

Visualization of Building Technologies Data for passive Users

Bachelor Thesis

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by

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Contents

Contents	1
I Abstract	3
II Überblick	5
III Acknowledgements	7
IV Introduction	9
1 Motivation	11
2 Task and deliverables	12
V Related Work	13
VI Process Documentation	19
3 Collecting User Data	21
3.1 Focus Aspects and Questions	22
3.2 Interview Questions	23
3.3 Conducting Interviews	24
4 Design Implications	26
4.1 Analyzing Interview Data	26
4.2 Interview Findings	27

5	Early Designs and Ideas	30
5.1	Brainstorm	30
5.2	Reducing Brainstorm Data	31
5.3	Three Ideas for further pursuit	33
6	User Scenarios and Storyboards	34
6.1	Thinking about Scenarios, drawing Storyboards	34
6.2	HCI-Expert Evaluation	36
6.3	Choosing a Prototype: The Noise Identifier	38
6.4	Improvements for the Prototype	38
7	Paper prototyping	40
7.1	User Scenarios for the Evaluation	40
7.2	Description of the Prototype	41
7.3	Evaluation using Cognitive Walkthrough	42
7.4	Results and Issues	43
VII	Conclusion and future work	46
VIII	Appendices	49
8	Interview Protocol	50
8.1	Begrüßung	50
8.2	Einleitung	50
8.3	kennen lernen	50
8.4	sicher fühlen	51
8.5	nicht sicher fühlen	51
8.6	Was tut man um sich sicher zu fühlen	51
8.7	das Haus verlassen	52
8.8	das Haus für die Ferien verlassen	52
8.9	Objekte zuhause	53
8.10	nach Hause kommen	53
9	Statements from Affinity Diagram	54
10	Categories of Ideas	57
11	Storyboard drawings and User Scenarios	58
11.1	AI-Cat	58
11.2	Noise Identifier (NI)	66
11.3	Help-Tool	82
12	Prototype	88
12.1	Screens for Scenario VI	88
12.2	Screens for Scenario VII	97
	Bibliography	99

Part I

Abstract

Having seen how tech-savvy people think about the security of their smart home [2], it is unclear what makes passive users [13] feel safe and comfortable in their smart home. We conducted interviews with passive users and can report that their perception is substantially different. Not the state of technical devices but other people play a big role. With an interface that is much more usable and not only suitable for tech-savvy people, we present a prototype that solves an issue that causes passive users to feel uncomfortable: strange and unknown noises.

Part II

Überblick

Brush et al. [2] zeigen uns wie tech-savvy Smart-Home Bewohner über ihr Haus nachdenken, unklar ist was passiven Nutzer [13] das Gefühl von Sicherheit und “sich wohlfühlen” gibt. Wir führten Interviews mit passiven Nutzern durch und stellen fest, dass deren Ansicht sich substanziell unterscheidet. Nicht die Zustände einzelner Geräte sondern andere Personen spielen eine grosse Rolle. Mit einem besser bedienbaren Interface, welches nicht nur für technisch Bewanderte geeignet ist, präsentieren wir einen Prototype der ein Problem löst, welches passive Nutzer unangenehm stimmt: komische und unbekannte Geräusche.

Part III

Acknowledgements

First and foremost my sincere thanks go my supervisor Sarah Mennicken. Her support as well as her patience with me was tremendous. Next I would like to thank the whole Lab Group here at the Zürich People and Computing Lab¹. Their time and effort to provide me with great feedback is very appreciated. Of course I would like to thank all of my interview participants. This thesis would have been a lot harder without your initial input. Also I would like to thank my friends for being there and supporting me through this, sometimes exhausting, part of my life. Last but not least I would like to thank my parents who made it possible for me to even be able to write these words.

Thank you!

¹www.zpac.ch

Part IV

Introduction

The idea of your home as this decision-making and task-completing thing has been around since the dawn of the computer industry. The traditional utility of your home that provides you with shelter and comfort has suddenly been extended with a vision of your home as an interactive partner in your life. Both scary and interesting at the same time. Since then, technology has come a long way. We transformed warehouse-sized mainframes into boxes on our desks into the world in our pocket. The past six years have disrupted our expectations from technology. The bulky devices that sat on our desks and in our laps on our train-rides to work have been torn apart into smaller pieces that accompany us throughout our day, supporting us in what we do and what we love. And this mass penetration of our society does not stop in our homes. We think we are heading towards a critical mass point at full speed. Technology *in* our home will soon turn itself into technology *of* our home.

1 Motivation

Mennicken and Huang [13] identified three different roles that influence the building of a smart home. **Home technology drivers** “showed strong interest in equipping their homes with home automation technology and conducted research on the subject in their spare time” [13]. Inhabitants that fall into this category typically have a strong technical knowledge and manage their home automation system on their own throughout the whole lifecycle of the system. **Home technology responsables** generally did not engage directly with the technology, they were the ones who were motivated to have the technology installed, and took responsibility for having the technology repaired or adjusted by professionals as needed” [13]. In Mennicken and Huang’s study, situations where home technology drivers and home technology responsables were living in the same household were non-existent. The third group, and for this thesis the most interesting, is the one of the **passive user**. Passive users “did not actively engage in home automation research, planning, configuration or maintenance, but had some familiarity with the systems and controls through use” [13]. Mennicken and Huang noted that mostly wives of (male) home technology drivers would fall into this category. Due to a small sample they were not able to generalize this finding. The interest of this thesis is on inhabitants that are not home technology drivers, the main focus lies on passive users. Mennicken and Huang “feel that there is an important open avenue of research to be explored on how other members of the household can shape and influence the technologies without investing significant time or effort, and possibly while avoiding the need for direct interaction with the system” [13].

Mennicken and Huang also mentioned “the tension between comfort and control” [13]. Their participants report on gained comfort due to increased automation but also on a perceived loss of control because of it. One participant even “feared becoming ‘a prisoner of the system’”. Difficulties also arose because of the above mentioned roles where for example a technology driver would change a part of the system without notifying the passive users.

We think there is a specific flavor in this tension. A certain degree of loss of control combined with the expressed “helplessness” of passive users when it comes to interact with a home automation system could cause security holes and potentially even put lives in danger. Passive users used to do a lot of things in their home. Some optimized, some not. But they knew their home environment pretty well and were able to adjust and use it to meet their needs. Suddenly a big gap was created between technology drivers, who know and configured the newly introduced home automation system, and passive users, who were confronted with this new and complicated system that broke their daily routines.

We want to have a closer look at passive users and figure out what key points contribute to their feeling of safety and comfort in their homes.

2 Task and deliverables

In Related Work (Part V) I will briefly introduce the work of others in the community. Process Documentation (Part VI) contains the main part of this thesis. We will explain the design process from gathering informations from passive users to designing user scenarios and finally prototyping. Each of this parts subchapters tries to follow a certain schema:

1. Preamble: What is it about?
2. Execution: What has been done?
3. Results: What are the take-aways?

In Conclusion and future work (Part VII) we will finally conclude the work that has been done and discuss potential areas of future work to extend the ideas from this thesis. The Appendices (Part VIII) contains several artifacts and materials produced during the thesis.

Part V

Related Work

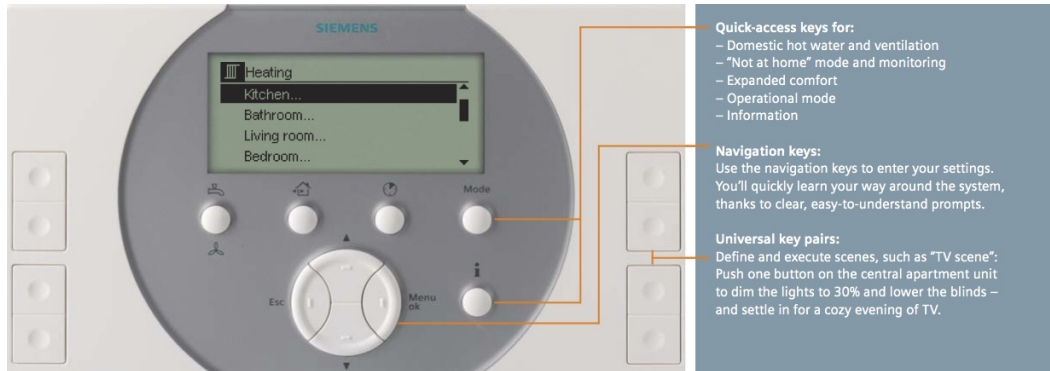


Figure 1: Siemens Synco living (www.siemens.com/syncoliving)

Crabtree, Hemmings and Rodden [4] note that “IT designers increasingly need to be aware of the social circumstances of technology usage in the domestic environment, especially of the everyday activities and interactions that shape technology usage in the home”. Others, [5] [15] [18], support a more social direction when looking at home technology too. Since then our industry has come a long way. Very successful services like Facebook² (over 900 million active users at the end of March 2012³) and Twitter⁴ (over 140 million active users as of 2012⁵) show that the social trend in technology is inevitable. With the success of the iPad⁶ technology has made its way into the living room and is now allowed to watch TV with us.

The breakthrough of these two examples show that the appeal of Crabtree, Hemmings and Rodden was well justified and the industry in general did move into this direction. Looking at current implementations and visualizations of smart home technology it seems that this shift has not happened yet. Non of the current implementations we are aware of pays attention to the social aspects and ease-of-use of technology which made Apple and Facebook so successful. Davidoff et al. also “report on six social characteristics of home life that *should but currently do not* influence the development of smart home services” [7]. Other research has been conducted to inform the design of easier to learn interfaces that reduce the users attention while using it [16] as well as simplifying control of smart home technology specifically [11] [17].

²<https://www.facebook.com>

³<http://newsroom.fb.com/content/default.aspx?NewsAreaId=22>

⁴<https://twitter.com>

⁵<http://blog.twitter.com/2012/03/twitter-turns-six.html>

⁶<http://www.apple.com/ipad>

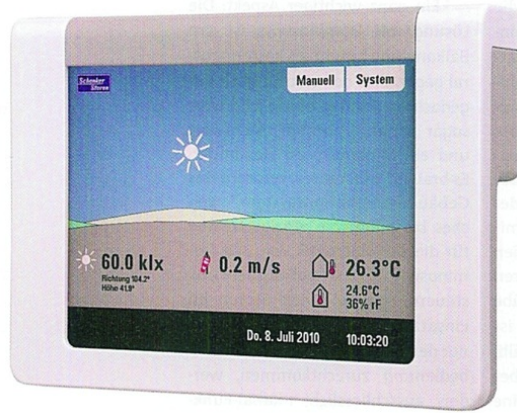


Figure 2: Schenker Storen multichannel-control SE 400 (www.storen.ch/index.php?id=751&L=03)

While researching we saw a lot of these products have good feature coverage and work hard to make integration easier, e.g. using standards like KNX⁷. On that issue Davidoff et al. also notice that “expanding system capabilities can easily overstep some invisible boundary, making families feel at the mercy of, instead of in control of that technology” [6].



Figure 3: ABB ComfortPanel (www.normelec.ch/produkte/produkteueberblick/neuheiten/comfortpanel.html)

⁷[http://en.wikipedia.org/wiki/KNX_\(standard\)](http://en.wikipedia.org/wiki/KNX_(standard))

⁸Dixon et al. proposes a *HomeOS* to “simplify application development” [8]. Edwards et al. looks at the network layer used by smart home technology and proposes a research agenda to consolidate its heterogeneity [10].

By just looking at current implementations and seeing demos we think they are far from being as pixel-perfect as the technology we use most these days. We also think current implementations have flaws when it comes to user experience design. Eight out of 14 participants from the study of Brush et al. rated “complex user interfaces as one of the things they most dislike about home automation” [2]. Imagine yourself using these devices after a day at work, having to figure out how to make it work the way you want it to when all you really want is to sit in your favorite chair and enjoy a cold beverage. This is nowhere near the experience you get from using an iPad for example.

The fieldwork conducted by Davidoff et al. also “shows that more than control of their devices, families desire more *control of their lives*. We suggest that the problem of home control should be widened to include not just control of artifacts and tasks, but control of the things families most value - their time, their activities, and their relationships” [6]. Edwards and Grinter present us seven challenges with smart home technology that users experience [9], these should be considered when designing smart home technology. By looking at current implementations we think that smart home technology is not up to the standards that research proposes and users expect and thus not ready for mass adoption.



Figure 4: Loytec (www.loytec.com)



Figure 5: Wallmount interface of Spline (www.spline.ch)

Brush et al. “uncovered four barriers that need to be addressed before home automation becomes amenable for broader adoption. These are high cost of ownership, inflexibility, poor manageability, and difficulty achieving security” [2]. Interestingly most security related issues Brush et al. present are mentioned by participants from the “DIY” group and are therefore implementation and technical details⁹. Seven out of their 14 participants “mentioned that remote access makes them concerned about security” [2]. One participant did not connect the alarm system to his remotely accessible wireless automation system because of security concerns specifically. Participants also requested special security restrictions for

⁹This could partly depend on the fact that nine out of 14 participants were identified as being part of the “DIY” group [2]. We do not want to imply that participants from the “Outsourced” group have less issues with security.

devices like doors and cameras as well as being able to define granular access control over certain resources. [2]

As these comments show these are very tech-savvy people. As mentioned by Mennicken and Huang there is a clear correlation between the “DIY” group identified by Brush et al. [2] and the home technology driver role identified by Mennicken and Huang [13]. Mennicken and Huang also identified the passive users group (see Motivation (chapter 1) for a condensed description of this group). As this group consists of users with less (or no) technical knowledge, we think there is an important opportunity to explore security related issues of passive users living in smart homes.

Part VI

Process Documentation

This chapter will explain the design process conducted to understand the stated problem and get a feeling of the needs of passive home users regarding the issues. We started interviewing potential users to better understand their needs. Inspired by the findings from these interviews we collected suitable ideas. Three ideas were chosen to be turned into user scenarios. We evaluated these scenarios with HCI-Experts¹⁰ and found one idea which would be turned into a prototype. At the end this prototype was yet again evaluated with HCI-Experts.

¹⁰HCI = Human Computer Interaction

3 Collecting User Data

To collect data from our users we conducted one-on-one interviews over the phone with potential users. We looked into other means of data collection methods, but they all seemed unsuitable for either the theme of the interview or the frame of this thesis. A diary study would produce A *lot* of data which would make the analyzation very hard and time-consuming. Having to talk about safety related things in their home, a focus group could make participants uncomfortable and thus holding back information. Finding and conducting home visits were unsuited for the given timeframe.

At first we tried to narrow our focus by thinking about the topics and questions we like to investigate and define what we were looking for. After that we created the final interview protocol which contains the questions that were asked in the interview.

3.1 Focus Aspects and Questions

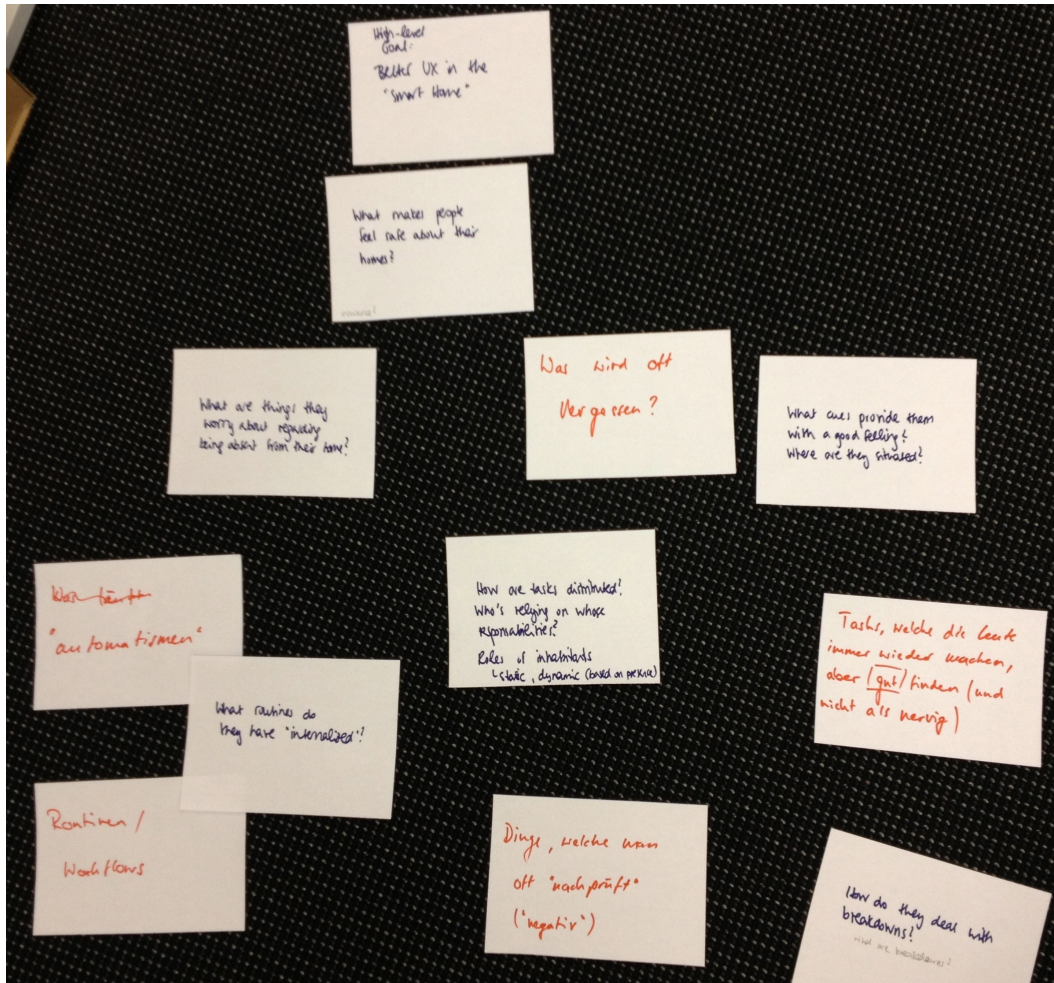


Figure 6: First collection of ideas

We started out with a broad collection of ideas and topics in and around the home. From there we created a few questions that would frame the interview to get a better feel about the direction of the interview and inform the creation of the interview protocol. We formed these questions and aspects while thinking about how to create a better interface for passive users, so that they feel safe and comfortable in their smart home. It shows what kind of information was expected to come out of the interviews.

What are the different things they want to achieve in their home?

This is the very broad “what do passive users do in their homes” question. We need to know this to constrain our solution. We want to prevent building a “Track you kid”-system when

all they wanted is to know if the kid is home or not.
In a more technical term we are looking for workflows and use cases people have in place.

What is important about their home? What do they care about?

This question is related to what people want to achieve. We do not want to build a fancy heating controller with very granular control abilities and very detailed consumption and cost statistics when all they need is an easy way to check if the heating is on or off. This question should ultimately result in a list of key aspects/characteristics of the house in the interviewees perspective.

Role of other People

We would like to figure out where people rely on each other to do some task and where they notice that others have done something.

What does not work how they want it to? Problems? Breakdowns?

Here we would like people to tell us about all sorts of problems. Like situations where

- they expected the result to be different,
- they could not do what they wanted (and/or could not think of a workaround),
- something bad happened (the interviewee saw the house in an ‘unprotected/vulnerable’ state"
- And how they handled the situation to resolve it.

We want to know if they have frustrations with the way their house works. In a way this is figuring out where the existing “bugs” are.

3.2 Interview Questions

Since the interview protocol was created in iterations, several draft versions have been created before the final one. One of the main difficulties we encountered was the conflict of goals between not influencing the users answers and getting valuable data. We started with very broad questions around our topic based on questions from the previous chapter. This approach created interview questions that would produce rather fuzzy interview results which clearly would not have added valuable points to our work. In a meeting with the research group to discuss the current draft of the interview protocol we decided that the questions must be much more explicit about our topic and limit the potential answer spectrum at the cost of missing out on potential relevant information. This decision was crucial for the rest of the project since a lower signal-to-noise ratio would have slowed down all following steps, especially analyzing the interview data.

In the Appendices you will find the full Interview Protocol (chapter 8) in german as used in the interviews with the participants. What follows is a description of the different phases of the interview. Of course at first one would greet the interviewee and introduce him to the theme of the interview. We started as below:

Our interview is about your home. I would like to know when and when not you feel safe and comfortable in your home. I am especially interested what you have to do to reach that state and which circumstances, objects, devices and people have an influence on it.

After the introduction we went through the interview topics as follows:

To feel safe People would be asked to define “to feel safe” and what would contribute to that feeling in the context of their home. This gets the interviewee into the right mindset.

Not feeling safe People are asked to talk about a specific experience where they did not feel safe. Having mentioned one the interviewer would then ask more detailed questions about the experience.

What you do to feel safe? People should tell us about specific things they do to feel safe and explain the last time they were doing that. Then one would ask about some of the responsibilities for these tasks.

Leaving the home People should talk about the last time they left their home and what they did so they would not have to worry about their home when they are away. Then one would ask about the things they know about their home when they are away (like if they know who will be home when). Participants with home automation would specifically be asked to talk about what they can do with this technology when they are away.

Leaving the home for holidays or any other longer time period Directly following the previous phase one would dive into the differences when leaving the house for a longer time period. People are asked to describe a recent event and what they did. We were also asking about specific devices and other people.

Objects at home Which objects would make people feel safe? Which objects were seen as “dangerous”? We also asked participants about frustrations with objects and how that affected their feeling of safety.

Coming back home People were asked to talk about the last time they came home, what they did, what they noticed and what they expected.

3.3 Conducting Interviews

We recruited interviewees via our friends network and postings to forums with a home automation subject. We offered an incentive worth around 20 Swiss Franks. We payed attention to have about an equal amount of people living in smart homes versus people living in “normal homes”. Of course it was important to find people who would qualify as passive users. The interviews were conducted on the phone, tape recorded and later transcribed. The duration was around the targeted time of 30 to 45 minutes.

Table 1: Interview Participants

Participant	Gender, age	Living Situation
Participant P1	Female, late 20s	Apartment, with boyfriend
Participant P2	Female, early 50s	Apartment, with husband, 3 kids. Daughter lives across the hall. Husband works in the same building
Smart-Home-Participant SHP3	Male, late 20s	Apartment, with girlfriend
Participant P4	Male, late 50s	Apartment, with girlfriend
Smart-Home-Participant SHP5	Female, mid 30s	Single family home, with husband, 2 kids (14 month, 4 years)
Participant P6	Female, early 30s	Semi-detached home, with husband, 2 kids (16 month, 4 years). Parents live on the first floor of the same house
Smart-Home-Participant SHP7	Female, 50s	Single family home, with husband

4 Design Implications

After having collected user data and finished transcribing we went on to analyze it. We focused on getting useful results to inform the design process. We used a tool called affinity diagram, which is a widely used tool to process such kind of data [1]. To speed up the process we used an adaption of the tool that uses predefined categories. The outcome of this process has been summarized into interview findings, which explain the users needs and requirements.

4.1 Analyzing Interview Data

At first we started creating the categories which later could be used as the building blocks for user stories and ultimately help us create an interface. The categories were:

- Group A: Information, that influences the feeling of safety
- Group B: Room for improvement
- Group C: Usage behavior
- Group D: Characteristics of passive users
- Group E: Other Things
- Group F: Responsibilities and distribution of tasks

All of them were defined before starting the sorting, except Group F which was added during the process.

We tried using digital tools in the beginning, but we soon figured that the paper approach was more suited.



Figure 7: Affinity Diagram

First we cut up the interview into meaningful quotes. These quotes were then sorted into the predefined categories. From there we created statements that were supported by a few quotes from the interviews, as known from the traditional affinity diagram process. All of these statements can be found in Statements from Affinity Diagram (chapter 9) of the Appendices. In parallel we noted ideas as they came up during the sorting process.

Some statistics:

- Categories: 6
- Statements: around 60
- Quotes: around 140

4.2 Interview Findings

After having analyzed the interview data we created a report to summarize the findings.

People make other people feel more safe

Other People are important and greatly contribute to one's own feeling of safety.

This especially shows itself in the various ways people interact with other people to make their home safe. Other people of course means people they know or have a certain amount of trust for. People feel more safe and calm just when other people are around. They inform other people when they leave their homes and might even ask them to check on their home from time to time. They rely on their neighboring municipality to keep an eye on their home. P1, SHP3 and P6 know their housemates schedule pretty well.

Being alone makes people pay more attention

With this in mind, the fact that people do not feel as safe when they are alone only comes natural. People then pay much more attention to the state of their home. They hear unusual sounds while they were alone, which they did not notice when other people were around (P2, SHP5, P6, SHP7). With no surprise to us lights, windows, doors and shades are very popular things to check. Specifically people turn on lights or leave them on when it is not really necessary just to give them a better feeling. SHP5 likes to have the shades rolled down automatically so the view into their home is blocked.

To once again emphasize the importance of other people one interviewee (P1) mentioned checking that windows and doors are closed when he is alone but not worrying much about that when somebody else is at home.

Being away requires preparation

Some participant (P5, SHP7) installed safety specific devices like an alarm system or fire detectors, some even bring their jewelry to a safe deposit box when they go on vacation (P2). As already mentioned people ask other people, like their neighbors or relatives, to check on their home. This is especially true when participants leave their home for a longer time period. Everybody mentioned at least informing somebody, that they are away. Others ask these people to do small tasks like watering plants or getting mail. To P2 it is also important that their home does not look as being empty. She pays attention, that the message on her answering machine does not sound like they are on holidays. The house of SHP7 does look occupied to the outside when they are away.

P6 specifically prepares her home so she is happy to come home to a clean and tidy home.

What makes people feel safe

People also have a sense of safety critical devices. These include kitchen equipment, Computers, washing machine, TV's and multimedia devices. P4 even mentioned shutting off whole power circuits when leaving the house for a longer time. P6 remembered having to replace a power supply from their computer after some thunderstorm. Reasons to do this were mixed, some security related, some energy related.

Other Things like the location of their home, both the municipality and how it is situated, as well as the quality of their equipment influences the feeling of safety. SHP5 mentioned very good windows and doors, where it would need a lot of force to get in. P4 told that he gets a bit nervous if a lot of burglaries have been committed in his municipality. Also it is perceived to be more secure not live on the ground floor, because it is harder to break it (P2).

Since it is impossible to replace the feeling of other peoples presence with technology one goal must be to make all these other things they do to increase their safety as easy and effortless as possible.

Surprisingly to us, remote access is not something the interviewees cared about much. SHP5 and SHP7 have partners with remote access from their smartphone, but only SHP7 had a good use case where her partner, who was already at work, told her to go back because something was still unlocked. Although in this particular event it would have been easier if she would have had a smartphone by herself, she shows no interest in having one. P6 has no remote access but could remember this one story where on a family trip, somebody returned home to check if everything was fine. It was but it still cost about an hour of her

Mothers time. When being away, P4 and P6 told that they worry about their home when they know some bad weather is coming. SHP3 stated that he is not the type who worries much about such things.

A shortage of time make people forget

From the interview we saw that people sometimes do not have enough time to properly check if their home is save or that they simply forget to do some things. Strategies to prevent that from happening were to do certain things specifically different (using more effort) or to check more than once to make sure somethings are as they should be, like double checking if the doors are locked before leaving the house. This is inefficient and should be addressed.

Automation is not always good

We have seen that people have routines and do things a certain way each time¹¹. Most people tend to check a lot of stuff when they leave and try to do it the same each time. This naturally calls for automation. From people with home automation we had good feedback, but it can get an overkill in this computerized world and some people (P7) like to do stuff on their own. A good way to do this would be to support the (partial) automation of task, but not to force it. SHP7 raised issues about the dependency on technology.

Sometimes inhabitants have different roles

We have learned that different inhabitants have different needs and want to know different things. In one case we saw that inhabitants even have different roles, where one was significantly more involved in the safety of their home (P1). SHP3, P4 and P6 all have specific tasks that mostly only somebody feels responsible for. An advanced system should be able to adapt to that.

¹¹SHP5: lights, shades and SHP7: coffee maker, checking doors

5 Early Designs and Ideas

After creating the report on the Interview Findings (section 4.2) we had very good insight on what the users needs and requirements were. We used our research group to generate ideas based on these findings using a brainstorm session. From the resulting collection of ideas we chose five ideas which have been thought-out a little bit more in detail. With these more detailed descriptions we were then able to decide on which three ideas were suited for further pursue.

5.1 Brainstorm

As mentioned the brainstorm session was held with our research group. Everybody was given a stack of cards to jot down their ideas. First we defined the scope of the brainstorm by giving a short briefing about the key points of the Interview Findings (section 4.2).

Other People Being alone is uncomfortable and just when others are around they feel more calm and safe. When being away, everybody informs others, some ask them to do small tasks like watering plants or feeding pets. Some even know their housemates schedules.

Increase Safety People check certain objects like lights, windows, doors and shades to increase security, especially when they are alone. Some even installed alarm systems or fire detectors. Two participants mentioned that their house should not look empty when they are away. The safety of their municipality is also a factor that can increase safety.

Objects that could harm the home People have a feeling for objects that could harm the home, for example kitchen appliances like a stove, oven or coffee machine. Also devices like a Computer, TV, washing machine and other electronic devices were mentioned.

Other Things People forget things when time is short, to prevent that they developed inefficient strategies. Routines are present but heterogenous since everybody's live is different. Automating things can be overwhelming, especially for passive users. Throughout all participant, remote access was not requested. Different cohabitants have different roles but there are no hard lines between these inhabitants.

After that we took ten minutes to do the actual brainstorm. Then everybody was able to present their ideas in a discussion like manner. Around 40 ideas have been generated during the session. A total of six people attended the session including the author.

After the session the attendees left and we did a quick sorting of the generated ideas and created categories of similar themed ideas. Around ten categories were created, they are listed under Categories of Ideas (chapter 10) in the appendices.



Figure 8: Brainstorm

5.2 Reducing Brainstorm Data

Having created a lot of ideas in the brainstorm session it was now time to choose which ones we were going to use to go forward. Especially important while choosing these ideas was the compliance with the Categories defined earlier¹² and the feasibility in the framework of this thesis. We also reminded ourselves that these ideas should satisfy several experience we came across in the Interview Findings (section 4.2). The following five ideas have been chosen to be presented in a more detailed manner. This was done as an intermediate step to be able to better judge the ideas before choosing the final three ideas, which would be turned into user scenarios in the next step.

AI-Cat

The AI-Cat¹³ is an artificial cat that represents the houses intelligent system. Like real cats it cannot be controlled and is just around the house to keep you company when you are home alone. The house could make the owner aware of potential security leaks thru the cat. We can imagine the cat as a hologram or a pet-robot.

¹²Analyzing Interview Data (section 4.1)

¹³AI = Artificial Intelligence

This addresses the issue of feeling uncomfortable when being alone. The house represented by this cat could mimic company. Also when people are alone they care more about the security aspects of their house and check these things. The cat supports this by making itself noticeable when something is potentially unsafe or anything suspicious happened.

Family Reward System

The Family Reward System would make the whole family participate in increasing the safety of their home. Family member can complete tasks from a pool of tasks and earn points, not completing an assigned task would decrease your points. In an automated home, the home could execute checks to see if a task really has been done and, depending on the task, execute the task automatically. This would allow parents to assign their kids task with more responsibility without the fear that something bad could happen.

The main point is to get people do and not forget the task they have to do to make their home more save. Using repeating tasks the system could adapt to their routines. The system is especially useful for families with kids. Having real people execute tasks with a system as a safety-net is a good combination.

Assisted checking

This system would allow you to define sets of granular checks for your home resulting in an overall rating of your homes safety level. Check could be built around various situations, like leaving the home. Other checks could “slice” the home into different security zones. Configuration and changes of such checks would require “admin” approval therefore no change could happen by accident.

In the interviews we found stuff that people do to increase safety and have a sense of what devices could harm the house. This system makes sure everything is how it should be in an easy way. The system could be adapted to suit their routines and thus make it effortless to check the safety of their home.

Noise Identifier (NI)

The Noise Identifier is a system the records strange sounds around the house. It is able to locate the noise and give a guess about its source. Users can replay the noise and ask others to help identifying it using the system. It could also inform about a strange noise.

Hearing strange noises has been mentioned by most of our participants. Most people only hear such noises when being alone and get upset by them. When other people are around they either do not seem to notice these noises or are less upset by them. The system should help to identify a noise and, if needed, contact others to help identify a noise since known noises are much less upsetting.

Help-Tool

The Help-Tool allows the user to ask somebody else for help with a problem in and around their home. Admin users can then check on the snapshot of the houses configuration and tell the other user what it is all about. Admin users also can mark a certain device as “admin-approved” to show everybody it is working fine. Users can also add new issues or feature requests for later reference. [19] and [12] provide research on helping users to figure out why something happened or is the way it currently presents itself. We found that passive users

are easily confused by their smart home technology which especially hurtful when it comes to security related aspects. Having a system that tries to clarify some of that confusion should be helpful to them.

Passive users were often asked to help with configuring the system to fit their needs. This system should support that by letting the passive users enter a new problem and letting the admin user know about it. Additionally the system saves the state of the house for later reference. After getting a bit more accustomed to the new living environment, passive users had good ideas to improve their workflow. Passive users also reported that they fear doing something wrong when interacting with a device. Using the system to check if the configuration is save would make them feel more secure while using the system.

5.3 Three Ideas for further pursuit

Now the final three ideas had to be chosen. This reduction was crucial for the subsequent task of creating user scenarios and drawing storyboards. As you may imagine this next task would be work-intense so fewer but more focused ideas were more helpful in the timeframe of this thesis.

The decision on which three of the five ideas to choose was made in a meeting between the author and the supervisor of this thesis. Applying the principle of exclusion we chose the following system:

- AI-Cat
- Noise Identifier (NI)
- Help-Tool

Both Assisted checking (section 5.2) and the Family Reward System (section 5.2) were weak in incorporating other people, which was our most important finding. Assisted checking had the potential to turn out to be a very “fiddly” system that could resemble existing solutions or only provide incremental improvements. The Family Reward System would provide an electronic interaction with other people, but not in the sense of providing some abstraction of the *presence* of other people.

6 User Scenarios and Storyboards

Having decided on which three ideas to pursue it was now time to build user scenarios and storyboards to illustrate how the system would be used. Storyboards and user scenarios are well known tools in user experience design and prototyping and thus are known to give outsiders a much better understanding of the system than just written language. The illustrated storyboards followed the created users scenarios. After finishing the creation of these materials we conducted an evaluation with HCI-Experts to make the final choice on which idea we would turn into a prototype.

6.1 Thinking about Scenarios, drawing Storyboards

For each idea at least three different user scenarios have been created. Each of these scenarios have then been formalized into a short description and a storyboard has been created to illustrate the action. Apart from the benefits outsiders get from these storyboards over written language also we, the creators, were able to benefit. The raised degree in detail we needed to create these scenarios was highly appreciated. We had to step down from the high-level perspective over our ideas and think about step by step interactions with the system. This allowed us to better understand the users motivation to use the system and gain more knowledge about the environment of the user and the system. It felt liberating to change perspective and think through the problems of the users. All of these experiences helped to better judge our own ideas and lead to a better overall outcome.

The full set of the sketches can be found under Storyboard drawings and User Scenarios (chapter 11) in the Appendices. As an example we included one complete scenario here.

AI-Cat, Scenario II

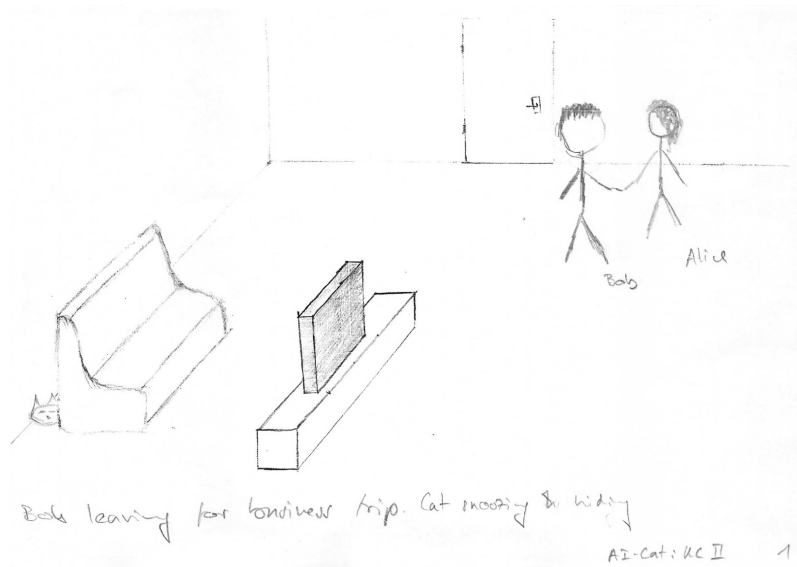
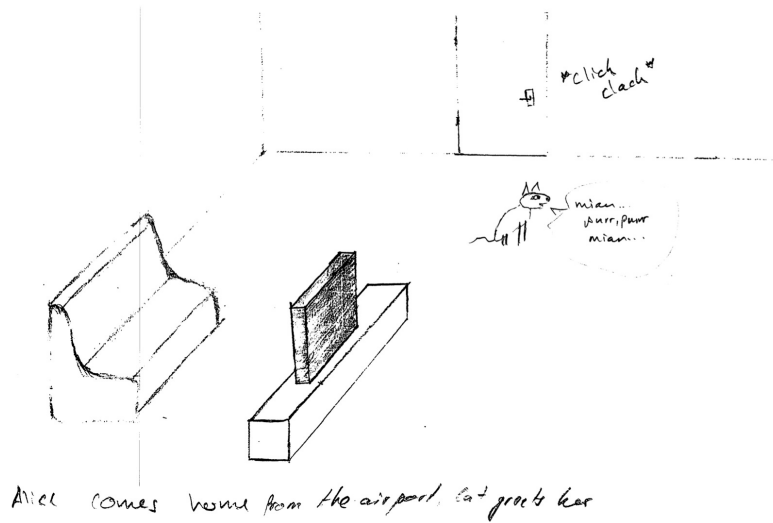


Figure 9: AI-Cat II.1

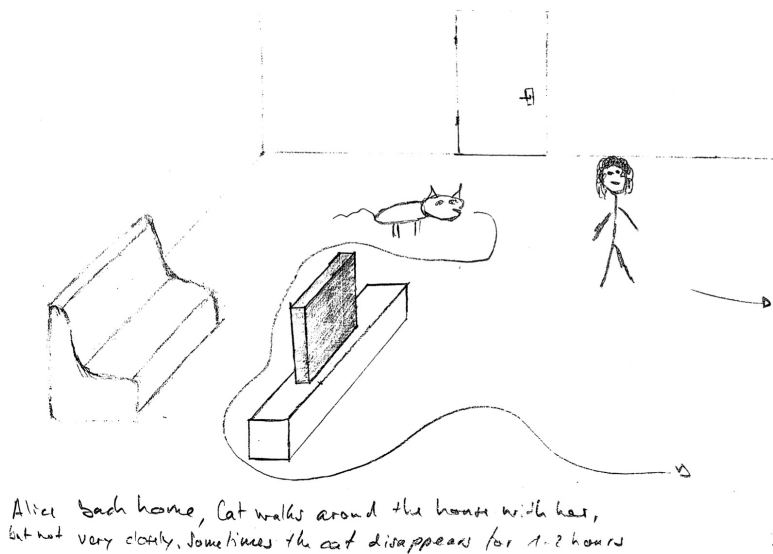
Bob is preparing to leave for a business trip for a few days. While he is still at home the cat is barely noticeable at all.



2

Figure 10: AI-Cat II.2

Alice drops him off at the airport and as she comes home the cat greets her.



3

Figure 11: AI-Cat II.3

As she is doing things during the day, the cat is kind of following her around but not very closely. The cat might stay in the next room or can't be seen at all for 2 hours.

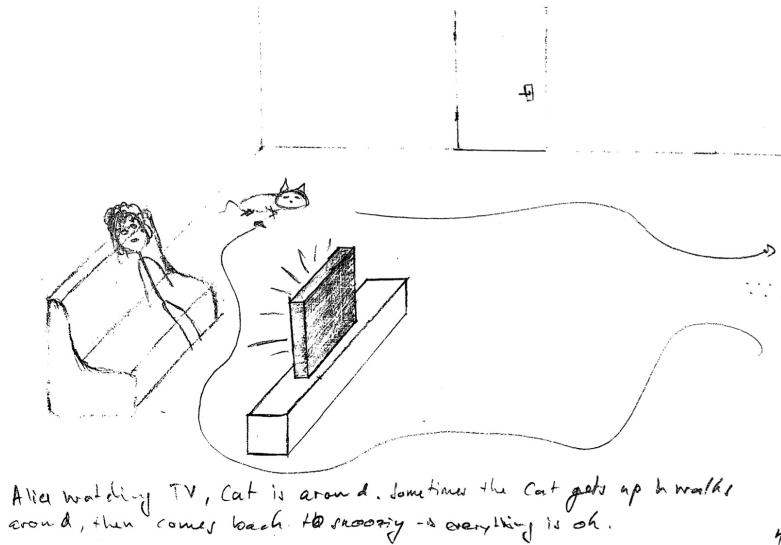


Figure 12: AI-Cat II.4

When Alice watches TV in the evening the cat keeps her company on the side. From time to time the cat gets up and walks around the house only to come back to the living room, indicating everything is fine.

6.2 HCI-Expert Evaluation

We now used these storyboards to get the first feedback from outsiders about our work. With these user scenarios and storyboards we were able to visualize our ideas for the first time and we now needed external input to evaluate them. The evaluation would allow us to make a better decision on which idea to use in the later process of designing a prototype and sort out any obvious kinks the system might have.

The evaluation took place within our research group. With a total of four HCI-Experts we have conducted interviews during which only notes were taken. At the end everybody would informally rank the ideas, in the final recess the author and supervisor of this thesis also added their vote.

At first we would explain the users setting to the evaluators. After that we would give a reminder about the Interview Findings (section 4.2). Since most of the evaluators already participated in the Brainstorm (section 5.1), this was only done briefly. We prepared some questions to have some guideline during the interview. It is to remark, that the interviews were done in an unstructured way so the evaluators would give very broad feedback. That way we would not miss or exclude any concerns the evaluator might have.

Questions

- How good are these storyboards with addressing the issues from the interviews?
- How efficient/easy is it to achieve the wanted outcome?
 - e.g.: go look where the noise was instead of use the Noise Identifier

- Would you say they improve existing ways to achieve the results? Can you see the added value?
- What could be difficult for the user? Understanding it? Using it?
- What other things could you imagine to use it for?
- How would you rank the ideas for further pursuit?

We will now present the findings from this evaluation.

AI-Cat

The idea was perceived well and the functions seem to fulfill a need. Concerns were mentioned where the users goal was not the same as the cats goal, which would make the cat and the follow-up messages more annoying then helpful and would require a good configuration facility (see Scenario III in Storyboard drawings and User Scenarios (chapter 11) in the Appendices for an example). In addition to that the analogy to the presence of other people was not instantly obvious and the cat has been identified as not essential for the system to achieve the desired outcome (e.g. locking the door). Also the success of such an idea would greatly depend on how realistic such a cat would be implemented and therefore, if implemented badly, could contribute to perceive the house as not normal, which would make the acceptance much more difficult. For Scenario I, where the cat stands by the door so somebody would come to lock it, it has been noted, that cats usually want to go out when they stand by the door.

Noise Identifier

The idea and the problem it tries to solve has been perceived well and genuine. Usability, connectedness to other people and the second opinion of a computer were mentioned as good features. One of the problems people identified was, that one gets accustomed to the noises ones home makes and at some point does not get upset by them anymore, because they might know it from an earlier occurrence. People also argued that they mostly can guess what a noise was, even when it was previously unknown (for example a noise from above is possibly from the neighbors when living in an apartment). In such cases the system would not add much value and probably left unused. On the other hand some other, possibly more anxious, people might get caught up in it and end up checking everything they hear. While the second concern clearly is an edge case, the first one has valid points and must be addressed in further iterations. Hand-in-hand with the first concern goes the need for the ability to get notified. Especially in cases where one might not have heard the noise which might be a potential harm for the person in the house, in which case the system would act as an additional alarm system and add real value to the user. Of course this would require a solid filtering engine such that the user will not get annoyed by a flood of notifications. Regarding filtering there was another, more technical, concern. One person was wondering about how the system would distinguish between a valid event and just noise from people living in the house. The expected privacy issues was another problem. Nobody seems to be fully comfortable with having a system that can potentially record every noise in ones home. To be able to shut the whole system off would help at least a little bit.

Help-Tool

The use of this less security-related idea was not rated very well. Though the problem itself has been acknowledged by the evaluators, for the chosen target group (mostly families), existing solutions (like talking to each other, SMS, Post-its, etc.), were rated good enough to solve it. Maybe in a bigger environment (Hospital, University, Nursing home, etc.) this system would be of more use. Also the creation of yet another place with potential “to-do” items and the implied dependency of one person on another was not perceived well. The storyboards have been criticized by not being very clear about their distinctive use of the system. Also the system would need to give a little bit more feedback to the person asking about what has been done.

6.3 Choosing a Prototype: The Noise Identifier

For further pursuit the Noise Identifier Idea has been chosen. While the problems are high in number, they all seem fixable. Use cases where the user does not hear the noise in advance have not been considered because the interviews did not indicate such problems. In further iterations this functionality has to be tested with a properly designed user scenario and potential users. For the current work, this is out of scope. While the problem of not adding much value for users seems valid in modern houses, this is clearly not the case in older apartment buildings for example. With neighbors and noises from the house itself, we expect the system to add value for the users. Also user scenarios, where the user might be scared or cause him too much hassle to go and look where the noise came from will add value for the user. Apart from discussions around potential hiccups with the system the idea seemed to appeal well with everybody and in an informal ranking the evaluators clearly favored the AI-Cat and Noise-Identifier idea leaving the Help-Tool behind. With the difficulties that would stem from a proper implementation of the AI-Cat in mind, the Noise Identifier also was better suited in the framing of this work.

6.4 Improvements for the Prototype

The privacy issues are hard to solve. The system affects privacy by design, possible changes will only create incremental improvements. Some machine will always be there to record and analyze the noises in and around the house for the system to be useful. With this in mind at least some ideas should be proposed as a solution, the most effective must be evaluated with end users.

Another issue that came up was filtering. This problem is two-folded:

- The engine that processes all the recorded audio must be able to find relevant events. This especially means filtering noise from relevant data to avoid cluttering the recent events log.
- Only seeing relevant events in the recent events screen is not enough. There must be other ways to filter and sort these events to account for different user needs when looking at the recent events (maybe the user only wants to see events in the kitchen)

The first concern is nearly purely technical. To solve it one must have a deep understanding of processing audio using a computer. As important as it may be for this System, it cannot be addressed in the scope of this thesis. The second concern is much more solvable.

A simple search function and/or predefined search filters could make the process of getting to the correct event a lot easier. The system might even be able to classify the noises in different threat-levels. Also it is important to note, that scenarios where user needs old information are probably very rare. Of course this has to be evaluated in a User Test at some point. Another possibility would be to visualize these recent events as a stream of sound, marking detected events in the stream with flags. This would give the user a very different experience and resolution of how to look at the events in his house. Such a visualization would make much sense combined with the notification functionality for users that are away from home and do not have access to the real world “live-stream” of sound in their home.

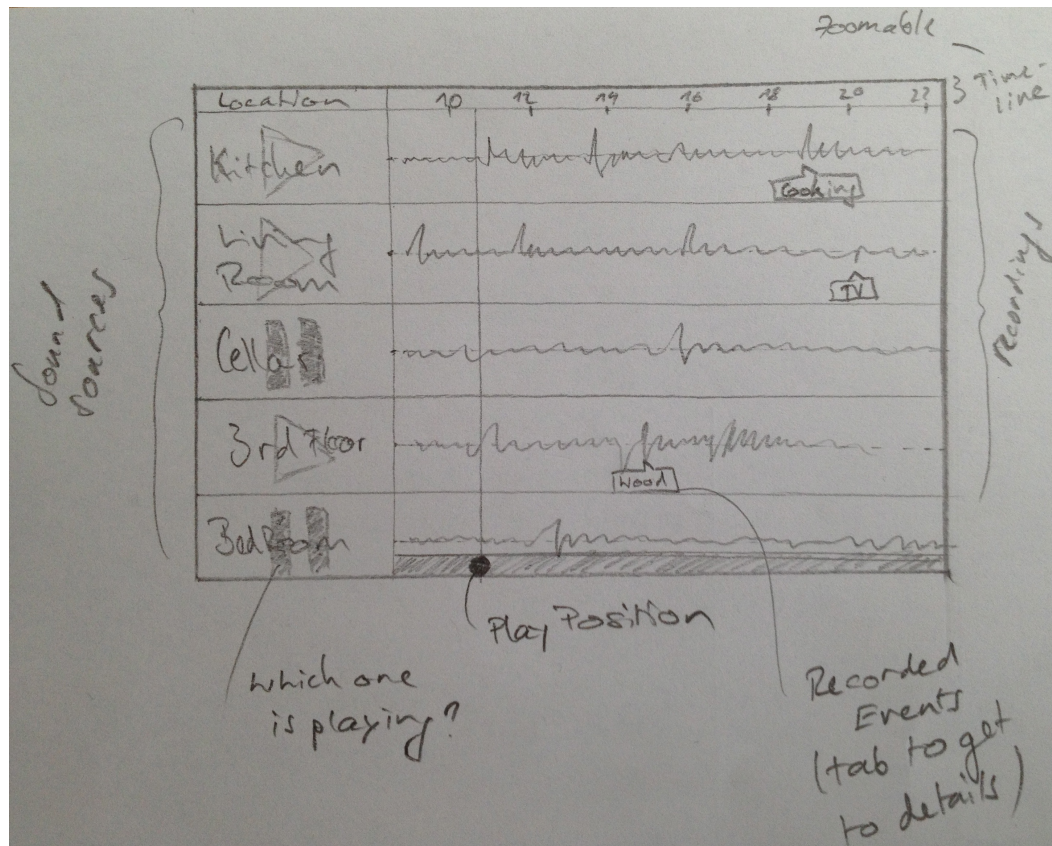


Figure 13: Stream of Audio Visualization

From a usability perspective the recent event screen could make the user check for events that are long into the past. Hiding events that are past a certain threshold would prevent giving users too much old information.

7 Paper prototyping

Deciding on the Noise Identifier left us with turning the idea into a well thought-out and detailed prototype. We decided to go for a paper mock-up which is again a well known tool in user experience design [1]. It would allow us to make the transition from the high-level perspective we gained with using user scenarios and storyboards in the previous chapter to a detailed user interface and interaction path which is a paper prototype. Still it can be built relatively fast and without having to learn a ton of tools. Due to its flexibility it is easy to change and adapt things to our needs along the way. We would use a more low-fidelity paper prototype because we think it will give us a good balance between detailed and constructive feedback versus nagging comments about the styling of interface details¹⁴.

At first two final user scenarios have been created based on the previous ones. Using these scenarios we created detailed screens to follow along the user scenarios interactions with the system. At the end a final assessment of the prototype has been conducted using a method called Cognitive Walkthrough [21] with people from our research group.

7.1 User Scenarios for the Evaluation

You might already noticed that we used Rachel and Ross instead of Alice and Bob as characters in our Scenarios. This is intentional since we later bring in the rest of the cast of the famous TV series Friends¹⁵. If you know Friends you might find the Scenarios a bit more illustrative than using generic names and pretending the people behind these names know each other.

Having created five scenarios for the Noise Identifier we now wanted to create two user scenario specifically for the evaluation that would combine the five previous ones. Scenario I is not represented because it is the most trivial case. Scenario IV was never implemented since the use case is a bit odd. The first of the new ones is designed along the lines of Scenario II and Scenario III. The second of the new ones is kind of like Scenario V, but more realistic. It should show the interaction where you cannot, do not want to, or are afraid to go look what that noise was about.

Scenario VI: Referencing what happened

Rachel hears a noise she heard before but which she cannot identify. Using the Noise Identifier she tries to figure it out but does not succeed. Within the Noise Identifier she then asks Ross for help who can identify the noise which calms her down.

Rachel chilling out at home hearing an unknown noise. She gets upset and nervous because she remembered hearing it before, and did not know what it was. Now that she has the Noise Identifier she launches it to check out what this could be. She replays to the noise, but still no clue. The app shows the balcony as the location, but cannot identify it either. She walks to the balcony, but does not see anything. She then messages Ross, to ask what it could be. Ross listens to the noise on the go, and remembers that he saw the neighbors cat running around their balcony. After editing the “Guess” tab, he messages her back. Rachel receives the message and is relieved.

¹⁴“I would make this button green instead of blue.”

¹⁵<http://en.wikipedia.org/wiki/Friends>

Scenario VII: Make checking easier

Rachel hears a noise but does not want to or is afraid to go look what it was about.

Ross is out of town on a conference. Rachel is exhausted from work and lies in her bed trying to fall asleep. She barely hears a noise, it sounded like glass-shattering. She grabs her phone, launches the Noise Identifier to check what happened. The app could identify the noise and confirms that it was glass-shattering in the living room, where they have an exit to their big garden. She is getting scared because she thinks it could be an intruder. She tabs the “Location” cell to see where exactly the noise came from. The app displays a plan of her Living Room with a “heat-map” of where the noise came from. It shows that the noise was near the sofa. She remembers that she left her water glass there. It must have fallen to the ground. She calms down and falls asleep.

7.2 Description of the Prototype

As hinted in Early Designs and Ideas (chapter 5) the prototype was going to be an iPhone application. This prototype of the Noise Identifier allows you to lookup strange noises recorded in and around the house in near-realtime. It provides you with the ability to playback the recorded noise, it shows the location of the sound source on a map of your home and tries to guess what could have caused the noise. Of course it will show you the exact date and time of the event and store recordings for later reference. If that does not calm down the user there is also a messaging functionality. Thru the app people can ask their housemates, friends or family to help identifying a recorded noise. Each of the involved parties must have the Noise Identifier installed on their device. Each message is sent on a per event and person basis. This means each message is not only bound to a sender and receiver, but also to the event. Therefor a conversation with the same person about different events is only possible in distinct threads. This is consciously chosen to be different from a standard text-messaging app where usually only one thread per user exists (broadcast and chat messaging excluded¹⁶). Directly in the thread one can access the recorded sound, guess, time and location to form an opinion about the suspicious event. After looking at these details of the event, the other person can then message back and soothe the sender. At any point it is possible to edit the guess if the system could not identify the noise or got it wrong. In a real world system I would expect the system to need a certain amount of training time to learn some of the more common noises in a home.

Apart from the iPhone application the system would need a high-powered server side component and a microphone-equipped house. The signals from the microphones would be recorded and processed by the server. The servers most challenging part would be to analyze a non-trivial amount of microphone signals and look for noises which would be worth declaring as an event. We expect this to be a very CPU intense process. After detecting an event it would calculate its location by analyzing different microphone inputs of the same event. Then the server would try to figure out a good guess for the noise and compress it into a snippet for the user to listen to. Finally the server would notify the iPhone client about the new event so it could cache the snippet and be ready for the user to listen to.

¹⁶In the iPhones Messages app you can have a one-on-one conversation with person A in one thread and a chat conversation with person A and B in another thread which would make person A be existent in two threads of your application.

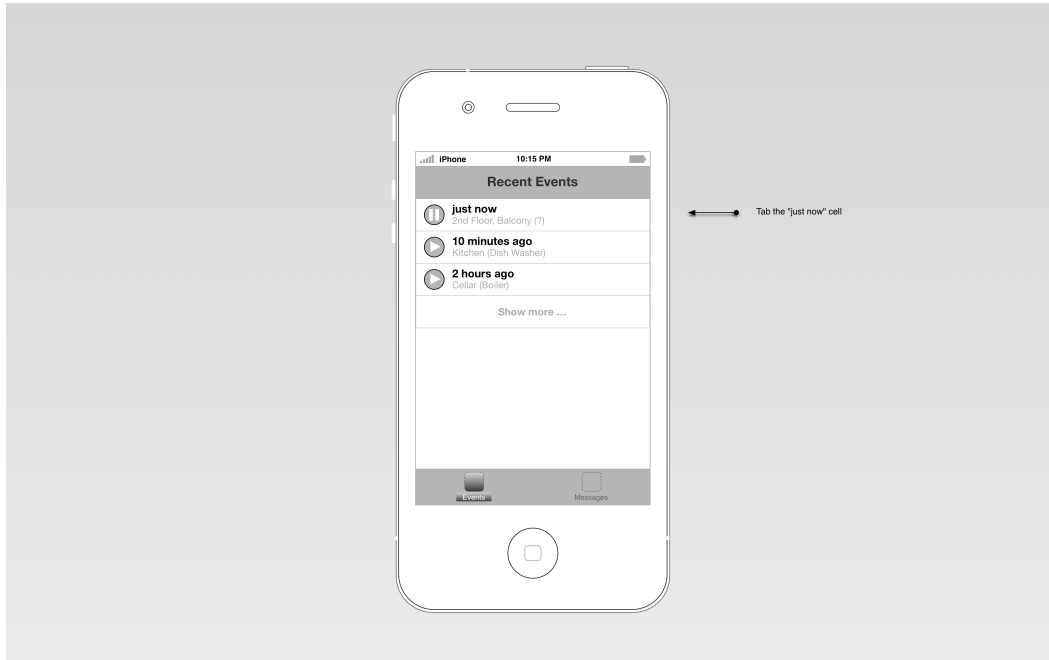


Figure 14: Sample screen showing Recent Events and playing the recorded noise

All screens produced for the prototype can be found under Prototype (chapter 12) in the Appendices.

7.3 Evaluation using Cognitive Walkthrough

As the last act in this thesis we use a Cognitive Walkthrough to evaluate our paper prototype. Due to the detailed interaction paths that have been illustrated by the prototype a Cognitive Walkthrough is well suited. The Cognitive Walkthrough has been conducted with six members of our research group, including the supervisor of this thesis. Due to the fact that our system was targeted at less technical knowledgeable users and would be used in less technical environment it was especially useful to use a Cognitive Walkthrough since it is known to be good at evaluating learnability, ease-of-use and the fit between the system and its goals. We were also looking forward to getting to know and split up the conceptual problems from the minor issues, which sometimes eat up a lot more time than they deserve during the creation of the prototype.

For each scenario the evaluators were given a description of the scenario and the associated screens. Each screen was printed on one piece of paper along with the questions from the Cognitive Walkthrough and a small note what the user has to do to advance to the next screen.

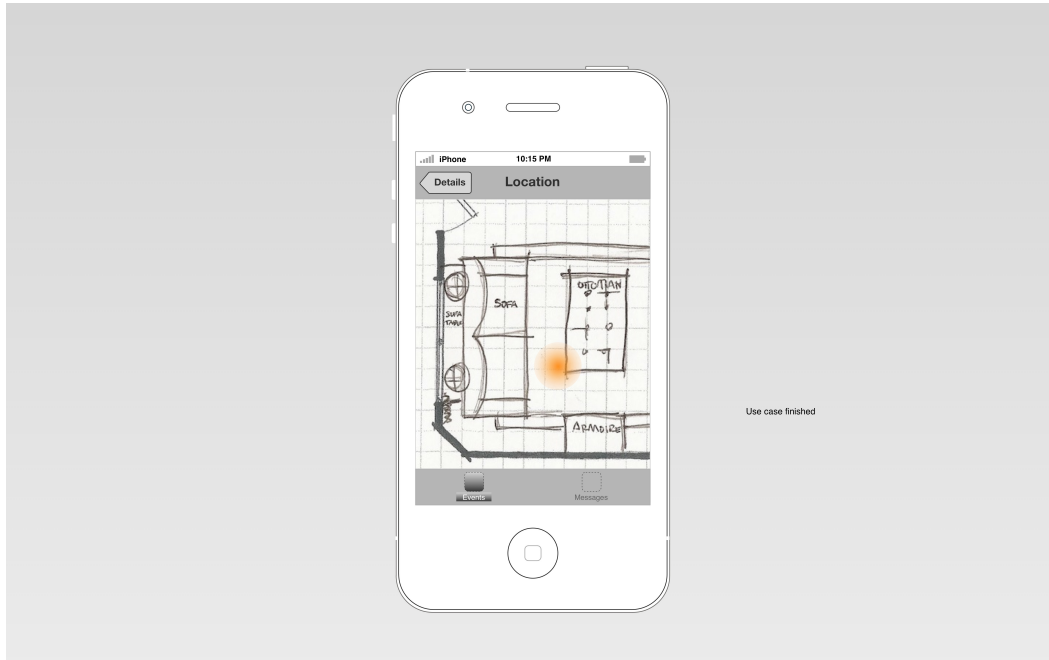


Figure 15: Sample screen from Cognitive Walkthrough evaluation

7.4 Results and Issues

After the evaluation all evaluators stayed to discuss issues, comments and feedback. Most big problems were mentioned in this discussion. After the session we went on and analyzed the evaluation sheets. We were looking through the sheets to find screens that were critically rated by most evaluators and to find similarities in the feedback evaluators gave. We then looked at the issues found and we will now list them here using a simple major/minor severity.

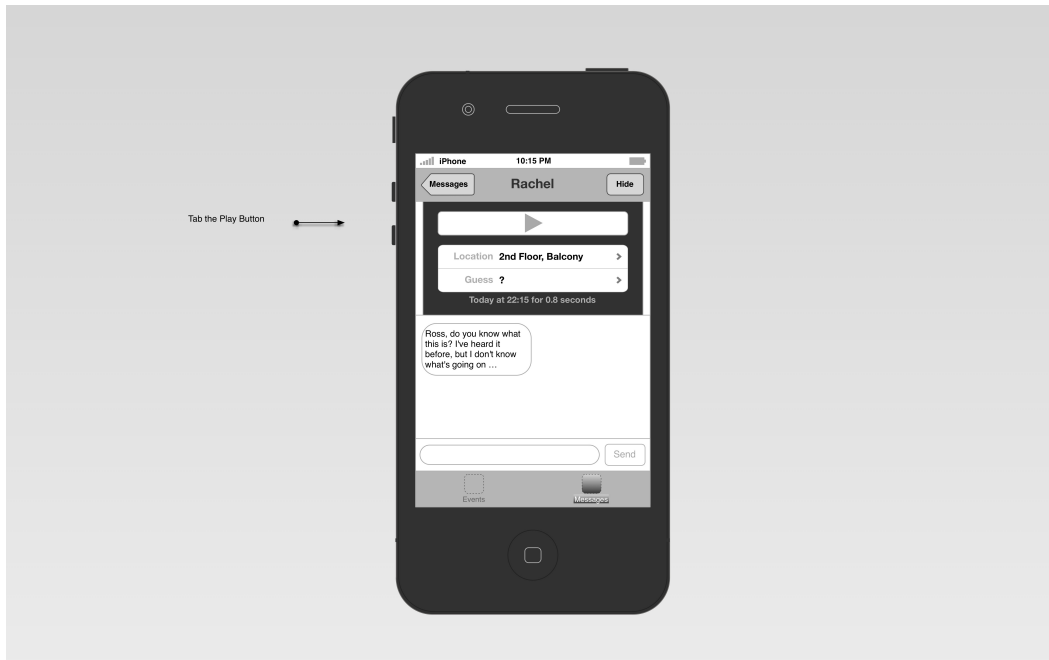


Figure 16: Sample screen showing the Message Thread with details about the event

Major issues

- UITableView Accessory Arrow Style: The arrow on the right side on the cell is sometimes missing or misleading. One would have to consult the Apples Human Interface Guidelines¹⁷ to make sure one uses these arrows as expected. A missing arrow caused problems while finding the correct action.
- The “Details” button to pull down the event details is not instantly recognizable as details about the event. It could be confused with details about the person you are messaging with. A simple rename might help.
- Generally a transition caused by clicking on a cell in a UITableView should provide more information about the cells content (Recent Events -> Event Details)
- The screen after a transition using a UITableView should clearly restate some information from the just clicked cell (Recent Events -> Event Details). If not then the user could mistakenly assume the contents of these two screens are unrelated.
- It is not obvious where the “Back” button on the messages screen goes back to.
- The play button in the event details drop-down looks different then on all the other screens.

Minor issues

¹⁷<https://developer.apple.com/library/ios/#documentation/UserExperience/Conceptual/MobileHIG/Introduction/Introduction.html>

- The small play button could be misleading. It might get not found and if found the user could stop looking for more actions.
- The “?” for an unidentified noise should be replaced with something like “(click to edit)” to make the action more visible.
- “Who to ask?” is too directive, use something more general like “Choose Person?”
- When editing the “Guess”, some people might type in their message.
- Ross might only edit the guess OR send a message. Doing both requires him to enter the same information twice.
- Tapping on “Location” and “Guess” produces (very) different results, make this difference visually clear.
- The “return” button when editing the guess should be named differently

During the discussion we also noticed a confusion with the “Messages” interface. While crafting the screens for the prototype we payed much attention to resemble the original Apple Messages app that ships with every iPhone. Apart from just being able to send messages our app adds additional features. These unusual things happening on this very familiar screen might confuse users and one could look into coming up with a different design that does not resemble Apples design. Another issue with this resemblance was the expectation that it would also behave very similar to Apples Messages app. This was especially problematic with the concept that one thread was bound to a person *and* an event, as described in the Description of the Prototype (section 7.2), as opposed to one thread just being bound to a person.

One proposal related to this issue was to use the built in system messaging and just attach the information about the event to an MMS message. That would remove the above mentioned confusions and the requirement of both users having to have the app installed. We had a quick look at Apples API and found the `MFMessageComposeViewController`¹⁸ class which allows developers to set up a message and launch the Messages app to handle the sending of the message. As in the latest iOS 5.1.1 release it is only possible to send pure SMS messages. One could speculate that with future releases Apple will add an API to send MMS messages. At this point we could argue for a 1.0 version of the Noise Identifier to just give the user to make a phone calls, which was also mentioned in the evaluators discussion, and add a messaging functionality later when an API exists. Of course such changes would have to be tested against a real end users evaluation in a next iteration.

¹⁸http://developer.apple.com/library/ios/#documentation/MessageUI/Reference/MFMessageComposeViewController_class/Reference/Reference.html

Part VII

Conclusion and future work

It is still true: people are human beings. Human beings who rely and trust the ones near and dear to them. Human beings who make irrational decisions, sometimes even based on vague facts. We think it is important that our industry gets reminded of these things from time to time. As a group of people who learned to trust and love¹⁹ technology we seem to forget or not care about it far too often. The vacuum we sometimes find ourselves in is not always as perfect as we might think. Instead we should go out and learn from “normal” people what it is that they care about.

In the near future we do not expect technology to be able to fully replace the presence of somebody else which we identified as being so key to the feeling of being safe and comfortable. But as our work shows we think it is healthy to push on the human side of technology and try to incorporate it into the typical use cases of your system. Our pursued system, the Noise Identifier, solves a specific problem, getting upset when hearing unknown noises, and includes other people by being able to talk to them and look at events collaboratively.

There is one more thing I would like to point out, especially to myself. As a designer, or in general anybody who creates something, you should highly value the input of others. Go out and ask people about it and figure out if they get it the way you intended. No amount of work can replace the insight you gain from doing that. And respect their answer, do not just go home thinking they are just not good enough to understand my excellence. If the majority of your test users run into the same problem you should probably go back and rethink your design, make it usable for them, no matter how proud you were about your work in the first place.

We also would like to make a few comments about how we would extend the work of this thesis.

End-user Evaluations

In our view the topmost priority deserves getting end-user feedback. We would propose doing incremental improvements to the prototype based on the Results and Issues (section 7.4) from the evaluation to get rid of obvious pitfalls. But we do suggest valuing end-user feedback more than fixing every issue from the evaluation. Together with the feedback from end-users one can then revisit these Results and Issues (section 7.4) and decide on the final design of an interactive prototype. Of special interest would be to see if end-users perceive the system to increase their feeling of safety and comfort in their home.

Notifications

In the evaluations we found the need for getting notification from the system where the user did not hear the initial noise. We think this could be turned into a very useful feature of the system. It would make the System more useful for less curious people that do not use the lookup feature or people that like to have another layer of security. We also think that combining this feature with the suggested stream of audio visualization in Improvements for the Prototype (section 6.4) would make a lot of sense. As we explained in Choosing a Prototype: The Noise Identifier (section 6.3) we did not consider it for this study but we strongly suggest testing it in future iterations.

Technical feasibility

We think this is a non-trivial aspect that has been completely abstracted from in this thesis. It would be interesting to see how far we can support the assumptions we made

¹⁹<http://www.nytimes.com/2011/10/01/opinion/you-love-your-iphone-literally.html>

while designing our system. Especially how good we are with identifying and classifying noises as well as using technology to automatically filter events preventing the user from being spammed by his own system (see Improvements for the Prototype (section 6.4) for further thoughts on this topic). Depending on how reliable we are with classifying noises, the system could act differently when a noise has been classified as being dangerous (e.g.: notify the user with a more aggressive notification).

Part VIII

Appendices

8 Interview Protocol

8.1 Begrüssung

- Vielen Dank für die Teilnahme
- Consent form
- Aufnahme starten
- nochmals bestätigen bezüglich consent form
- Ablauf erklären
 - Administratives (erledigt)
 - Einleitung
 - Teilnehmer auf Interview vorbereiten
 - * kein Antwortzwang
 - * wir können jederzeit abbrechen
 - * kein Richtig oder Falsch
 - Start Interview

8.2 Einleitung

In unserem Interview geht es um Ihr Zuhause. Ich möchte erfahren, **wann Sie sich in Ihrem Zuhause sicher und wohl fühlen und wann nicht**. Speziell interessiert mich was Sie dafür tun mussten und welche **Umstände, Objekte, Geräte und Personen darauf Einfluss haben**.

8.3 kennen lernen

- Beschreiben Sie mir ihren Haushalt
 - Welche Personen?
 - Tagesablauf /Beschäftigung der Personen (ganz kurz halten)
 - Kinder?
 - Haustiere
- Wie lange wohnen sie schon in dem Haus?
- Wohngegend
- Arbeiten sie zuhause?
- Kümern sich noch andere Personen ausser ihnen und ihre Familie um ihr Haus?
- **Alter!**
- *Stellen sie mir bitte ihr Home-Automation-System vor. Was können sie alles machen damit?*

8.4 sicher fühlen

- Beschreiben sie was “sich sicher fühlen” für sie bedeutet.
- Wenn sie über ihr Haus nachdenken, was gibt ihnen ein beruhigendes Gefühl?
 - aufschreiben, was erwähnt wird für Rückfragen (Objekte, Räume, Geräte, Personen)
 - Gehen sie im Kopf durch die Räume
- *Unterstützt Ihre Technologie dieses Gefühl?*
 - *Wenn ja, wie?*
 - *Wenn nein, erläutern sie?*
- (falls keine Antwort kommt) Ich mache mir über mein Zuhause keine Sorgen, weil ich weiss, dass ich meine Türe abgeschlossen und das Licht gelöscht habe. Kurz bevor ich ging habe ich das Badzimmer-Fenster geschlossen, welches ich zum Lüften aufgemacht habe. Ich weiss auch, dass meine Eltern nach mir das Haus verlassen haben, und deshalb noch mal kontrolliert haben.

8.5 nicht sicher fühlen

- Erzählen sie mir von einem Moment, wo sie sich in Bezug auf ihr Zuhause unsicher gefühlt haben
 - Was genau gab ihnen das Gefühl von Unsicherheit?
 - *Irgendetwas in Bezug auf Automation? Konnten sie herausfinden, warum das passiert ist?*
 - Wer war im Haus anwesend zu dem Zeitpunkt? Hat das ihr (Sicherheits-)Gefühl beeinflusst?
 - Was haben sie dagegen gemacht?
- Sie sind auch schon aufgewacht und hatten das Gefühl, dass irgendetwas im Haus oder draussen nicht in Ordnung ist?
 - Was haben sie dann gemacht?

8.6 Was tut man um sich sicher zu fühlen

- Welche ganz bestimmten Dingen machen sie, um sich sicher zu fühlen?
 - Erzählen sie mir vom letzten Mal wo sie das gemacht haben.
- Was finden sie daran mühsam und was machen sie gerne?
- Für welche Aspekte des sicher & wohl Fühlen in ihrem Zuhause sind sie verantwortlich?
- *Welche Technologie/Geräte haben sie speziell zur Sicherheitssteigerung angeschafft?*
 - *Wie genau helfen Ihnen diese Sachen?*

8.7 das Haus verlassen

- Das letzte mal als sie ihr Haus verlassen haben, wie haben sie ihr Haus vorbereitet, damit sie sich keine Gedanken machen, wenn sie weg sind.
 - Erklären Sie mir die einzelnen Schritte.
 - * “Warum machen sie den genannten Schritt?”
 - Was ist davon typisch und was weniger?
 - *Was macht ihr Haus automatisch wenn sie weg sind?*
- Erzählen sie mir vom letzten Mal als sie nach verlassen wieder umgekehrt sind um etwas zu erledigen.
- *Welche Dinge können sie remote ändern/kontrollieren?*
 - *Aus welchen Gründen nutzen sie diese?*
 - *Wann haben sie es das letzte Mal genutzt?*
 - *In welchen Situationen nutzen sie diese Dinge?*
- Wie oft kommt es vor, dass sie unterwegs an ihr Haus denken?
 - Können sie sich an eine bestimmte Situation erinnern?
 - Sind das eher positive oder negative Gedanken?
- Wenn sie weg sind, wissen sie wann wieder jemand zuhause ist?
 - Wie verändert das ihr Sicherheitsgefühl in Bezug auf ihr Haus?
- Wenn sie als Erstes aus dem Haus gehen, welche Dinge müssen Andere erledigen bevor diese gehen? z.b. Fenster schliessen?
 - Gibt es spezielle Absprachen?
 - Wie sieht es umgekehrt aus?
 - Wenn sie gleichzeitig gehen, gibt es da Unterschiede?

8.8 das Haus für die Ferien verlassen

- anschliessen an vorhergehende Fragen
- Wie bereiten sie ihr Haus auf ihre Ferien vor?
 - Wie unterscheidet sich das vom alltäglichen verlassen des Hauses
- Welche Geräte lassen sie laufen /welche nicht? Warum?
 - tatsächlicher Nutzen daraus? Faulheit?
 - ökonomische /ökologische Gründe?
 - Sicherheitsaspekt?

- Welche anderen Personen sind involviert? Was tun diese?
 - Wohnungscheck? Was genau?
 - Schlüssel aufbewahren?
 - Kontakt während den Ferien?
- An welche Dingen von ihrem Zuhause denken sie in den Ferien?
 - Über was machen sie sich Sorgen?
 - (Fällt ihnen etwas speziell Gutes oder Schlechtes ein wenn sie ein Hotel mit ihrem Zuhause vergleichen? Vielleicht finden sie die Plastikschlüssel genial.)
- *Machen sie einen Remote-Check? Bekommen sie eventuell Statusnachrichten von Ihrem Haus?*

8.9 Objekte zuhause

- Welche ganz bestimmten Objekte /Geräte geben ihnen das Gefühl von Sicherheit?
- *Haben Sie spezielle Konfigurationen aus Sicherheitsgründen?*
- Erzählen sie mir von einem Erlebnis, wo sie in Bezug auf ihr Haus frustriert waren?
 - (Wo etwas nicht so funktionierte, wie sie wollten)
 - Wie hatte dies Einfluss auf die Sicherheit?
 - Wie konnten sie die Situation lösen?
- Gibt es Geräte, mit denen sie nichts zu tun haben (wollen)? Warum?
 - Was ist zum Beispiel mit der Heizung?
- Interessante Objekte
 - Multimedia: TV, Audio, Recorder, Radio
 - Küche: Herd, Ofen, Spülmaschine, Kaffeemaschine
 - Waschküche: Waschmaschine, Trockner
 - Haus allgemein: Türen, Fenster, Licht, Alarmanlage, Heizung, Lüftung

8.10 nach Hause kommen

- Erzählen sie vom letzten Mal, als sie nach Hause kamen?
 - Wie lange waren sie weg?
- Wenn sie nach Hause kommen, sagen sie mir ob sie wissen wer Zuhause ist und was die Personen machen.
- War etwas nicht so wie sie es erwartet haben?
 - TV lief, da bereits jemand zuhause

9 Statements from Affinity Diagram

You can find the pictures related to these statements on the CD.

A_001_Group A - Informationen, die das Sicherheitsgefühl beeinflussen.jpg

- A_002_Meine Nachbarn beobachten mein Haus in meiner Abwesenheit.jpg
- A_003_Ich bin beruhigter wenn andere Personen im Haus sind.jpg
- A_004_Bei längere Abwesenheit kommt jemand regelmässig schauen ob alles ok ist.jpg
- A_005_Die Ausstattung meines Hauses erhöht mein Sicherheitsgefühl.jpg
- A_006.1_Ich informiere andere Personen wenn ich in die Ferien fahre ...das Haus alleine ist.jpg
- A_006.2_Ich informiere andere Personen wenn ich in die Ferien fahre ...das Haus alleine ist.jpg
- A_007_Ich achte mehr auf Sicherheit wenn ich alleine bin.jpg
- A_009_Ich fühle mich sicherer wenn jemand da ist.jpg
- A_010_Ich will keine unbekannten Personen im Haus.jpg
- A_011_Ich vertraue der Technik - UNUSED.jpg
- A_012_Ich werde unsicher, wenn ungewohnte Geräusche zu hören sind.jpg

B_013_Group B - Verbesserungspotential.jpg

- B_014_Es braucht mehr Kontrolle und Überwachung - UNUSED.jpg
- B_015_Ich brauche Infos remote.jpg
- B_016_Ich will etwas das (noch) nicht möglich ist - UNUSED.jpg
- B_017_Probleme mit bestehenden Dingen (Konfiguration, Feedback) - UNUSED.jpg
- B_018_Manchmal habe ich keine Zeit.jpg
- B_019_Es gehen Dinge vergessen.jpg

C_020_Group C - Nutzungsverhalten.jpg

- C_021_Licht anschalten gibt mir ein sicheres-wohles Gefühl.jpg
- C_022.1_Geschlossene Storen geben mir das Gefühl von Sicherheit.jpg
- C_022.2_Wertvolle Dinge bringe ich ausser Haus wenn ich weg fahre.jpg
- C_024_Ich kontrolliere elektrische Geräte, ob sie ausgeschaltet sind.jpg
- C_025_Diese Dinge bringen das Haus in Gefahr, Haus !OK.jpg

- C_026_Mein Haus soll in meiner Abwesenheit nicht abwesend wirken.jpg
- C_027_Ich habe mir angewöhnt Geräte direkt wieder aus zu schalten.jpg
- C_028_Das Lüften läuft bei mir automatisch (Gewohnheit).jpg
- C_029_An gewissen Dingen erkenne ich, ob jemand zuhause ist - UNUSED.jpg
- C_030_Ich fühle mich sicherer mit geschlossenen Türen oder Fenster.jpg
- C_031_Über diese Dinge weiss ich gerne Bescheid (awareness).jpg
- C_032_Informationen unterwegs (wollen, haben, sich fragen).jpg
- C_033_Wieso ich Dinge ausschalte (weil mal etwas passiert ist).jpg
- C_034_Es gibt mir ein Gefühl von Sicherheit, wenn ich weiss, das sich im schlimmsten Fall jemand anderes drum kümmert - UNUSED.jpg
- C_035_Gewisse Dinge laufen automatisch ab.jpg
- C_036_Das habe ich mir so angewöhnt.jpg

D_037_Group D - Charakteristika der passiven Nutzer.jpg

- D_038_Bestimmte Ereignisse lösen aus, dass ich an mein Haus denke.jpg
- D_039_Gewisse Dinge mache ich bewusst anders, damit ich sie nicht vergesse.jpg
- D_040_Gewisse Dinge bekomme ich (ungewollt) mit.jpg
- D_041_Automation erhöht meine Lebensqualität.jpg
- D_042_Ich mache mir nicht wirklich Gedanken um mein Haus, wenn ich unterwegs bin.jpg
- D_043_Ich fühle mich wohler wenn ich den "Einblick ins Haus" kontrollieren kann.jpg
- D_044_Ich habe keine speziellen Dinge, welche mir Sicherheit geben - UNUSED.jpg
- D_045.1_Ich, oder PartnerIn, schaue eher mehrmals nach, ob alles so ist, wie es sein sollte.jpg
- D_045.2_.jpg
- D_045.3_Partnerin und ich haben unterschiedliche Bedürfnisse.jpg
- D_048_Ich kenne den Zeitplan meiner Mitbewohner ungefähr.jpg
- D_049_Meine Kinder sind mir wichtiger als ich selbst - UNUSED.jpg

E_050_Group E - Other Things.jpg

- E_051_Ich mache mir Gedanken über die Abhängigkeit von der Technik.jpg
- E_052_Was ich über mein Haus wissen will - UNUSED.jpg

- E_053_Die Sicherheit meiner Wohngemeinde beeinflusst mein Verhalten in Bezug auf Sicherheit.jpg
- E_054_Anrufe von suspekten Personen machen mir Angst - UNUSED.jpg
- E_055_Ich möchte mich mit der Technik nicht so viel beschäftigen.jpg
- E_056_Die Lage-Art der Wohnung selbst gibt mir ein gutes Gefühl.jpg
- E_057_Ich freue mich wenn ich nach Hause komme und das Haus ist aufgeräumt.jpg

F_058_Group F - Responsibilities - Task sharing.jpg

- F_059_In Abwesenheit haben dritte Personen Aufgaben-Verantwortung bezüglich unserem Haus.jpg
- F_060.1_Es gibt bei uns keine Absprachen, wer sich um irgendwas beim Verlassen des Hauses kümmert.jpg
- F_060.2_.jpg
- F_062_Es gibt Absprachen wer sich um was kümmert.jpg
- F_063_UNASSIGNED.jpg

Unused

- Z_069_Unused.jpg

10 Categories of Ideas

You can find the pictures related to these statements on the CD.

- 001_Presence of Others.jpg
- 002_Exercise What-If Situations .jpg
- 003_Personalized Automation.jpg
- 004_Assisted planning.jpg
- 005_Being aware of what happened.jpg
- 006_Alerts, Notifications and Warnings.jpg
- 007.1_Involving Others.jpg
- 007.2_Involving Others.jpg
- 009_Gamification and changing Habits.jpg
- 010_Aggregated single info.jpg
- 011.1_Roles and Responsibilities -> Lists.jpg
- 011.2_Roles and Responsibilities -> Lists.jpg

11 Storyboard drawings and User Scenarios

11.1 AI-Cat

Scenario I

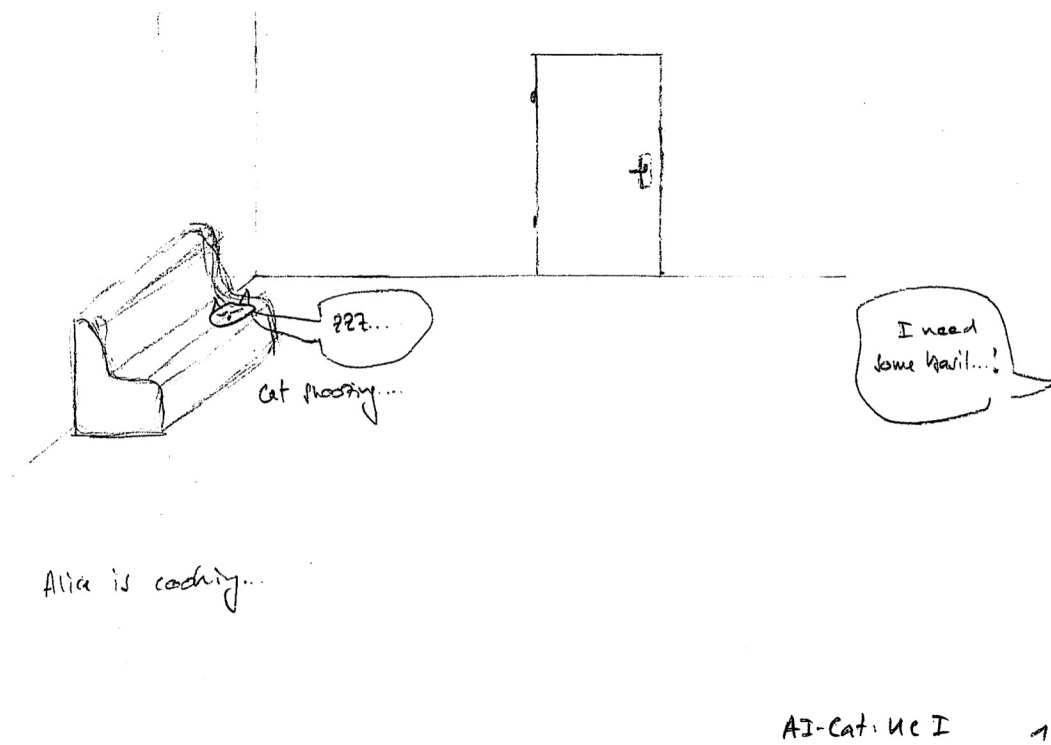
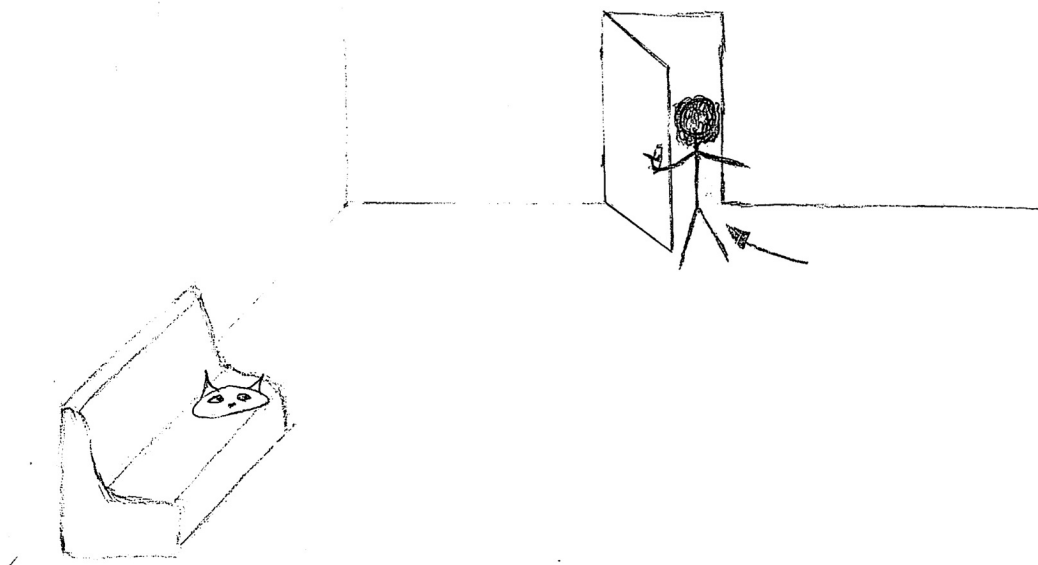


Figure 17: AI-Cat I.1

Alice is cooking in the kitchen, the cat lies on the couch snoozing.

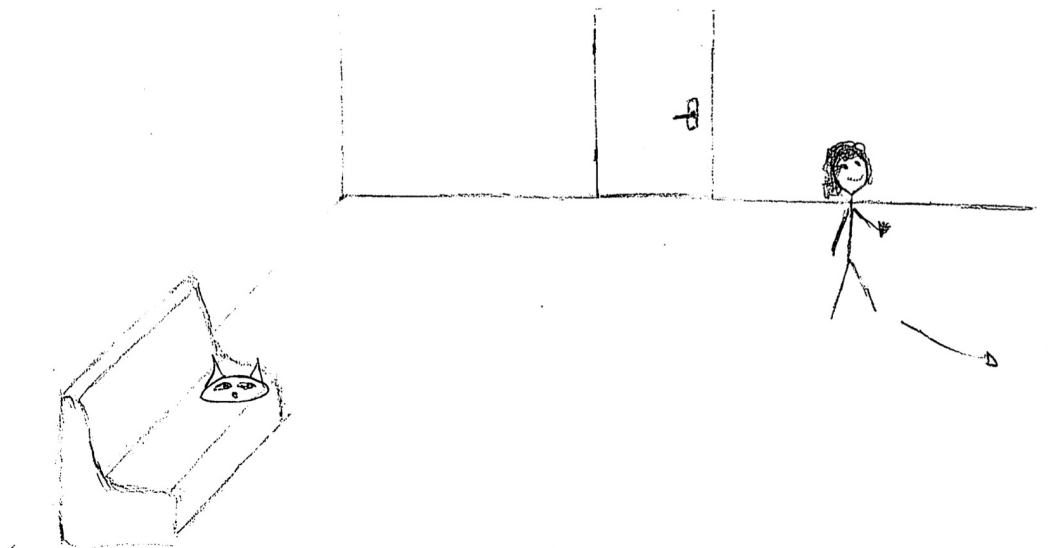


Alice goes into the garden to get some basil.

2

Figure 18: AI-Cat I.2

Alice gets out to get some basil for the tomato salad. The cat notices and looks up, but doesn't care so much.

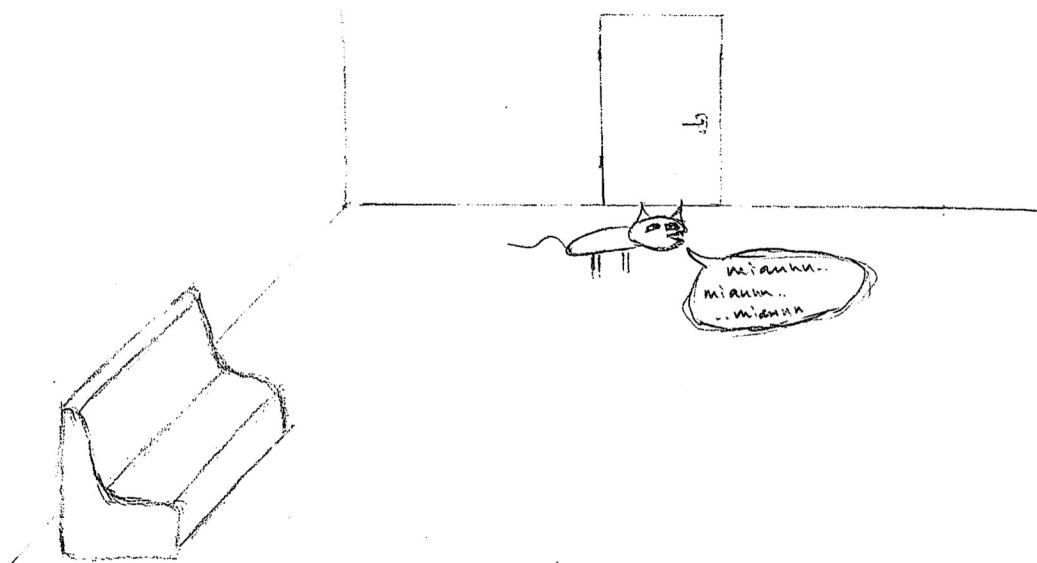


Alice closes the door, but forgets to lock. 5 minutes later...

3

Figure 19: AI-Cat I.3

Alice returns but doesn't lock the door. The cat notices again, but still doesn't care so much.



The cat calls for attention because Alice hasn't locked the door.

4

Figure 20: AI-Cat I.4

After a few minutes, the door still hasn't been locked and nobody walked in or out, the cat gets up, stretches itself and walks to the door. By the door it draws attention to show the inhabitant, that something is not ok with the status of the door.



Figure 21: AI-Cat I.5

Alice comes to look after the cat and locks the door.

Scenario II

See AI-Cat, Scenario II (section 6.1).

Scenario III

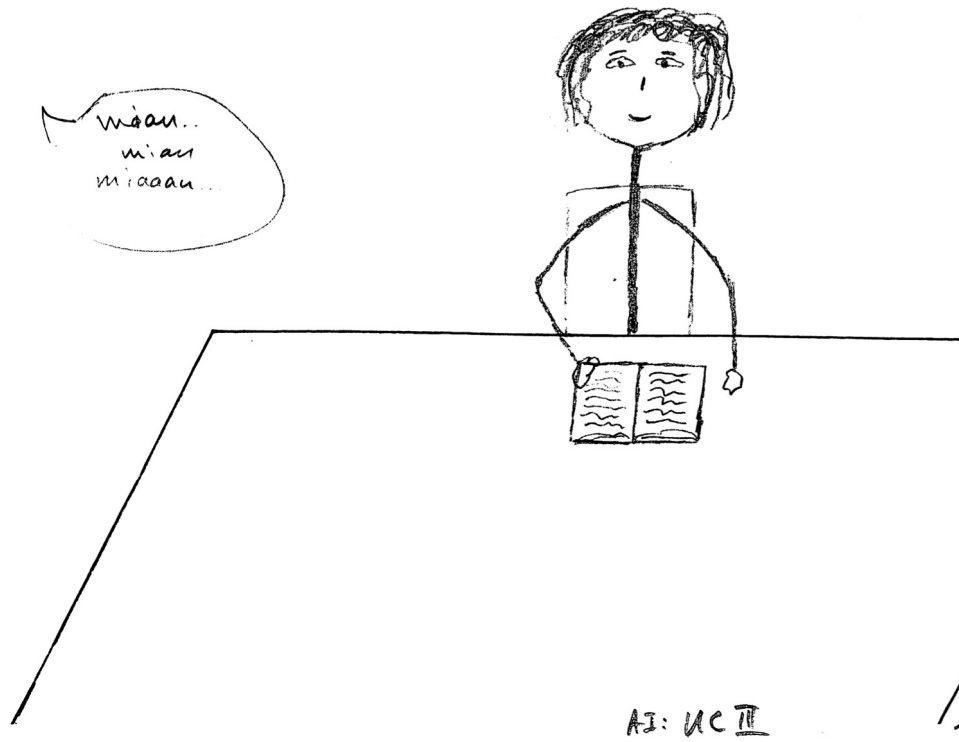


Figure 22: AI-Cat III.1

The cat is miawing.

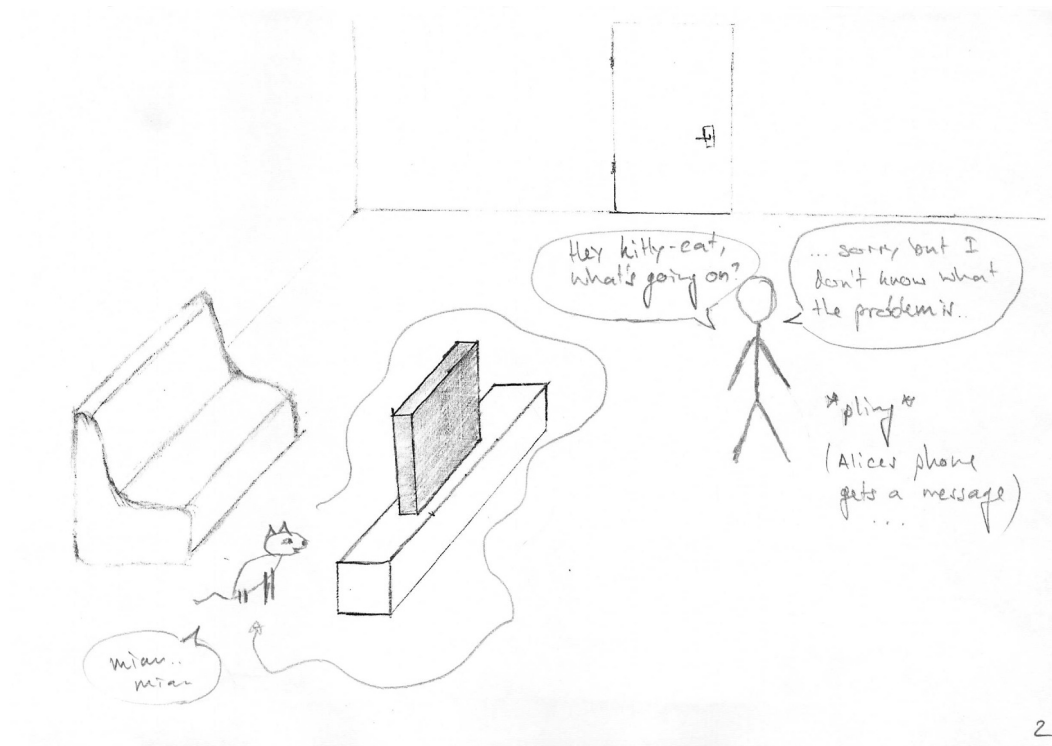
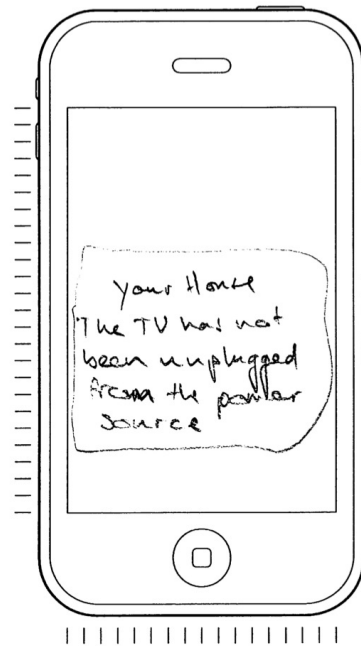


Figure 23: AI-Cat III.2

Alice knows something is not quite right and follows the cat, but Alice can't seem to figure out what is wrong. The system notices that the cat has been unsuccessfully trying to show Alice where the problem is. Alice receives a notification...

Alice's phone



③ Alice now can
fix the problem &
the cat is happy
again.

Figure 24: AI-Cat III.3

...showing her the exact problem zone and after fixing the problem, the cat purrs and goes back to snoozing.

11.2 Noise Identifier (NI)

Scenario I

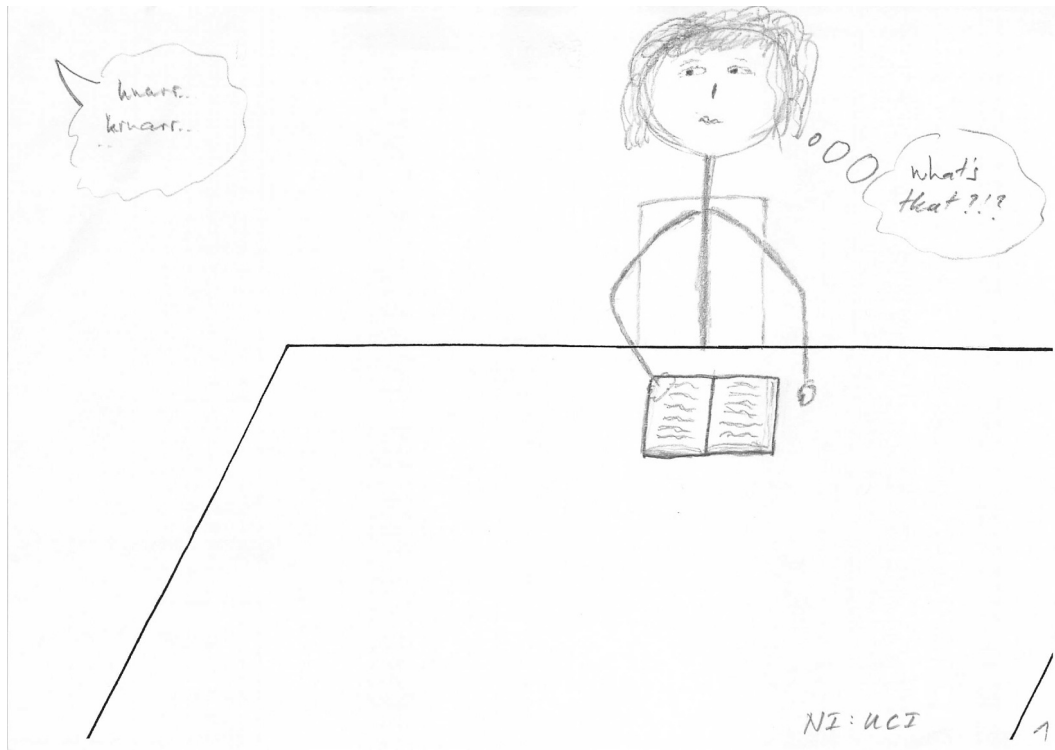


Figure 25: Noise Identifier I.1

Alice is home alone reading a book, her husband is out on a business dinner. Suddenly she hears an unfamiliar sound and feels uncomfortable.

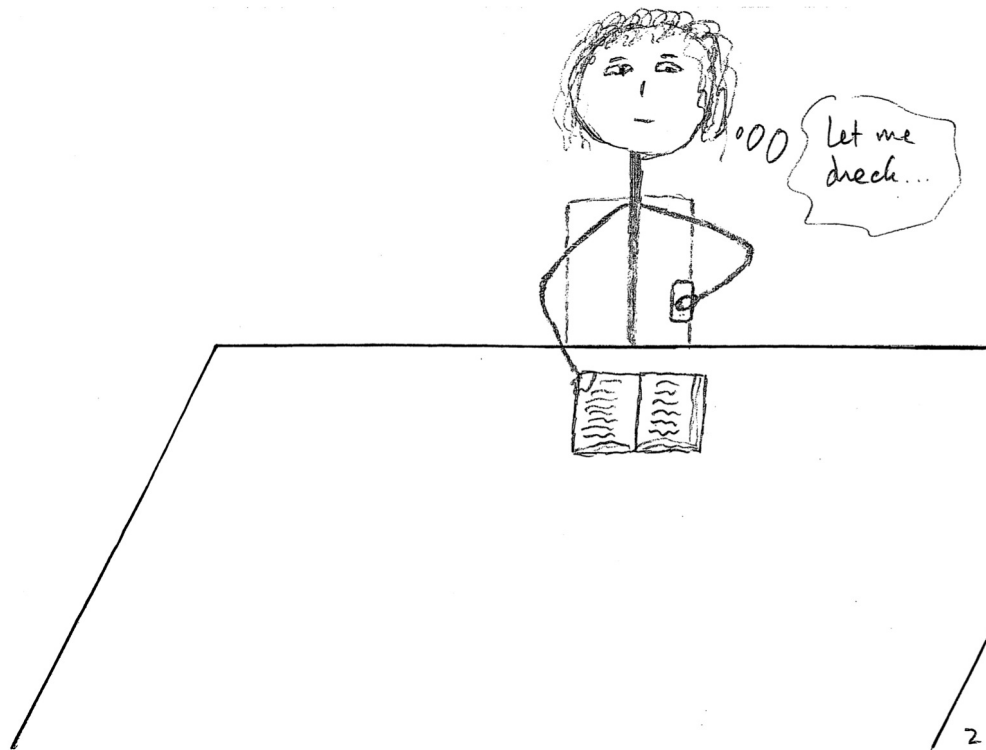


Figure 26: Noise Identifier I.2

She picks up her phone and launches the Noise Identifier.

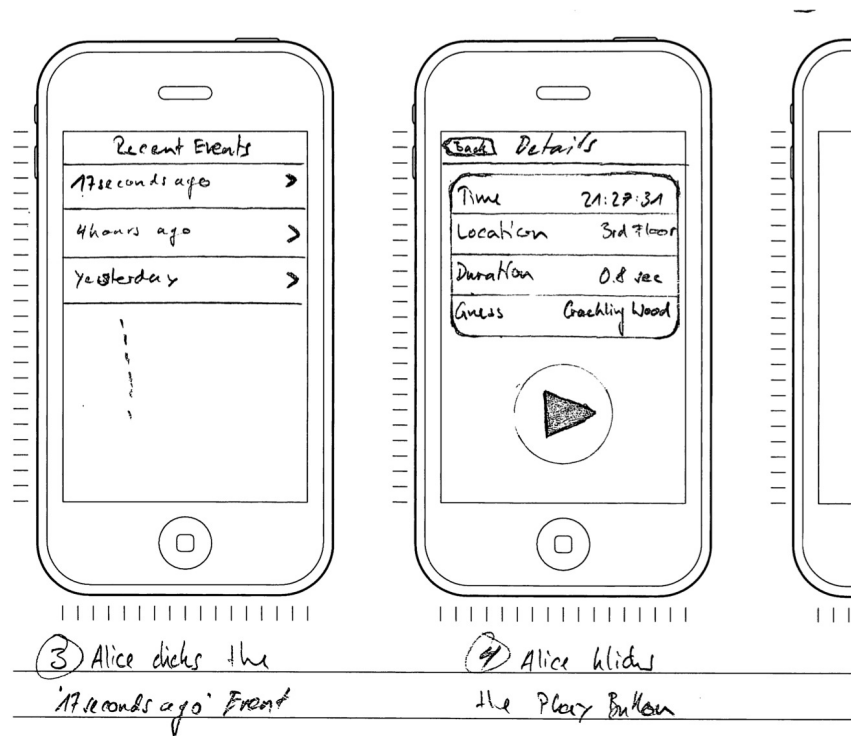


Figure 27: Noise Identifier I.3

After launch it shows her a list with the most recent events the NI recorded, the first one was 30 seconds ago. She clicks it and sees additional details about the sound: Location, exact time, duration and the result of a search for a reason of the sound. She first notices that the system classified the noise as “Crackling Wood”, which makes her less worried, but to be sure she hits the “Play” button to hear the sound.

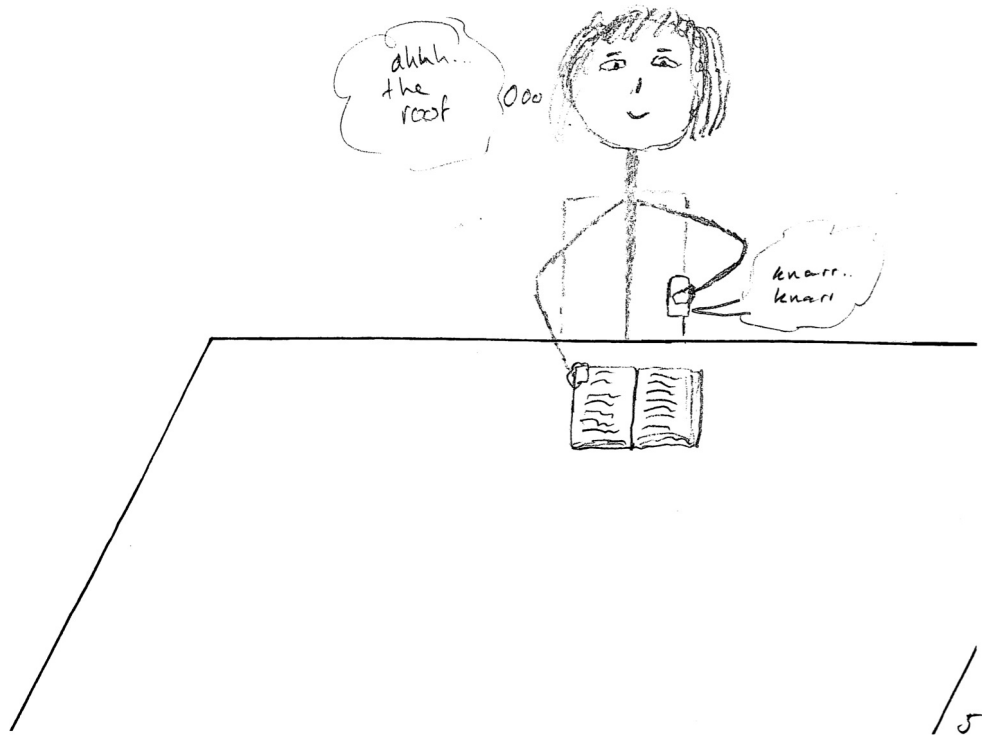


Figure 28: Noise Identifier I.4

After hearing the sound and looking at the location she is sure it must have been the wooden roof of their rural house.

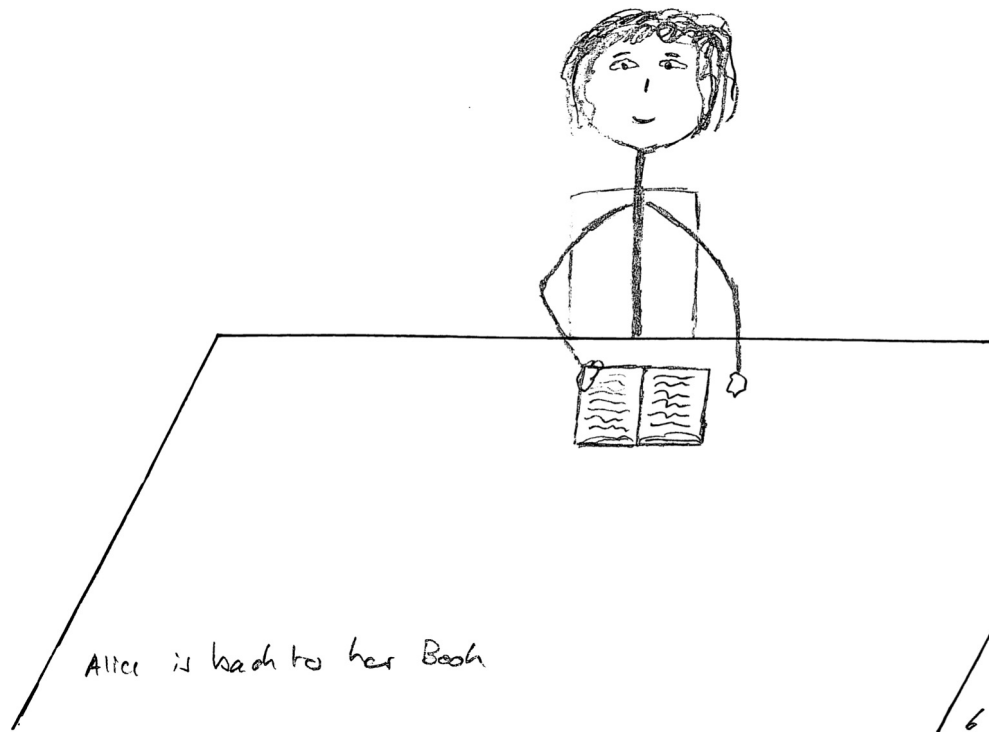


Figure 29: Noise Identifier I.5

She feels relieved and returns to the story of her book.

Scenario II

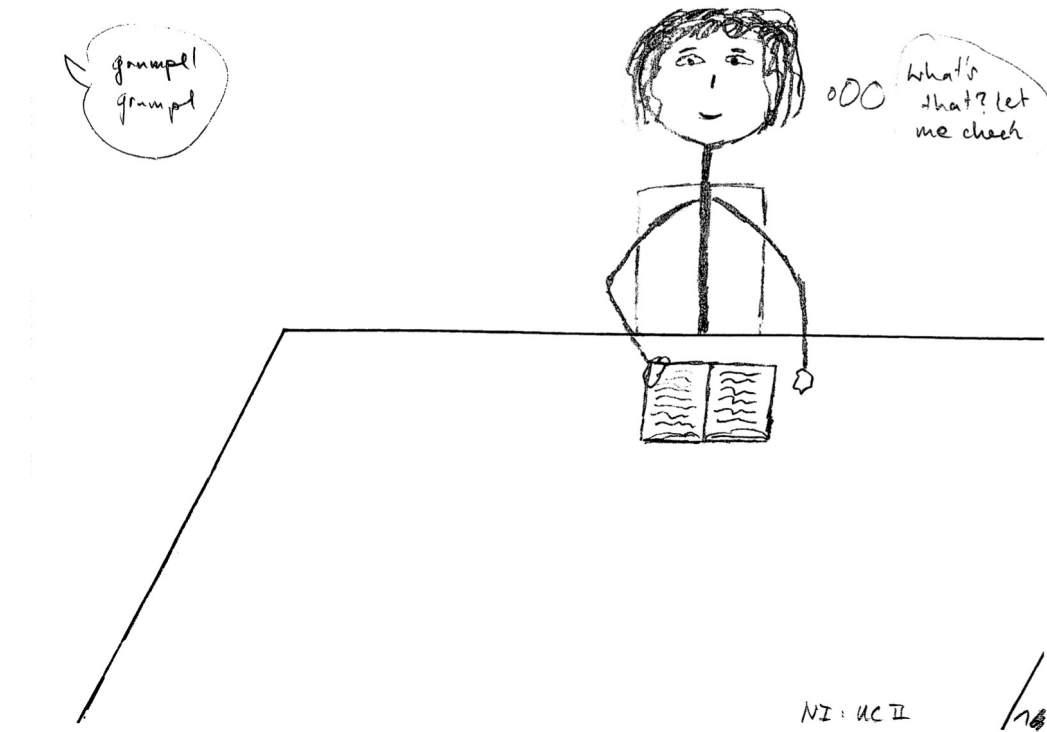
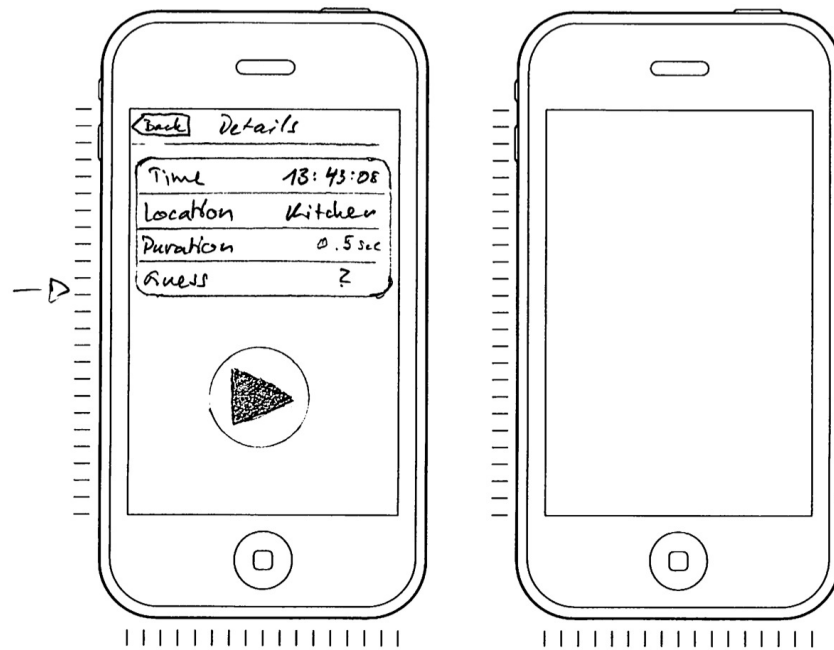


Figure 30: Noise Identifier II.1

Again Alice is at home and hears a strange noise. She launches the NI and wants to see what is going on.



② Alice goes to the
kitchen to check...

④ Alice slides 'Guess'
to edit & types "dish washer"

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Figure 31: Noise Identifier II.2

This time the Noise Identifier cannot classify the Noise. She get up and walks to the kitchen, where the NI located the Noise.



Figure 32: Noise Identifier II.3

As she looks around she notices the red light of the dish washer and remembers that she set it to start around now. She is relieved, tells the NI what the Noise was for future reference and goes back to what she was doing.

Scenario III

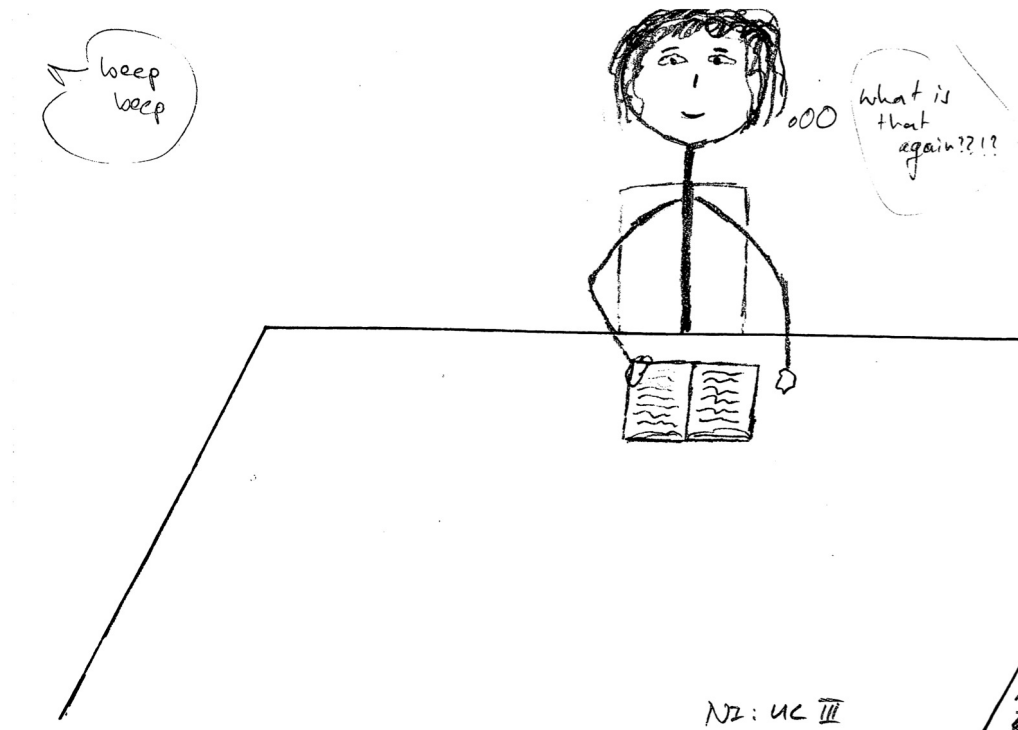
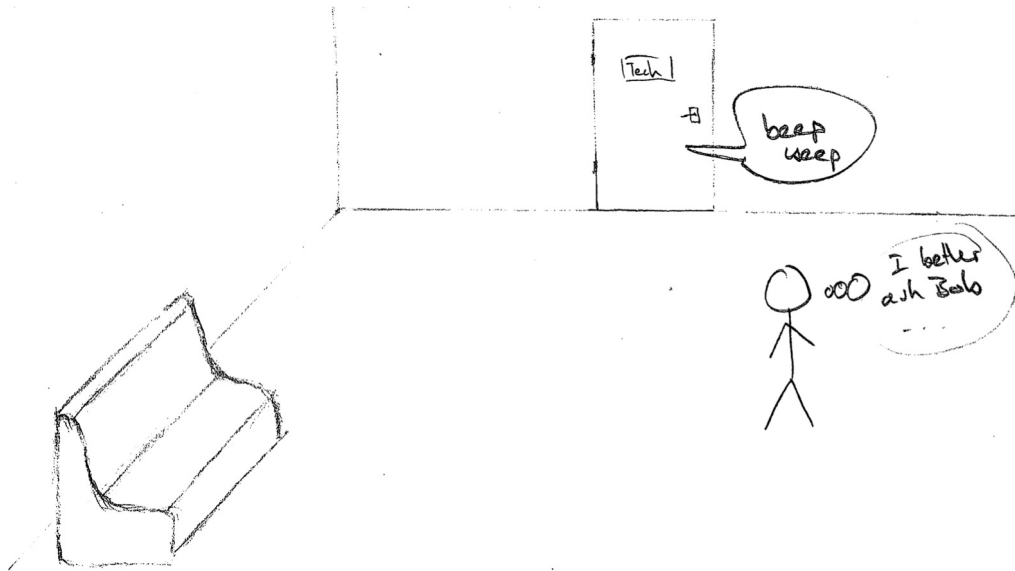


Figure 33: Noise Identifier III.1

Alice is at the kitchen table reading her favorite magazine. She is interrupted by some upsetting beeping noise, that keeps repeating every few minutes.



2

Figure 34: Noise Identifier III.2

The NI helps her locate the source, it is some device in the room that contains the devices that run the house.

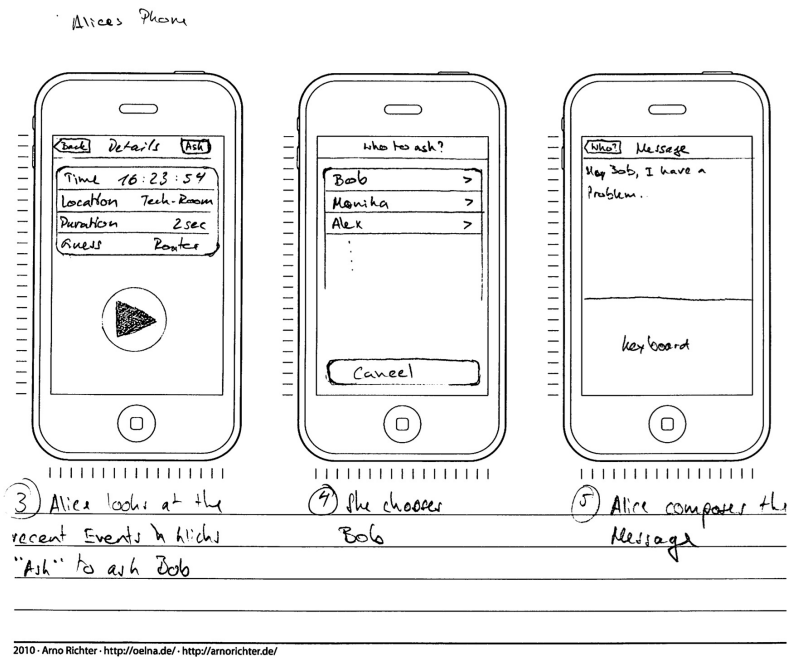


Figure 35: Noise Identifier III.3

She has no clue how to make it stop and clicks the “Ask Others” Button and then chooses her husband Bob, who is out with the Kids.

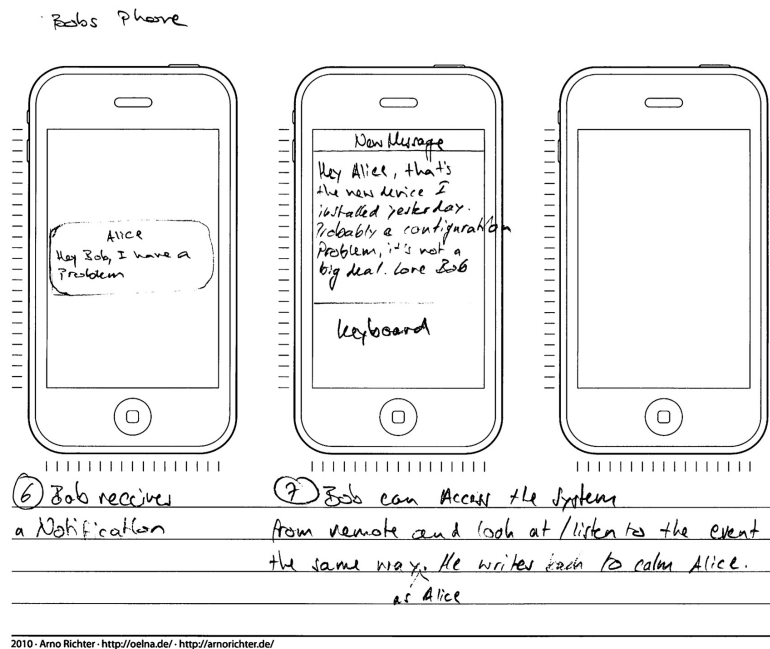


Figure 36: Noise Identifier III.4

Bob gets notified by the NI that Alice needs help. He quickly replies that he knows what it is and that everything is fine. In the meantime he remotely connects to the House and fixes the problem.

Alternative Ending

Bob can identify the source of the problem but cannot fix it remotely and the device keeps beeping, after some time it even gets louder. For such cases Bob created Step-By-Step Guides with pictures and brief descriptions of what to do. From a library he chooses the appropriate steps and confirms them. The NI then sends Alice a Notification that Bob needs her to do something and displays her the appropriate steps of what to do. She follows the Guide and at end gets asked if it solved the problem. It did so she clicks “Yes” and the NI again notifies Bob that everything is back to normal again.

Scenario IV

This ideas was not put into a storyboard because it seemed to be too simple.

Alice hears something that definitely came from above. She checks with the Noise Identifier but it also cannot fully locate the noise. She clicks the “Ask Others” button and then chooses Bob, because she knows he’s up there. He receives a notification and replies that it’s ok because he moved some tables around.

Scenario V

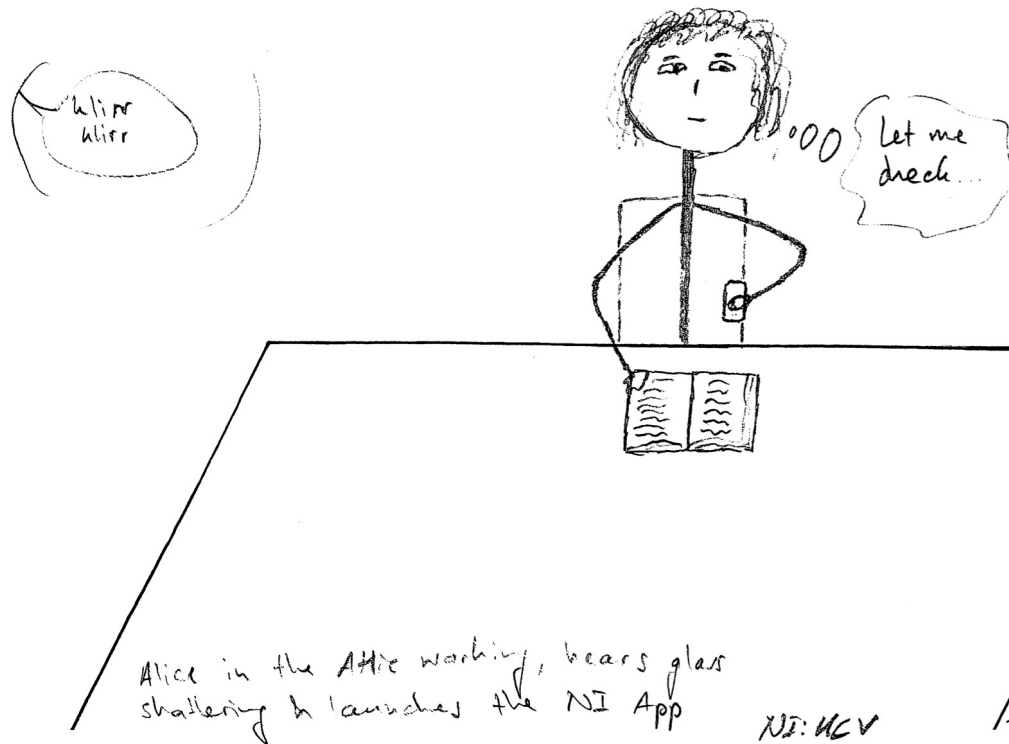


Figure 37: Noise Identifier V.1

Alice got caught up in her home office in the attic. Bob is out of town and it is already late. Suddenly she is disturbed by a noise that sounds like glass shattering. She gets nervous and launches the NI.

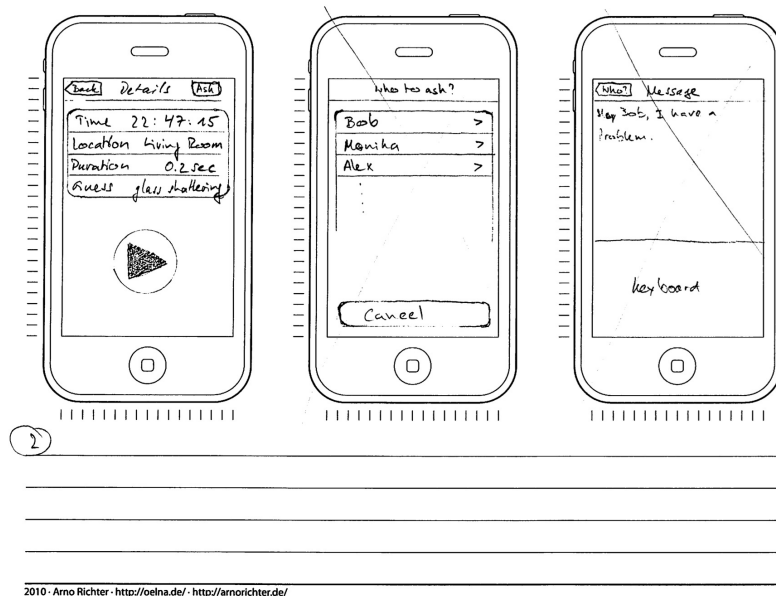


Figure 38: Noise Identifier V.2

As she sees that the location is “Living Room”, she gets seriously worried.

Alice replays the recording while walking down the hall,
 she hears footsteps and turns around. She then calls
 the police and waits for ~~the~~ their arrival.

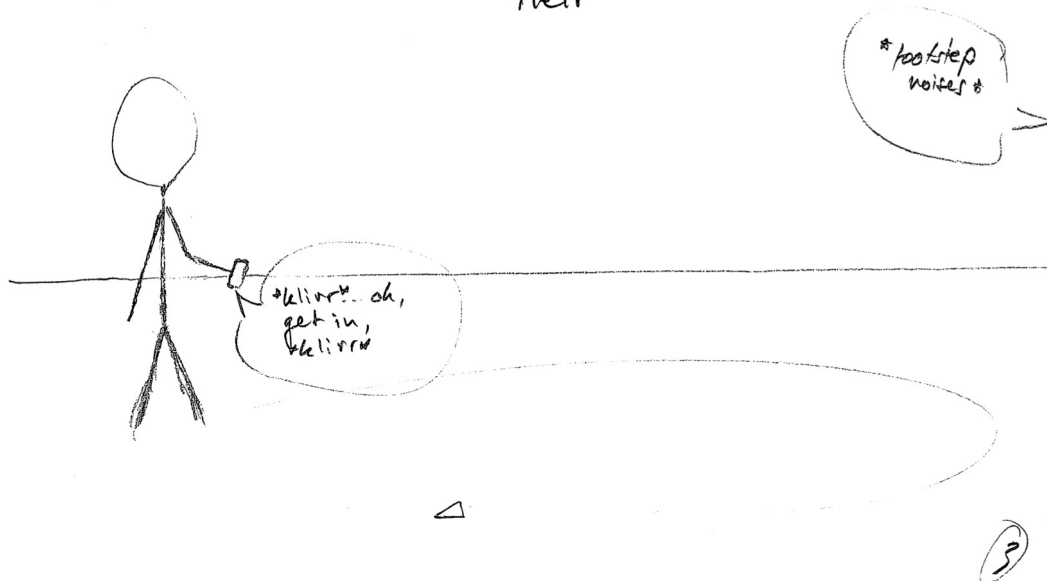


Figure 39: Noise Identifier V.3

While walking downstairs, she replays the recording of the event, clearly there are voices audible. She stops and listens to what is happening right now. When she hears footsteps she locks herself into the attic and calls the police.

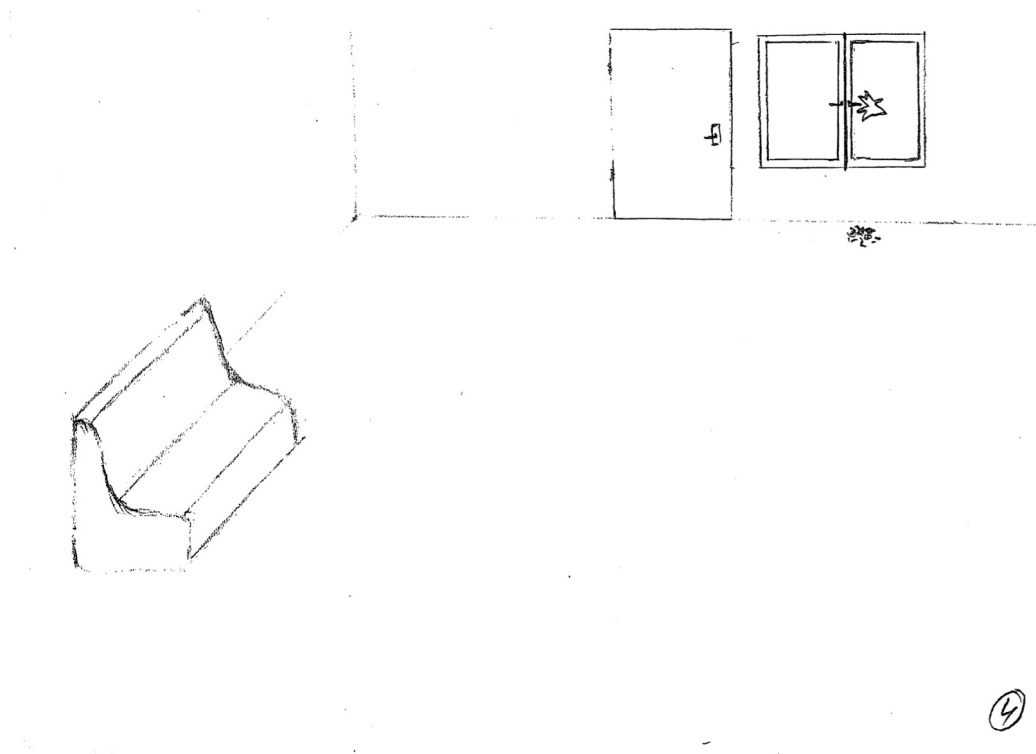


Figure 40: Noise Identifier V.4

Showing the scenery: Somebody broke the window glass by the door and must have entered.

11.3 Help-Tool

Scenario I (ask for help)

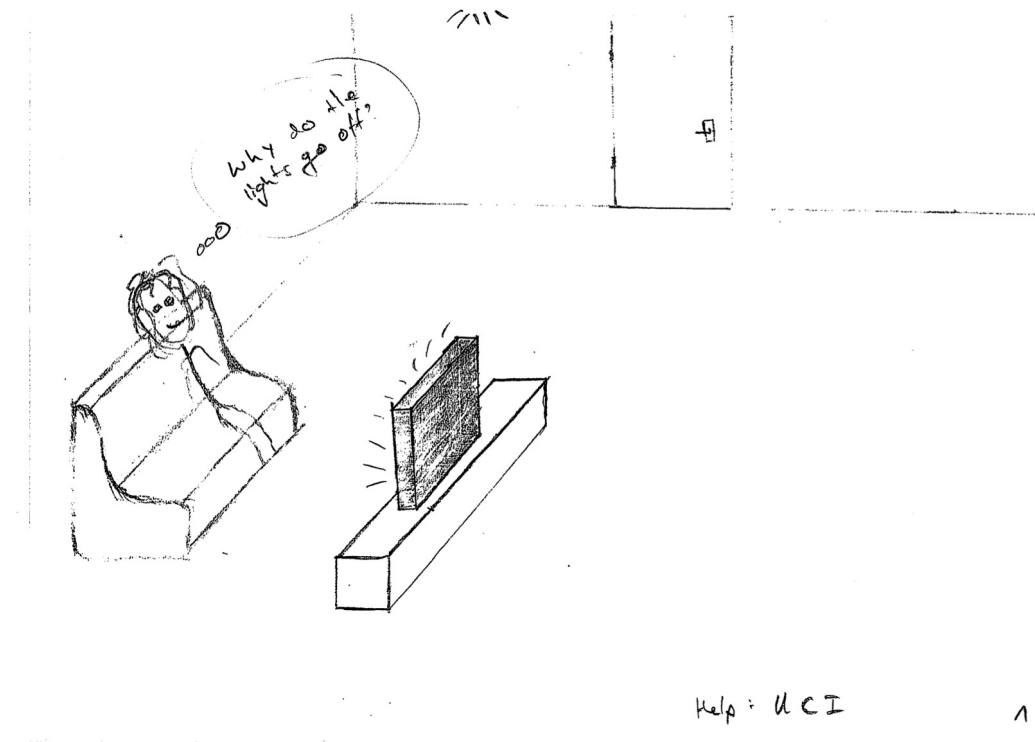


Figure 41: Help-Tool I.1

Alice has problems with the configuration of the house. She turned on the lights in the living room and wants to watch TV, but the lights seem to go off at random times.

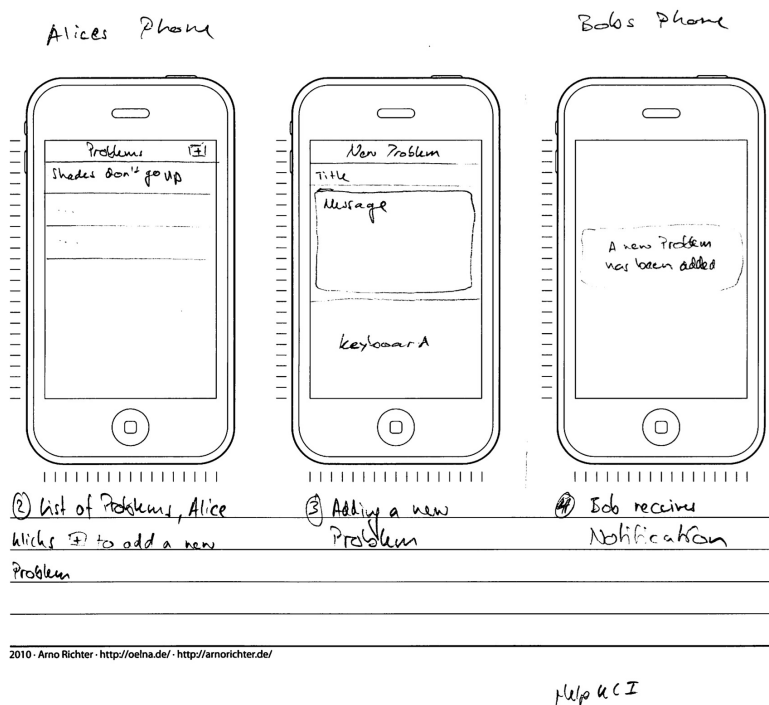


Figure 42: Help-Tool I.2

She uses the phone to ask her husband for help. In the message she writes what the problem is. Along with additional informations about the system (log over the last few hours, snapshot, ..) the message goes into a pool along with other messages. Bob receives a notification about the problem and decides to look into it when he arrives home.

Scenario II (ask for verification)

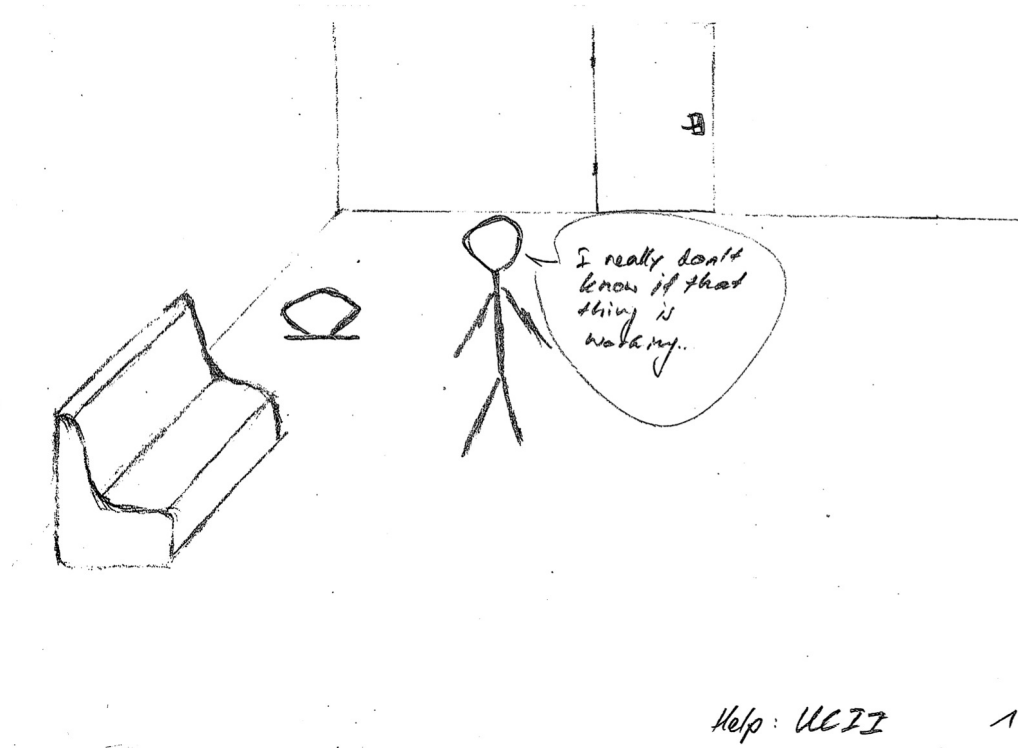


Figure 43: Help-Tool II.1

Alice is home alone and unsure if everything is ok with the house. She especially does not know if that new device is working correctly.

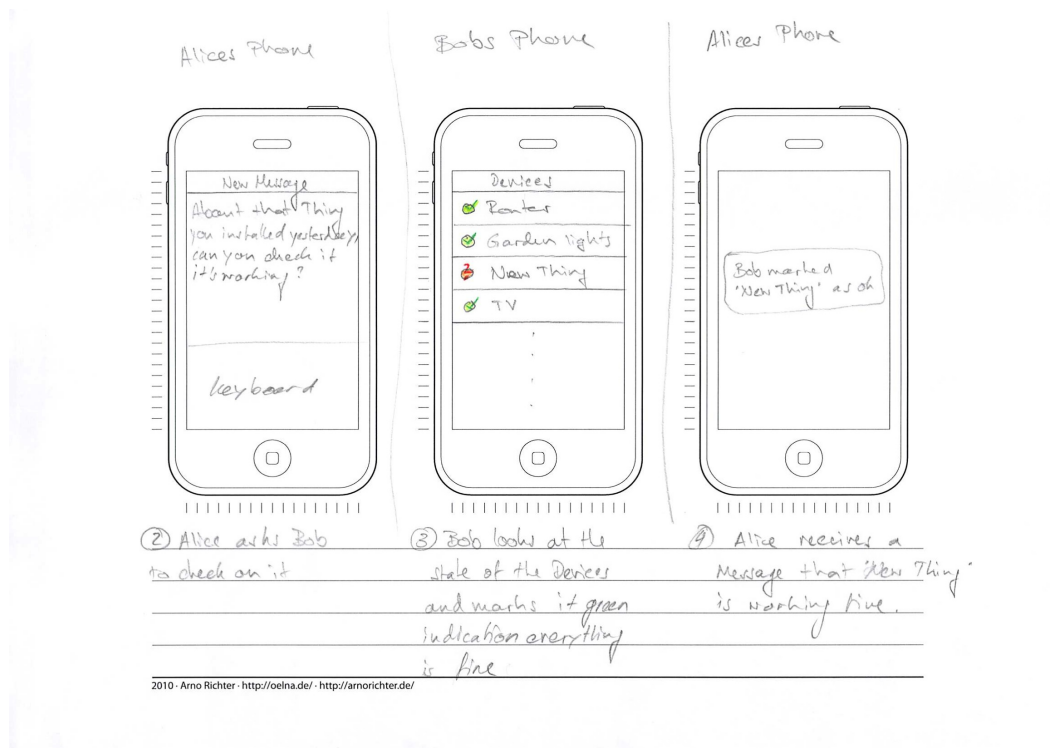


Figure 44: Help-Tool II.2

She takes her phone and sends Bob a message, the system also sends a snapshot of the houses configuration along. As Bob receives the message, he looks at the device in the snapshot and marks it green to show that he has reviewed its state. Since an incoming phonecall is coming in, he cannot look at anything else and confirms his doings and closes the app. Alice receives a message that tells her that Bob has looked at the new device and that everything is fine.

Scenario III (ask for a new feature)

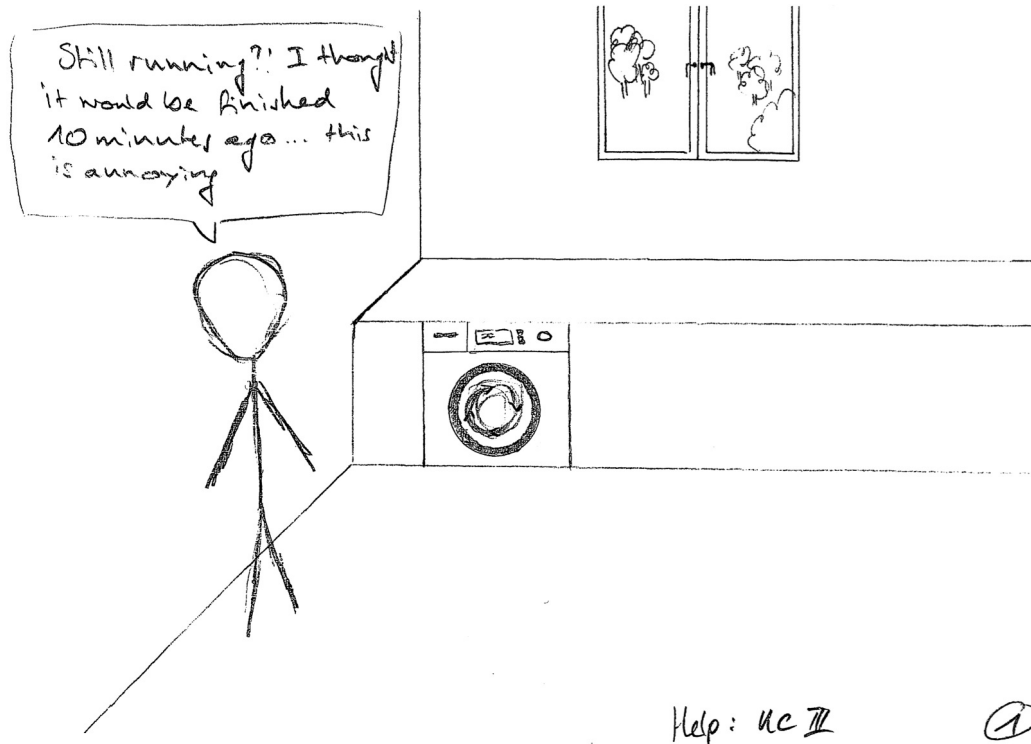


Figure 45: Help-Tool III.1

In Alice's house the laundry room is near the garage and its devices are barely audible in the rest of the house. So when Alice is doing the laundry she often has to check if the machine is still working or ready for a new run.

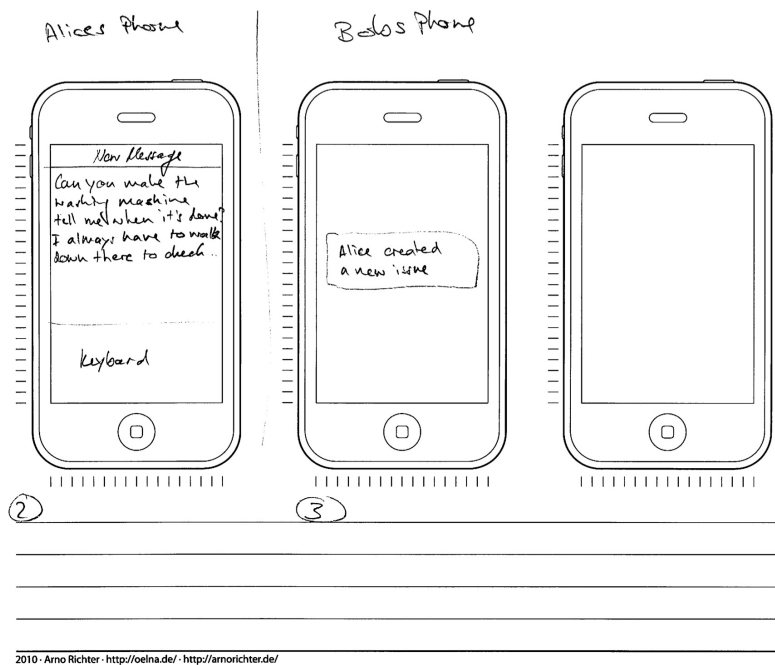


Figure 46: Help-Tool III.2

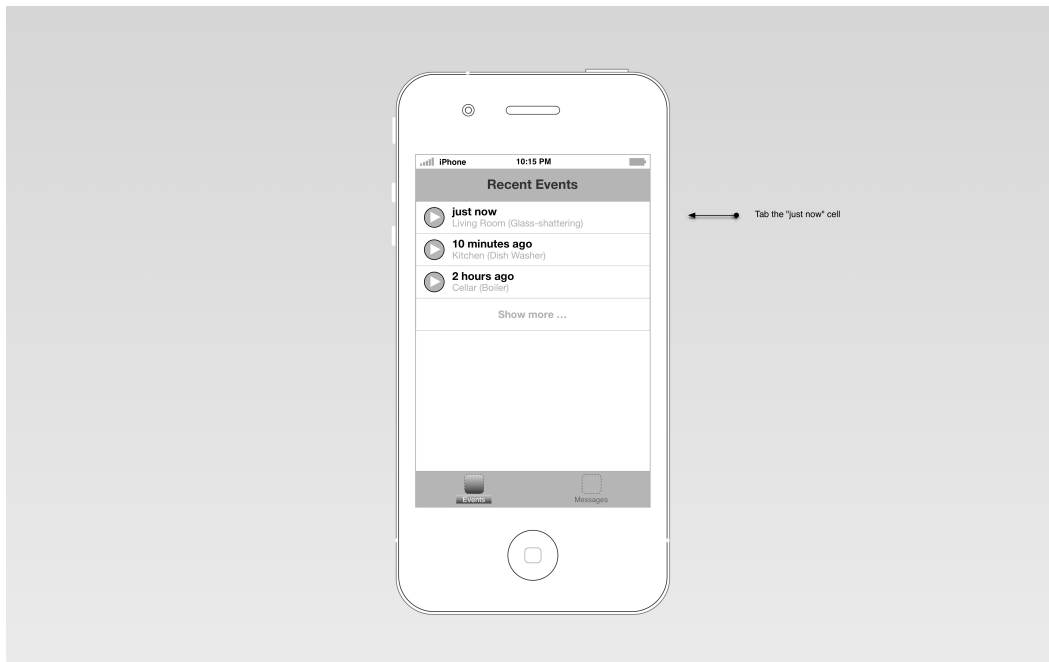
It would be much more efficient if she gets a message when the machine is done. She launches the App and creates the new issue.

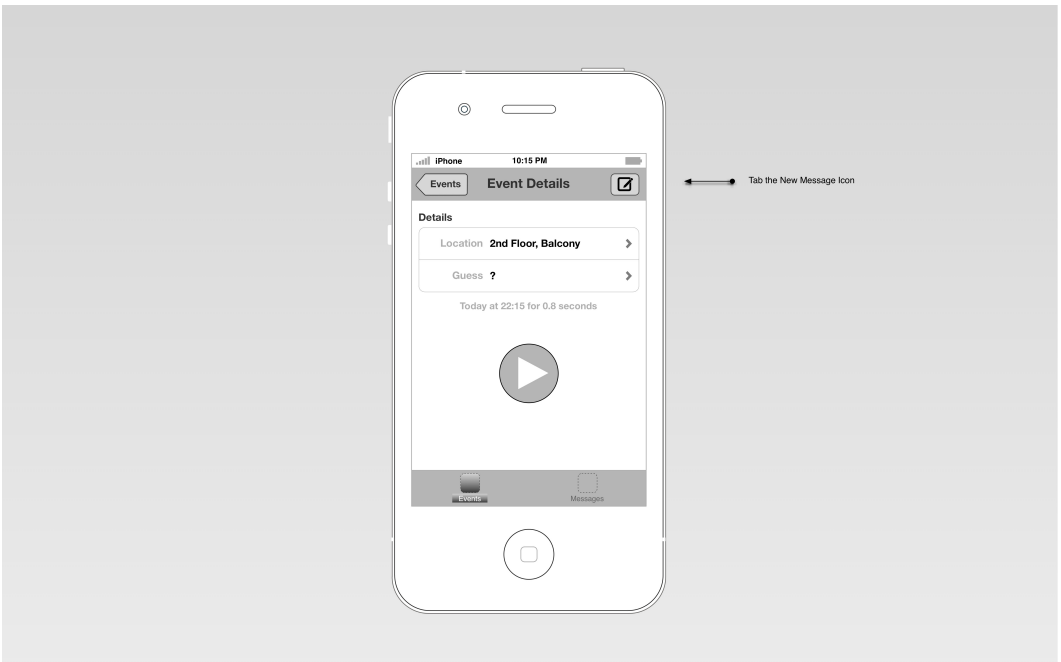
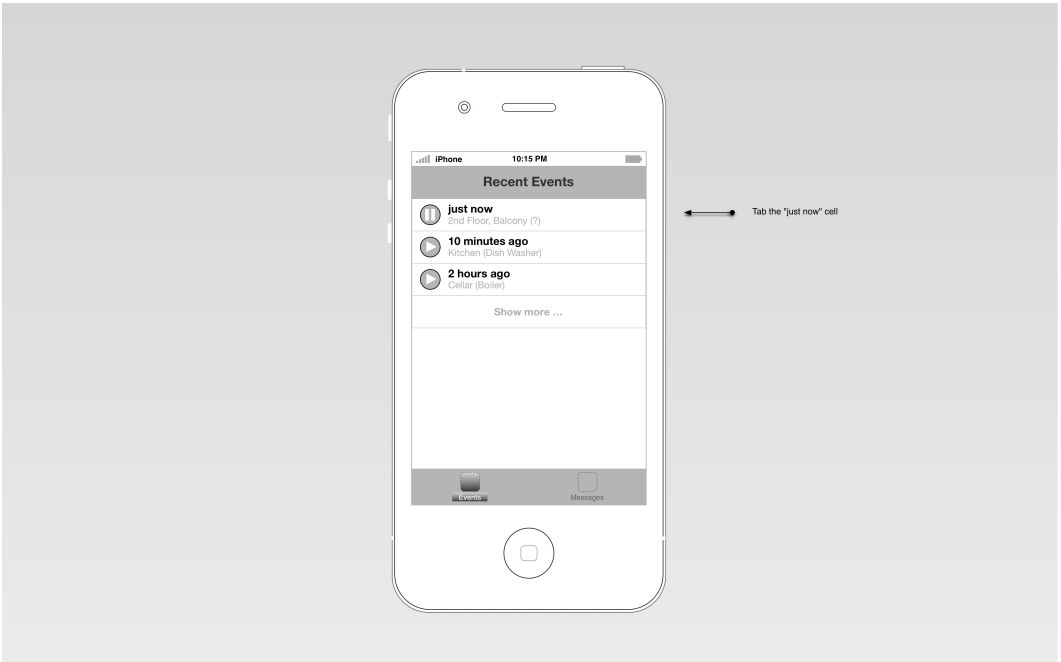
12 Prototype

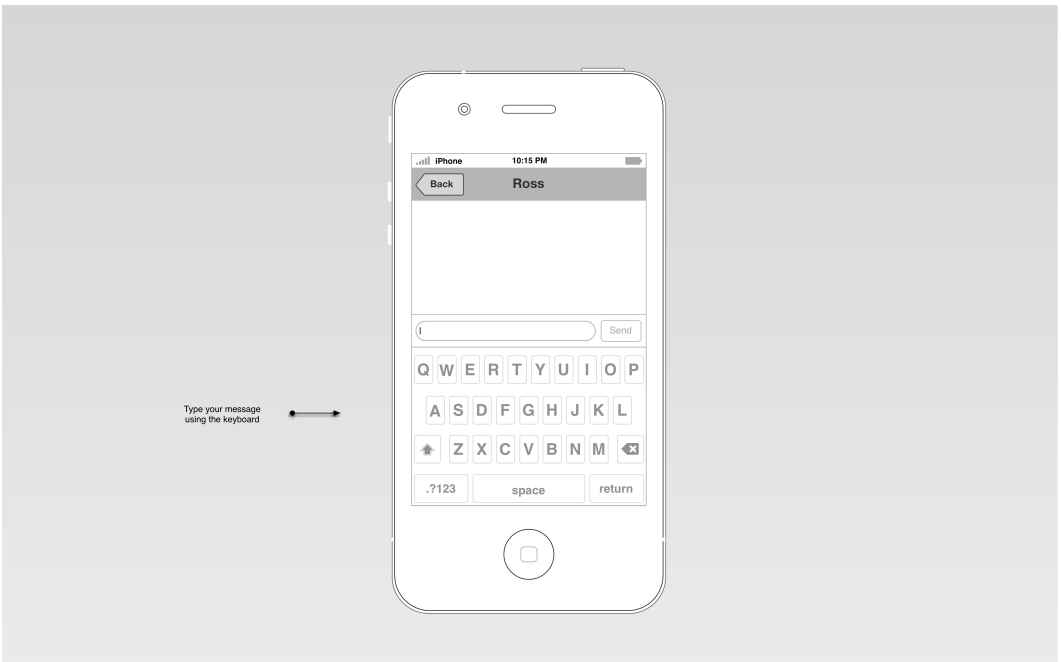
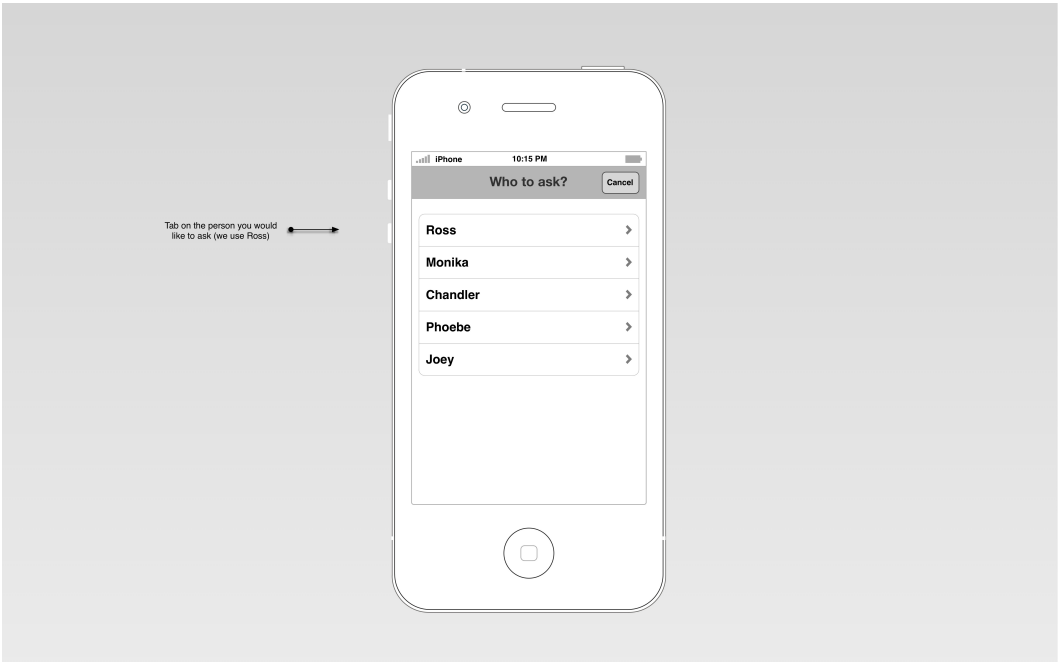
These are the screens as used in Evaluation using Cognitive Walkthrough (section 7.3).

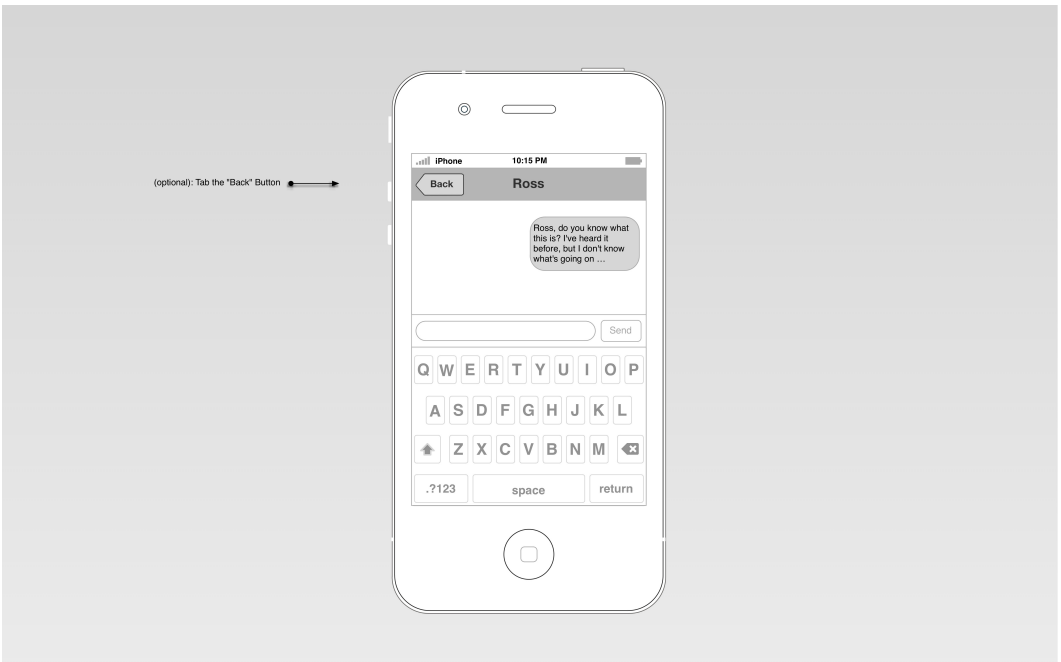
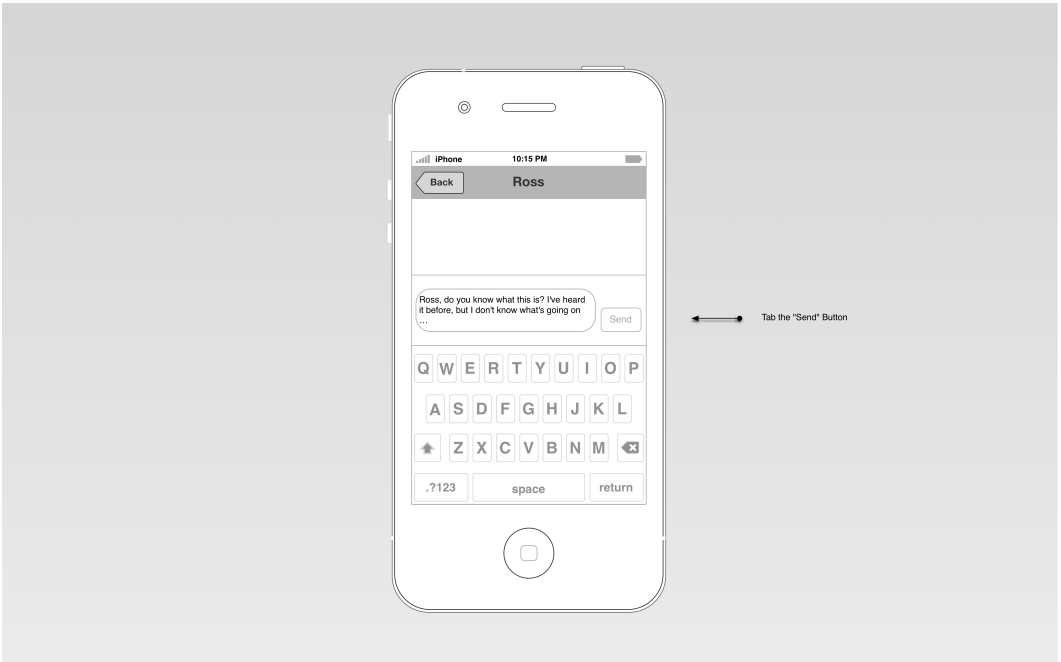
12.1 Screens for Scenario VI

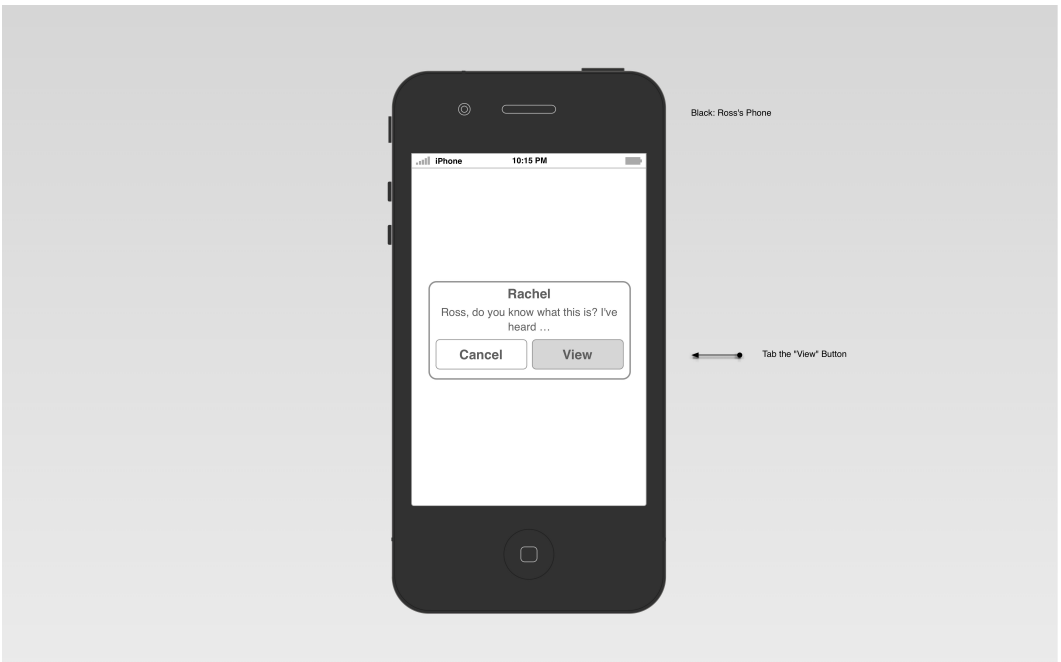
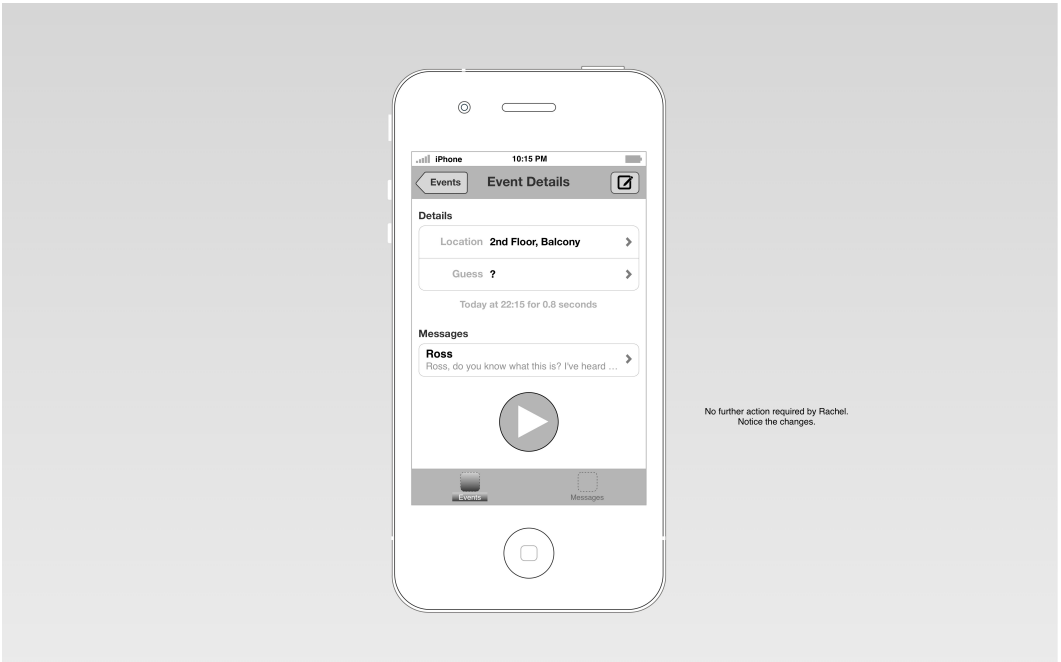
Find the description for the scenario at Scenario VI: Referencing what happened (section 7.1).

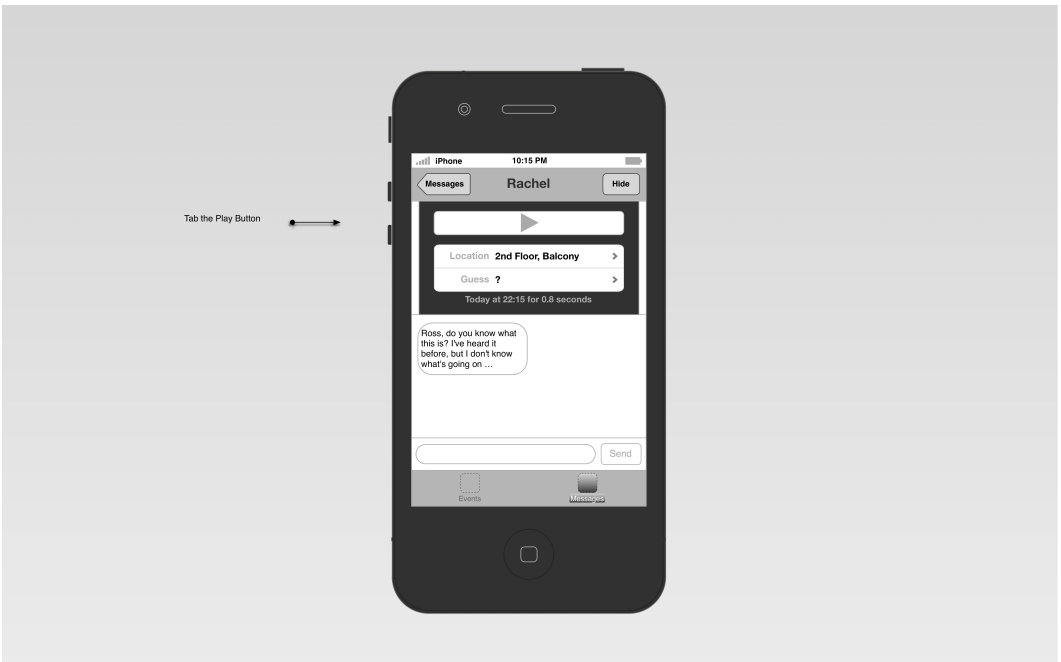
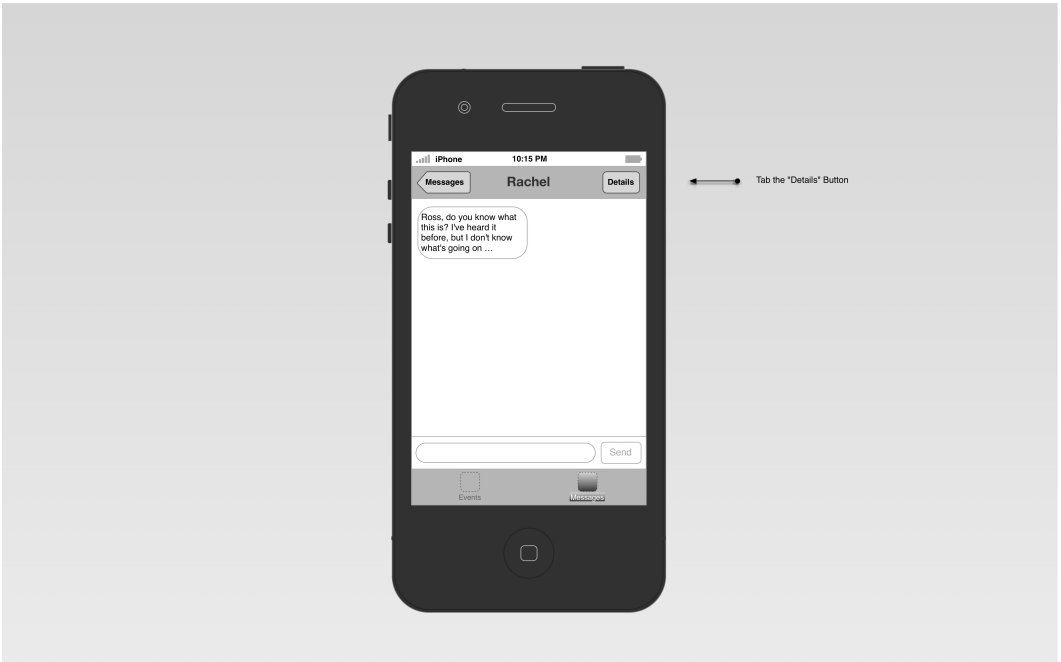


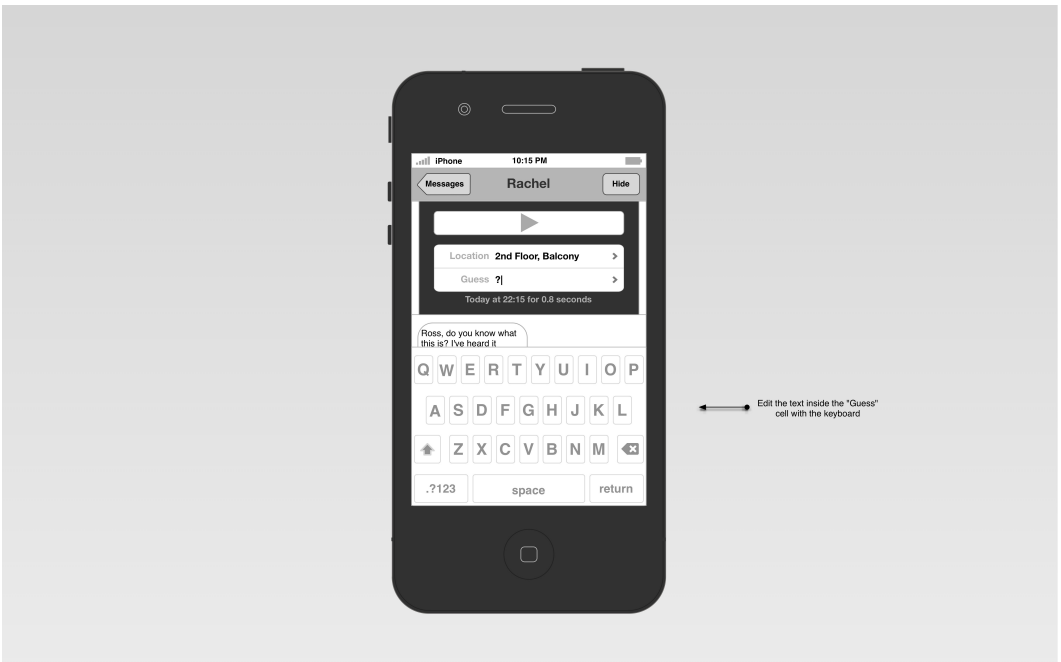
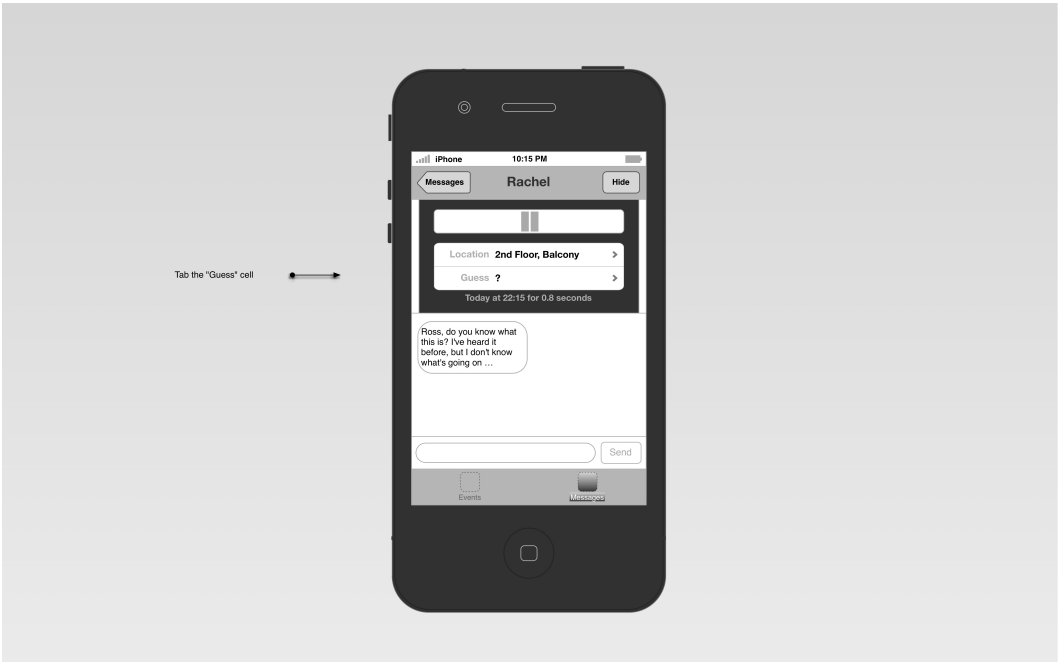


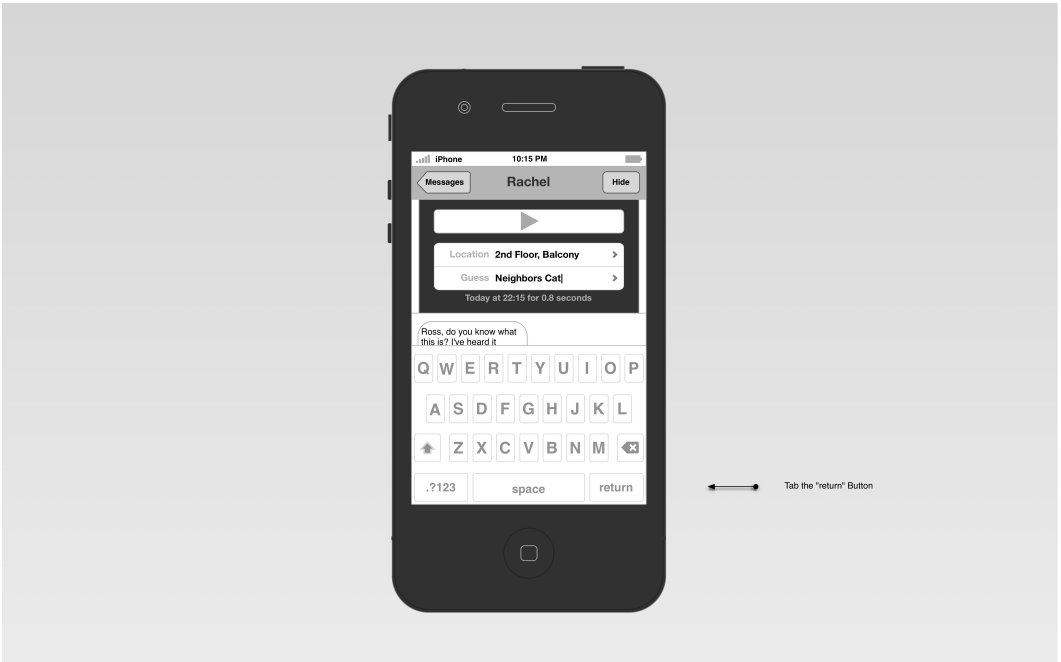


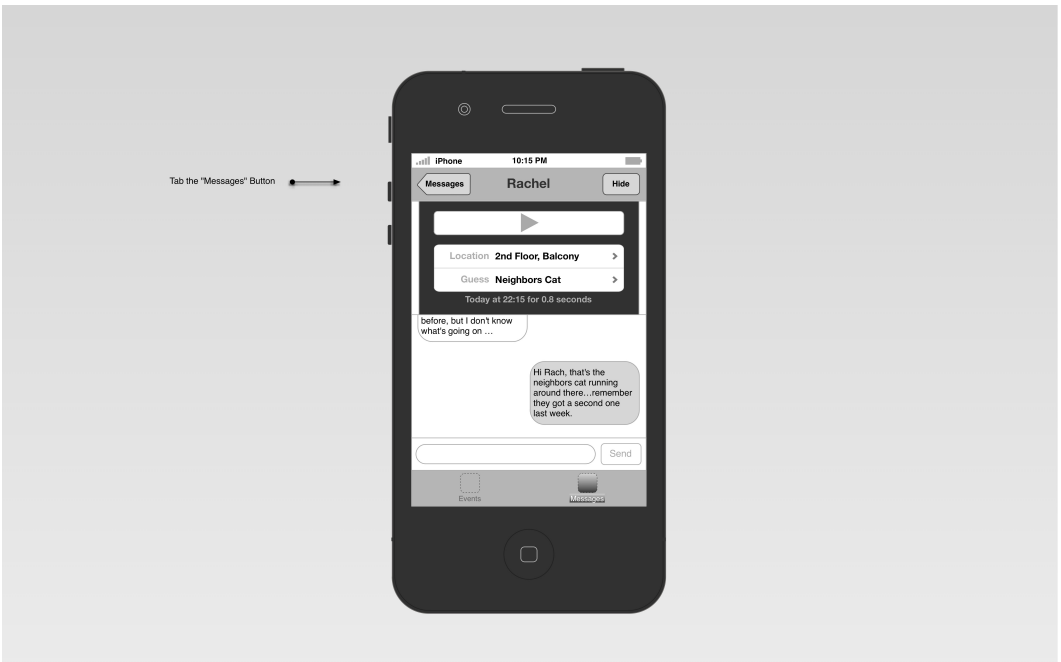


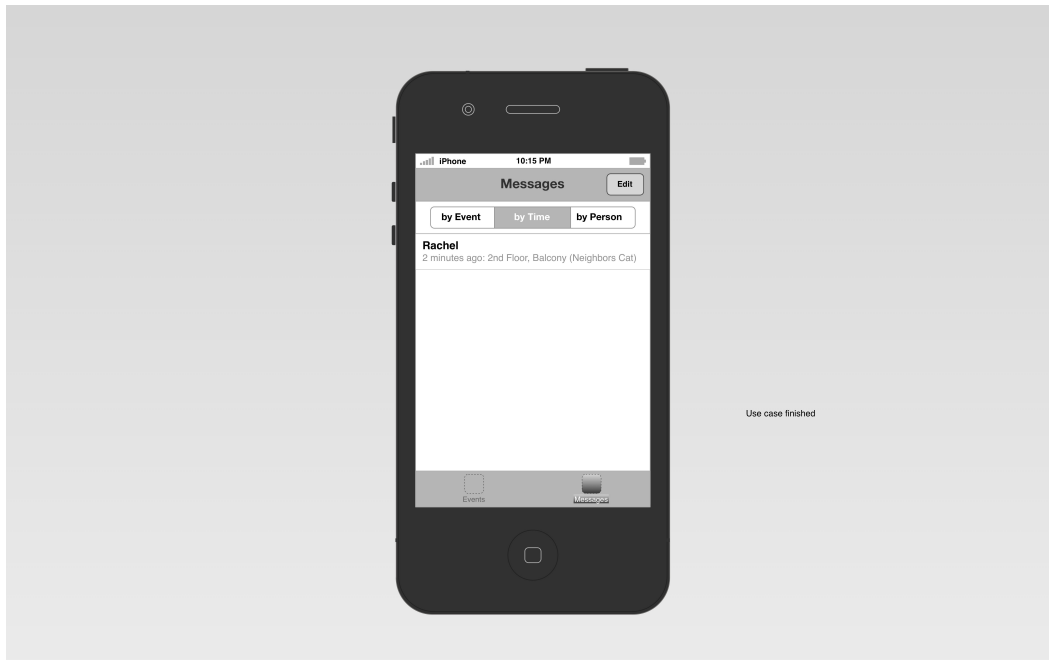






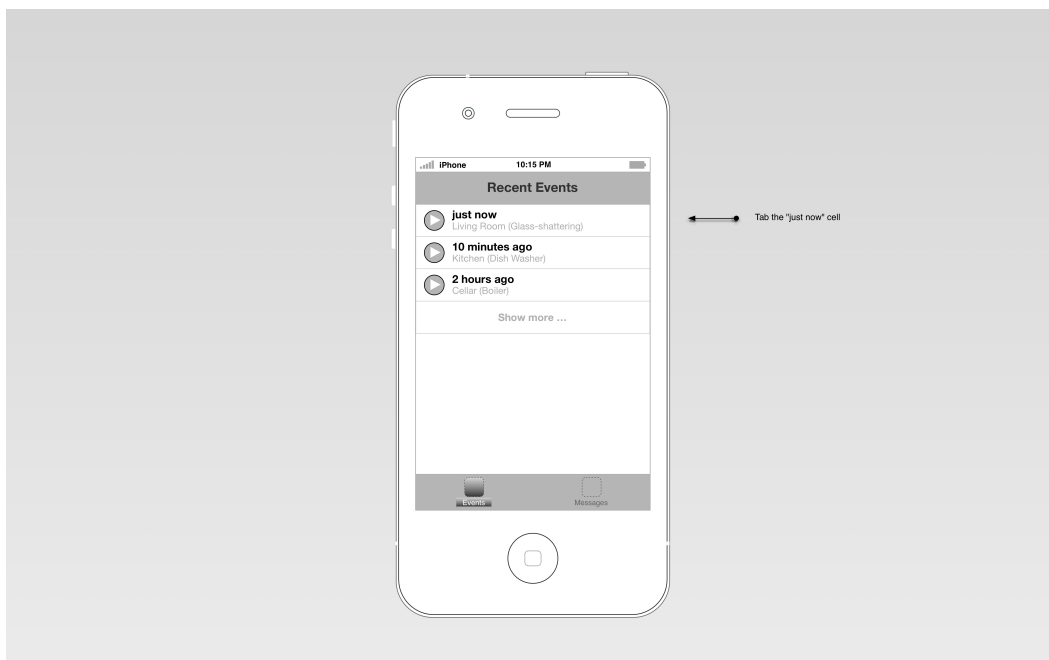


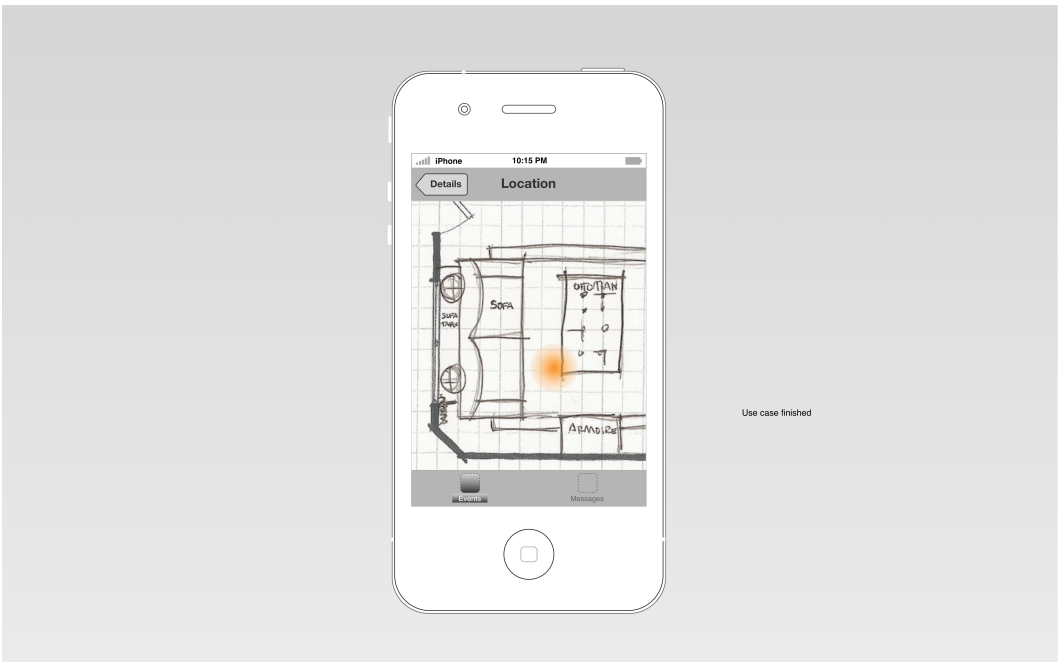
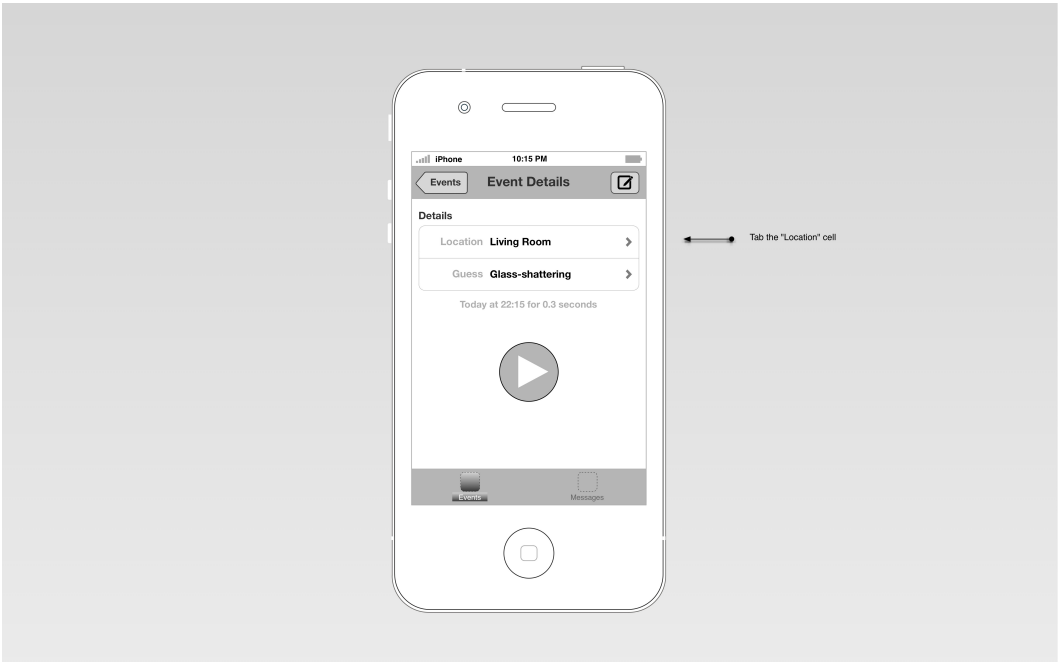




12.2 Screens for Scenario VII

Find the description for the scenario at Scenario VII: Make checking easier (section 7.1).





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