.

Because they'd had that, and they'd been given this assessment to say they could actually have help, that's why they were able to go through the council. And we just got Mum the help to do the shopping because the lady from the council said you've got to get into the system. Once you get into the system, you're fine. So Mum had someone cleaning for her for a long, long time. And anyway, she couldn't do it anymore, so we rang the council.

Like once they were in the system, they had things happening. Everything they've needed now has happened very quickly, because they're actually in there. But there's a waiting list to get in. And they kind of wait... Fall off the perch. There's just not enough people... They're very lucky they're in a council area, which is predominantly young families. So they're not in an older area. It's a sort of a younger area. So I think they've been lucky in that regard, that they've been able to access the services a lot easier.

I think this is really interesting, and I hear three things. All these services are tied to a lot of organisational and bureaucratic assessment and paperwork and that takes time…

And the assessment, I had to actually go. I had to be at the assessment. And then you get the paperwork and they go, "Oh, the daughter was at the assessment." And it can be quite... Like with Dad, when he was in aged care, it was really awful because I was involved in this assessment that was potentially putting him into aged care.

But in some ways, they take... They have this third person there so it's not the family saying it, but I could tell, Mum couldn't look after Dad. And this person that came from, I think it was Peninsula Health actually... I had all the notes at home. I should have... It was only last year this all happened, but it was all... At this time last year, before Christmas, we actually got Dad home, so it all happened right at the busiest time of the year for me. And then trying to work...

And Dad wanted to come home and he'd ring Mum. Again, this is a male thing, sorry. Men don't typically like to be in hospital or be sick. And dad kept saying, "I'm ready to come home," and we're going, "No, you can't, Dad." And Mum was ringing me, saying, "I can't cope. He can't come home. I can't cope anymore with it." We're now really good, because there's all these services, and it has improved.

And is that standard, that the relatives are at that assessment? Are they kind of obliged, or could your dad or yourself have said no?

They like to have a family member there.

And your dad was alright with that?

Not really, probably, because I'm the one that's more... I'm not the softie. He probably thought, "Oh, it's her. She can see through me." But it was very difficult, because you are between your parents. You've got this one wants to come home, this one says, "I can't cope with his level of needs," and I'm in the middle. I'm thinking, what do you do?

It seems also that all these services require that people have been basically hit by some sort of health problem quite massively. Not putting people in a position to slowly or gently adapt to the situation.

Yes. It's the most stressful... And the learning curve, just about understanding. And I'm actually OK, I understand finances and looking at having to do bonds, like selling your family home to pay the bond to get into aged care.

If you do this, then you don't have to, and there is low care and high care. You can't come in at high care, you've got to come in at low care. You got to put your name on a waiting list, and you can't be on a waiting list until you've been assessed. And you got to be assessed to be able to need aged care. But in the meantime there's this big gap that family usually gets left with having to manage.

Well, thanks so much, because it really opens this space for us, understanding more around the whole system as well.

And you have so many issues happening, so many emotions. Like I said, Dad had a fall, and that was the beginning of... It was traumatic, it was a fall. But there was a bit of drama going up to that. His medicines weren't right, and we didn't know, and he'd been forgetting to take tablets. So we've got all that under control. But that, really, by going into the aged care, they got all that sort of on control.

And then, I guess, it's like we had to go right down low, and had to be really, really bad, and then things started happening. And one of the nurses said to me, and it was so true... And you would actually appreciate this, being a mum yourself. She said it's just like bringing a new baby home. You get there eventually. But the the beginning bits, and thinking, I'm not gonna cope. How do I do this? How do I feed? How do I do that?

And you look back and you think, well, yeah, you know, the baby's one and I've kind of got there and we've managed. You sort of look back and think, how did I do it? But you do. And it's all a bit of a blur, but you do get there. And I remember her saying that to me, and I'm thinking, oh, yeah, sure. I just couldn't... You know, what are we going to do? Where are we going to put him? We don't know.

Then I get a call here at work, saying, "Quick, there's a vacancy at this aged-care place, but you got to get there today. Come down and have an interview." So I've had to call my sister. Can we go down there, see if we can get Dad in? You know, all of that trauma.

And the other thing that's really interesting, which will happen... My parents are 86 and whatever, but my sister hasn't had children until a lot later. I've actually got a 22-year-old, but I've also got a 16-year-old. But my sister's got a 10-year-old, and she's got parents who are 86. So she is trying to manage her children, whereas I can say, "See you later, you guys, Mum and Dad need help. Look after yourselves. I'm off." But she can't.

And with women having children later, we're gonna have a bigger gap again, where the carers are still caring for kids themselves. And my father, his mum must have had him when she was 20. She died when she was 93. And Dad was... Was he 70? But he was still... He had none of us kids around. He was able to go up there and help out a lot more. It's a lot harder, and it's actually going to get harder, because people are having children later.

It's something that people don't put into the factor. But as I said, my sister, she couldn't... Like I used to get phone calls in the middle of the night, like three o'clock in the morning this one time when Dad fell. So I jumped in the car. I said, "Mum, you ring the ambulance." But I could leave my girls at home. "You get to school yourself. Make your own lunch. Off you go."

But below 12 years of age, you're not even allowed to leave her alone.

No. And so she couldn't. And it was stressful for her as well. Like, I need to get there but I can't. And I think that's actually gonna be a bigger factor as well. There's going to be more people ageing, but there's a lot more that actually are in the midst of having teenagers themselves instead of being at an age where they finished the parenting.

Appendix C:

Statistical data

For continuous research, it would also be beneficial to get the following statistical data on of personal emergency alarm users:

/ Age (range, percentages)
/ Distribution of different types / models of emergency alarm systems
/ Service (e.g. battery change)
/ Accidentally pressed pendant alarm
/ Did not press daily check
/ Any other reasons for false negatives
/ False positives (e.g customer not able to press alarm

Appendix D:

Typical problem scenarios

These personas illustrate some of the common use problems different users face, but also the user and individual living situation.

Persona illustrations
by Norman Adhy Maulana

Persona Len: Fear of initiating a false alarm consequents in not wearing the pendant in bed

Persona Maria: Difficulties to remember if the well-being button has been pressed

Persona Maria: Aesthetical problems with wearing the pendant enforced by traditional customs

Persona Maria: Problems with visibility and a feeling of stigma.

Appendix E:

Environments and technical information

This is a rails on ruby application. The ruby version is ruby 1.9.3p125. The rails version is Rails 3.2.11.

The source code is hosted on github
https://github.com/SmartServicesCRC/LEAN.git
(this is a private repo belonging to SmartServices)

We use several libraries, the most important are listed below:
1) pickle (https://github.com/ianwhite/pickle)
2) factory girl (https://github.com/thoughtbot/factory_girl)
to make cucumber testing easier

To associate images with records:
rmagick (https://github.com/rmagick/rmagick)
paperclip (https://github.com/thoughtbot/paperclip)

For build, hosting and CI we use:

TDDium for our CI (https://www.tddium.com). We deploy to heroku from TDDium (http://www.heroku.com/)

Two points of note
1) if you want TDDium to deploy to heroku see this web page (http://blog.tddium.com/2012/05/09/heroku-continuous-deployment/)
2) We use S3 for storing the attachments on heroku (heroku runs as a read-only webserver) (https://devcenter.heroku.com/articles/paperclip-s3)

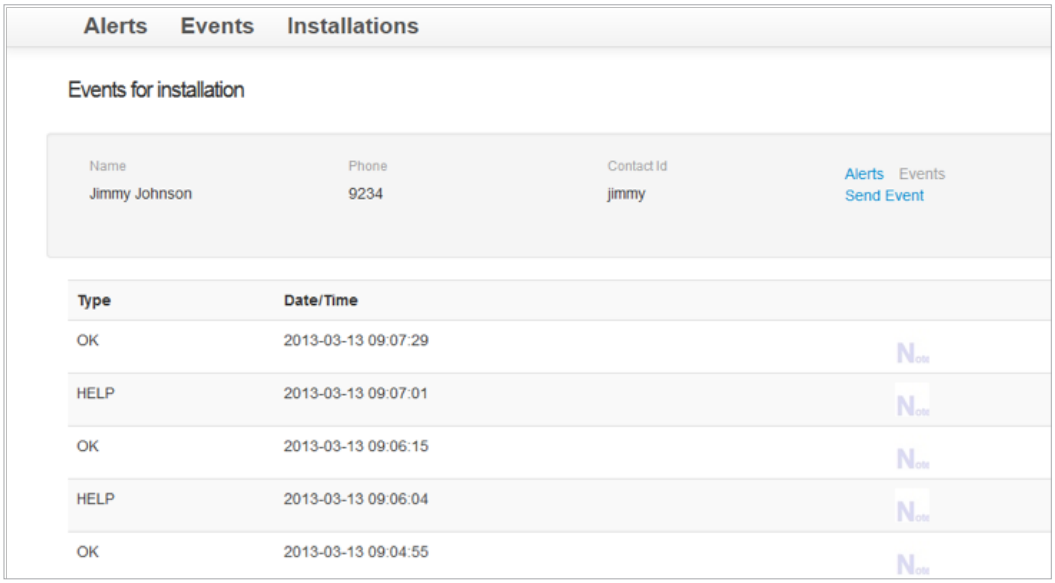
Production (i.e. heroku) polls smartserviceslean@gmail.com (password smartservicesleanpass) for new emails the local dev environment will poll smartservicesleandev@gmail.com (password smartservicesleandevpass)

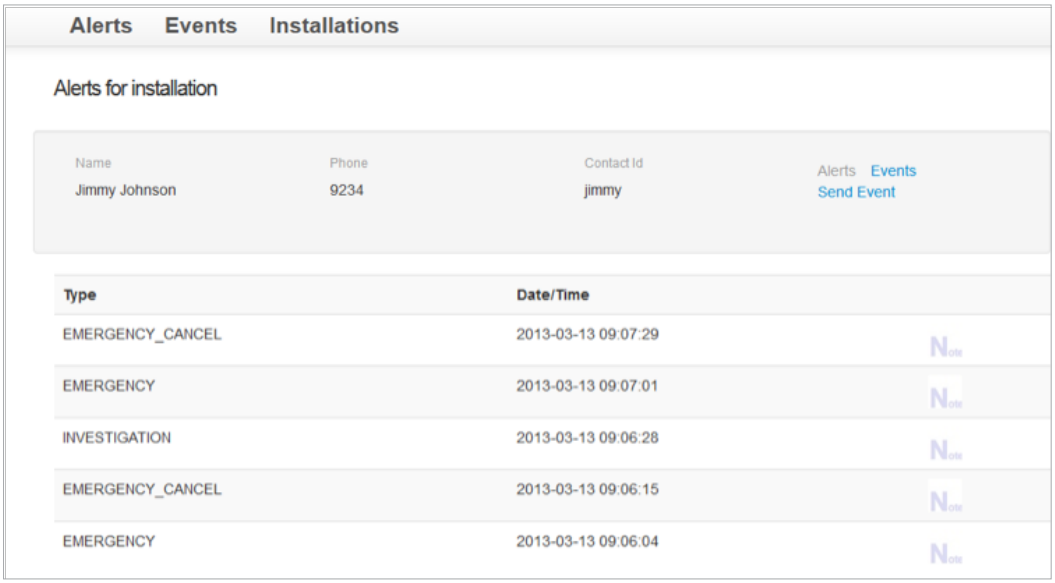
High level design overview: The main model class in the system is Installation. It has Alerts and Events. An alert is generated by lean in response to events or the lack of them. Lean can create alerts when a event is saved (using EventObserver) or from a periodically activating process (EventAnalyzer). Emails are read via the MailSynch class and sent via the InstallationMailer class.

Installations also have Conversations which in turn have Messages. The Carousel behaviour (i.e. what picture is displayed) is encapsulated within the Carousel class.

Appendix F:

Example of picture frame screens; Installation events, alerts and carousel Mode.





Appendix G:

User stories.

User stories used during prototype development
(Note: Ian is the elderly person that utilises the installation).

EPIC/STORY	SUB-STORIES FOR EPICS
As Ian I can receive photos and messages and the system will collate them into conversations	If an email is received from a contact that doesn't exist a contact will be created and any existing contacts will remain The system will carousel to show images from all contacts with order determined by date message received The message button will only show messages related to current conversation (based on current picture)
As Ian I can scroll through my photos	Need to confirm requirements but at a minimum photos should scroll to next later or earlier received image (as per carousel behaviour). Potentially different behaviour when new messages have been received.
The system can get more accurate and frequent information about Ian's actions with the tablet	Record events related to Ian's scrolling – forward, backward and picture scrolled to Record events relating to Ian receiving a message – new message/reply, from which contact, time received, message text, included a photo Record Ian sent message – which contact, time sent, message text Record events relating to Ian's movement of the tablet Record information about how long each photo has been shown on carousel (to highlight favourite photos)
As Ian I should be notified that I have received pictures/ messages since my last check in	Highlight that any messages have been received, current picture has more replies, the current message is new
As a researcher I can view all the events for an installation (reporting)	Needs links to photos shown on carousel Can export to excel Filterable by installation or all installations Report includes message information Reporting needs to include action and type information i.e. ok notification, sub-category – scroll
Allow for responsive views on smaller screens (i.e. smart phone etc)	To be considered in next version
The system will handle delivery of emails addressed to multiple installations (be used for trialling purposes)	To be considered in next version
The system will display images preserving their original aspect rations	To be considered in next version