



**"Improving the Understanding of 'Smart Home'
Information Using Temporal Metaphors"**

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Abstract

This thesis focuses on temporal metaphors for smart home information visualization, whereas traditional smart home interfaces often make use of spatial metaphors like floor plans to visualize smart home information. With home automation becoming increasingly widespread the affected audience is becoming broader as well. Research has shown that a lot of smart home inhabitants – especially persons without technical background – experience several barriers to understanding and satisfaction.

In order to provide more understandable interfaces and thus improving user acceptance and satisfaction, two paper prototypes were created. These were evaluated in an iterative design process that led to an interactive prototype that can be accessed through a web browser.

Usage of temporal metaphors for display of smart home information can open new perspectives, not just for users without technical background. Temporal metaphor based interfaces can provide a high-level overview to a complicated system hiding much of the involved complexity.

Zusammenfassung

Die vorliegende Arbeit konzentriert sich auf die Benützung von zeitbezogenen Metaphern zur Visualisierung von „smart home“ Informationen im Gegensatz zu traditionellen smart home Interfaces, die verfügbare Information oft in Form räumlicher Metaphern anzeigen. Durch die steigende Verbreitung von Häusern und Wohnungen mit integrierten Hausautomationssystemen wird die dadurch beeinflusste Gruppe von Personen wesentlich breiter. Untersuchungen zufolge bestehen vor allem für Personen ohne technischen Hintergrund gewisse Probleme bezüglich des Verständnisses der dargebotenen Information, die eine befriedigende Bedienung behindern.

Um einfacher verständliche Interfaces bereitzustellen, wurden zwei Papier Prototypen erstellt mit dem Ziel die Akzeptanz und Zufriedenheit der Benutzer zu verbessern. Diese Prototypen wurden dann in einem iterativen Prozess verbessert, der letzten Endes zu einem interaktiven Prototyp geführt hat.

Die Benützung zeitbezogener Metaphern kann neue Perspektiven für Nutzer eröffnen, da solche Interfaces, die die zugrundeliegende Komplexität ausblenden, einen simplen Überblick über ein kompliziertes System bieten können.

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1 Introduction

In today's emergence of technology reaching all dimensions of modern life, the spreading of ubiquitous devices does not stop at our working places. More and more people are willing to install networked building controls and automation functionalities in their homes.

1.1 Problem Description

Devices necessary for sophisticated means of smart home functionality are getting cheaper and technical limitations are diminished due to emerging of standards and advanced cooperation between multiple manufacturers and providers of smart home consultant services which influence the proliferation of smart homes. Unfortunately, comprehensibility for users without technical background gets often left behind in favor of technical concerns. As we know from studies with inhabitants of such homes, the main source of satisfaction is to be found rather in the social dimension than in technical means¹.

1.2 Motivation

Traditional smart home interfaces make use of ordered lists or spatial metaphors such as floor plans or room plans to visualize or offer access to available information and control. Those interfaces' main purpose is to provide control to certain devices of the smart home system and not to facilitate understanding of the system in a simple manner.

Exploring the usage of temporal metaphors for visualization of smart home information could open new perspectives to interaction with home automation systems, especially for users without technical background, referred as passive users². By improving their understanding of the relations between occurring actions and underlying causes the user experience could be improved.

Whereas spatial metaphors are limited to particular rooms or floors, temporal metaphors might offer a more high-level view of the state of the smart home. This could provide new insights not only passive users could profit from. In contrast to spatial metaphors for smart home interfaces, the practical use of temporal-metaphor-based smart home interfaces has not yet been investigated.

This thesis will offer an exploration of possible applications for temporal metaphor-based

¹ See [17, p. 9]

² See [12, p. 154]

smart home interfaces and point out the limitations of such devices.

Aim of the bachelor thesis on hand is to receive insight into improving the understanding of smart home information using temporal metaphors. Understanding of systems can be improved by making it easy to evaluate the current state of the system³. The primary starting point is to improve understanding through visibility (at a glance overview what the system has done, is doing or will do) and intelligibility (indicate reasons and triggers for actions performed or to be performed).

1.3 Structure

The structure chosen to achieve the objective described above is detailed in the following section.

Chapter 1 outlines the problem of making available technical information to non-technical experienced persons in an intelligible way and gives an overview of the thesis' structure. In chapter 2, specific literature concerning smart home challenges and benefits and information visualization is analyzed along with research regarding calendar usage in family environments. The following chapters are generally following the paradigms of iterative design illustrated in figure 1. After completion of an initial interface design, this design was evaluated and the located problems have been used to refine the prototype for the next evaluation cycle. This process started with simple wire drawings and by deciding on the most promising ideas, two first prototypes were created. Those prototypes were then undertaken an informal evaluation by a group of human computer interaction (HCI) experts. The gathered feedback provided input for the creation of the two paper prototypes being tested in user studies. Based on the evaluation results of the user study an interactive prototype based on HTML 5, JavaScript and jQuery is created and evaluated in a final step by a persona supported expert evaluation. The insights gained through the iterative design process are summarized and discussed in chapter 8, followed by a last part about prototype refinement and future work.

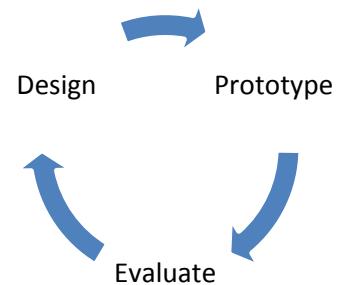


Figure 1:
Iterative Design Cycle

³ See [14], page 188.

2 Related Work

How users understand and interpret information provided by systems is one of the main concerns of today's research in the field of ubiquitous and pervasive computing. While several researchers mainly focus on general information interpretation, there are rather few that specifically target users of smart homes or users of ubiquitous and context-aware systems.

To understand the current research concerning the field of smart home environments, an extensive research on available devices and technologies was conducted.

The challenges faced when implementing a smart home system are versatile and reach from technical problems concerning interoperation of devices to providing holistic satisfaction for the users. The following literature served as background and in-depth information source for the thesis.

2.1 Smart-Home, Challenges, Benefits

A smart home is regarded to be a house or flat that is equipped with technology and intelligence to provide additional benefit to its users [16]. While the term "smart home" implicates that a home adapts to inhabitants, Brush et al. support the hypothesis that the current available technology is more closely described by the term "home automation" due to the existing disparate systems [5]. To support the deployment of such systems and advance related research they enunciated four significant challenges that represent barriers to broader adoption relying on long term experience of people living with home automation. These are high cost of ownership, inflexibility, poor manageability and difficulty achieving security [5]. The "seven challenges for ubiquitous computing at home" Edwards and Grinter described ten years before Brush et al. are even broader and focus on technical challenges like impromptu interoperability and reliability and social challenges such as the technology has to be adapted to domestic use and that the social implication of aware home technology needs to be taken care while minimizing the interference by wrong assumptions of the system due to the presence of ambiguity [7].

Other researchers focus on the ongoing evolution the field of smart home environment is undergoing by applying the principles of ubiquitous computing and relying on practical experience of persons living in smart homes. Koskela and Väänänen focused their research on three different user interfaces (PC, Media Terminal and Mobile Phone) for controlling the smart home and concluded that "no single UI or access technique fully

replaced the old (manual) access modes” [10]. Their findings constitute two main types of activity patterns that require different UI solutions, pattern control for predetermined and planned tasks and instant control for immediate control in a real-use context.

Concerning the motivation for inhabitants to bring smart technology into homes Mennicken and Huang describe several key factors which cover “Modern Homes Are Smart Homes”, “Hacking the Home Is a Hobby” and “Smart Homes Save Energy”⁴ while they also pragmatically focus on impacts on people’s lives [12]. Benefits for inhabitants realized by smart home technology are rather small conveniences which increase the comfort level rather than substantial support according to their study’s participants. Mennicken and Huang introduce the concept of different roles of inhabitants in smart homes based on research findings by Brush et al [5]. The group of people characterized by having a strong technical background and assuming primary responsibility for the technology are referred to as “home technology drivers” [12]. According to the naming of Brush et al., besides the so called gurus, there are other household members who assume primary responsibility for home automation technology without being interested in specific technical details. The third distinguished group represents most other members of the households and is referred to as “passive users” which implies they just have some familiarity with the systems and controls through use [12].

Challenges for all involved groups range from complex planning and need of high-level expert advice to the “Tension between Comfort and Control”⁵. The last mentioned challenge includes the inevitable impact on people’s lives especially if smart home installation and constant reconfiguration is considered to be a hobby for the home technology driver. For inhabitants who are not interested in the technology and process of the implementation of smart home functions there is a bigger potential impact. They think about the technology in terms of how it supports their routines and tasks, so the possible benefit is nonexistent if the installed technology does not work in terms of supporting a determined task [12].

Takayama et al. also focus on people already living with their own systems in their own homes and depict possible satisfaction and meaning achieved by home automation [17]. Having peace of mind, optimize, experiment, entertain and impress others and personalize the home were the main sources of satisfaction mentioned by their study’s

⁴ [12, pp. 150-151]

⁵ [12, p. 156]

participants. They also point out that connecting with the home and family is providing far more meaning than just having control over the home. Overall, “having a supportive partner seemed to be highly correlated with overall satisfaction with home automation projects”⁶.

The findings of Takayama et al. match closely with the findings of Brush et al., who concluded that the most satisfactory aspects of a smart home can be convenience, peace of mind and centralized control but emphasize the issue of the social dimension [5].

The technologies a smart home consists of are manifold and basically comprise sensing, actuation and networking devices which entail interoperability and administration problems [5].

Kim et al. address the interaction of smart home devices from a technical perspective. They illuminate aspects of different communication protocols and software architectures to finally propose a software architecture that seamlessly integrates heterogeneous protocols and diverse device types used in home networks by introduction of an abstraction layer based on a semantic domain model [9]. The proposed “smart home gateway” connects various devices and ensures enforcement of access control policies and makes it easier for users to install new devices.

2.2 Making information visible

A smart home system is by definition an invisible system that acts based on rules and user input which leads to the issue of proper visualization of system behavior and system state. This lack of visibility inhibits users from forming a correct mental model of the system and exacerbates the Gulf of Execution and the Gulf of Evaluation proposed by Norman [14].

Multiple authors dedicated their research to overcoming the problem of lack of proper visualization to improve user understanding. Vermeulen et al. proposed a system that “Makes the Invisible Computer Visible” mainly for debugging purposes due to its obtrusive design [19]. A follow-up work by Vermeulen et al. - “The Feedforward Torch” - addresses a similar aspect of visualizing how the system works, what and why it is doing and showing available user actions for bridging Norman’s Gulf of Execution, the gap between a user’s goals for action and the means for executing those goals. Therefore it improves intelligibility of the system by providing information on request, instead of being always-on

⁶ [17, p. 5]

and thus invasive [18]. The concept of providing the user with information about the system to enhance interaction was also investigated using “Why and Why Not Questions” by Vermeulen et al. They used a mobile device running their system “PervasiveCrystal” which allowed the user to pose a question to the system in order to learn why something happened or did not happen [20]. Their system has proven helpful for their experimental setup providing information to visitors of a museum but has yet to prove its value for more complex applications. Nevertheless it proves that providing the user with information about the system’s reasoning improves intelligibility of the system which corresponds with Bellotti et al.’s findings about context aware systems representing to their users what they know, how they know it, and what they are doing about it [3].

Knowing about the system’s inner reasoning and to what extend the system is reliable does improve the user’s trust in a system according to Antifakos et al. [1]. Because decisions made by sensing systems are always intrinsically tied to – in some situations incorrect – assumptions, incomplete and uncertain information, indicating system confidence improves the user’s trust in the context-aware system. This assumption was confirmed by their study because the users with information concerning system confidence tend to rely on the system more often which indicates an increase of the user’s trust in the system.

The availability of information about a system is the most important aspect of understanding the system’s behavior. The most common way to facilitate communication of system information to the user is done by providing a (graphical) user interface. Those interfaces should not only convey information how to use the system, but also provide the user with input for building a correct “mental model”, the mental representation of the way the system works that emerges from its use [14]. Rehmann et al. based their research on interfacing techniques on Norman’s paradigm mentioned above and claim visibility as the most important aspect of ubiquitous computing systems; when a system is staying out of the user’s sight it’s also staying out of the user’s mind. So a well-designed interactive system does make itself noticeable at some points to make the user aware of system behavior [15].

Bellotti and Edwards present a framework for designing context-aware systems that are both intelligible to their users and support the accountability of other users and the system itself [4]. Their principles for ensuring intelligibility and accountability in context-aware systems have proven useful to many research scientists and consist of rules that include providing feedback “Feedforward – What will happen if I do this?, Confirmation – What am I doing and what have I done?”, enforcing identity “Who is that, what are they doing and

what have they done?" and providing control to the user⁷. In their paper "Making Sense of Sensing Systems", Bellotti et al. take a further step to concretize their interaction paradigm [3]. The proposed five basic questions are "Address, Attention, Action, Alignment, and Accident" and include specific exposed challenges as well as examples for systems which did or did not overcome the stated problems and explained how to improve the human computer interaction.

Another approach to support context-aware intelligibility and control was taken by Dey and Newberger by exposing an API to the internal logic of a context-aware application to graphical user designers and developers allowing them to provide custom user interfaces [6]. As Bellotti and Edwards stated, the most important design principles for context-aware systems are informing the user of the system's understanding of the world and providing control to the user [4]. Dey and Newberger incorporated this concept by making context input from application logic available to interface designers allowing them to provide the user with contextual information [6].

A very specific example on how to deal with information visualization is provided by Mayer et al. who developed an augmented reality overlay on a mobile device to show the user network traffic between devices in smart homes [11]. Their proposed system makes use of techniques from the domains of network sniffing and augmented reality to make otherwise invisible information visible to the user in a form that can be understood without being a network administrator or computer scientist.

2.3 Calendar Research

A very comprehensive study concerning usage of calendars was conducted by Neustaedter et al. They include findings from studies of 44 different families' coordination routines in order to understand how to best design technology to support them [13]. The proposed guidelines for supporting families in their calendar routines by a digital family calendar are the following:

1. Public and Accessible: A digital family calendar should have a publicly available client in high traffic areas of the home that is always-on and accessible.
2. At-a-glance Awareness: A digital family calendar should provide at-a-glance

⁷ [4, p. 10]

awareness of activities and calendar changes for easy awareness acquisition.

3. Appropriate Information: A digital family calendar should support adding and viewing appropriate event information at different levels of detail.
4. Work Access: A digital family calendar should be accessible for viewing and editing family events while at work.
5. Mobile Access: A digital family calendar should provide a mobile interface for viewing and editing family events while not at home or work.
6. Multiple Home Locations: A digital family calendar should be accessible from multiple locations within the home where the information displayed may vary.⁸

Besides suggesting a wall-mounted large display in a high traffic area of the home for the family calendar, Neustaedter et al. propose digital family calendars should use pen-based or touch-based interaction, as this form of interaction is better suited for locations away from a desk [13]. A calendar should always provide at-a-glance awareness, so having the calendar publicly visible in the home is just one part; information within the calendar has to be discernable quickly.

Devices for displaying calendar information may vary in accessibility, screen size and other aspects, especially for smaller devices a solution needs to be found to display important information in context of the available vast amount of information. Bederson et al. propose a so called “Fisheye Calendar Interface” for PDAs that facilitates his visual representation for different configuration by “semantic zooming” [2]. These visualization techniques are appropriate when users need to see details of some specific items in the context of a large information space. Bederson et al.’s “DateLens” system offers the potential of having a single design that scales across device sizes and could therefore be applied to smart phone screen-size as well as to tablet or wall-mounted family calendar display size [2].

⁸ [13, pp. 36-40]

3 Early Design Ideas

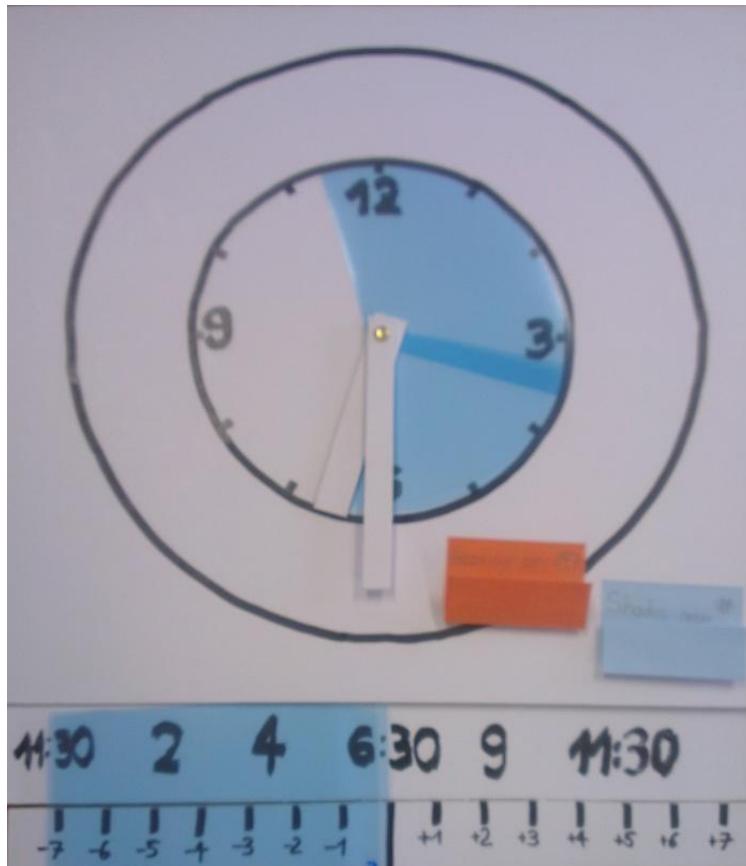
After exploring literature about smart home related topics, the first design ideas were carried out. The first drafts consisted only of drawings and brief explanations aside with it. Those first concepts were assessed and the best parts were incorporated into the two first prototypes: The “Clock Prototype” and the “Calendar Prototype”.

3.1 Design of the Two prototypes

To get a first impression of the prototypes, focus on design details and to sort out less promising design ideas, two preliminary prototypes were created.

3.1.1 The Clock Prototype

The first prototype consists of a standard analog clock that incorporates additional information in addition to showing the current time. Before creating the prototype shown below there were many more ideas on how to visualize the additional information, for example by adding a button in the center of the clock indicating the previous event with a letter M for manual, S for sensor-based or T for time-based event cause.



The calendar prototype is capable of visualizing events that already happened and events that will happen in the future. In order to distinguish the component showing past events from the component showing future events, a blue layer was introduced. The blue layer indicates the fraction of the clock that displays past events. To further clarify the time span available, a time bar is added underneath the clock which shows the past seven hours colored in blue.

Figure 2: Clock Prototype First Iteration

Separation of past and present

The time span available for displaying events is set to seven hours past and five hours future in the example seen before. Time span indicators in blue film were designed to be flexible to adjust to time spans from four up to eight hours by layering them on the clock and changing the plastic film covering the time bar.

In order to understand at which time the users would like to have what kind of information displayed, several scenarios were created. The mentioned scenarios go from wake-up time (having whole night displayed) to coming home from work at noon or afternoon (whole morning / whole day). However those can vary greatly from one household to the other and even from one family member to another. One of the most obvious disadvantages of the clock prototype is the limited time span of twelve hours that can be displayed.

By introducing scenarios the device could provide tailored information based on the situation the viewer is currently experiencing. After getting up, the user presumably wants to know about events happened while he was asleep, so the time span for past events could be increased, whereas after breakfast the user could wonder about events happening during his absence, during the morning or the whole day. In these cases the time span for past events could be reduced to make more room for future events. This concept of dynamic time spans based on viewing scenarios could be promising, but introduces a great deal of uncertainty because the device will act on the assumption of the scenarios exactly reflecting user behavior, which is, as we know, just possible to a certain extent.

3.1.2 The Calendar Prototype

Concerning the initial calendar prototype, the design guidelines were rather obvious; to facilitate user understanding the calendar structure needs to be based on established calendar metaphors so the framework was created similar to already existing calendars. The one day view was one of the two proposed views for the calendar prototype and would provide information about the smart home as well as the inhabitants on one page. The week-view would be specific to the smart home or a particular person in the household. Displayed time spans hence range from 24 hours to a whole week which is by far the biggest difference between clock and calendar prototype.

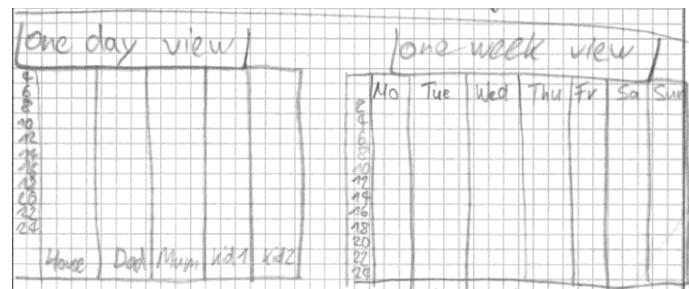


Figure 3: Wireframe of One-Day & Week View

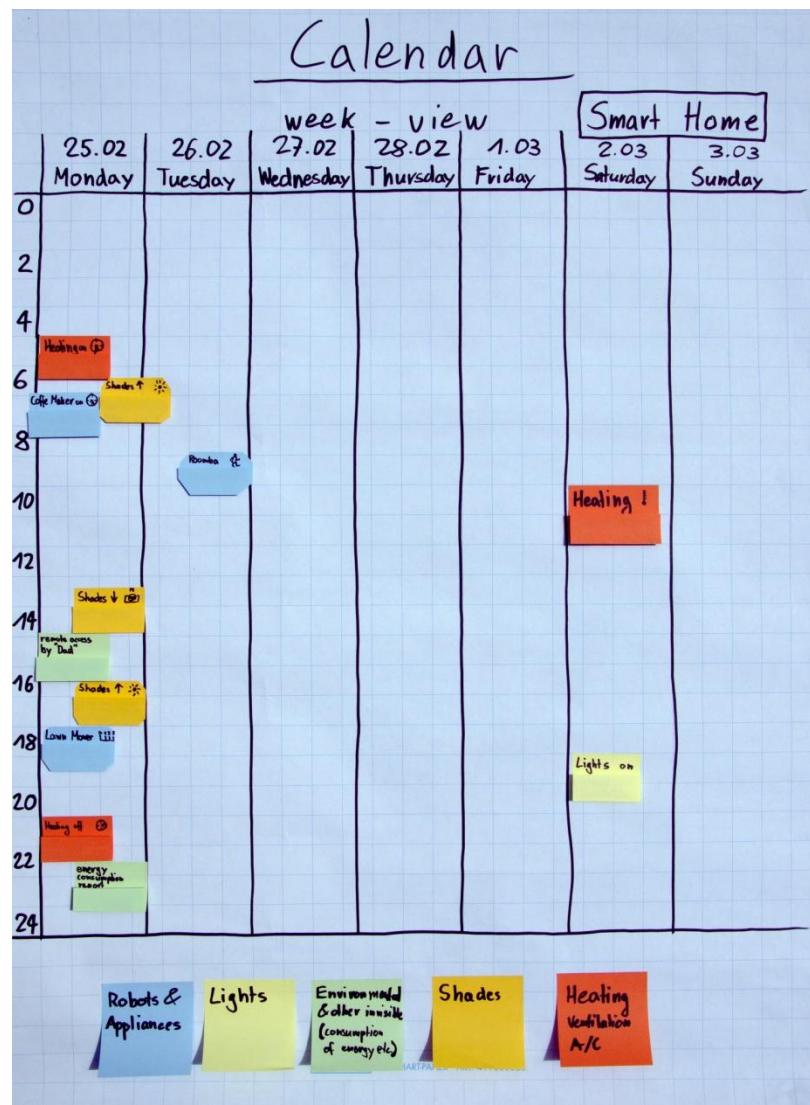


Figure 4: Calendar Prototype First Iteration

3.2 Event Classification

The events displayed on the two prototypes were identical in terms of content and representation. In order to facilitate recognition of different event types, a possible taxonomy of smart home events was created. The high-level breakdown is parted among actors / devices and sensors. Those two main categories are then further subdivided. The following list is a summary of the full taxonomy that can be found in appendix A on page 46.

- Actors / Devices
 - Invisible or imperceptible
 - For example heating
 - Visible or Perceivable
 - (Smart) Appliances
 - Robots
 - For example Roomba
 - Other Appliances
 - Lights
 - Shades
- Sensors
 - Environmental Sensors
 - For example brightness or humidity sensors
 - “Inhabitant-Triggered” Sensors
 - For example motion detectors or buttons
 - Security Sensors
 - For example magnet-contact sensors
 - Monitoring Sensors
 - For example electric consumption

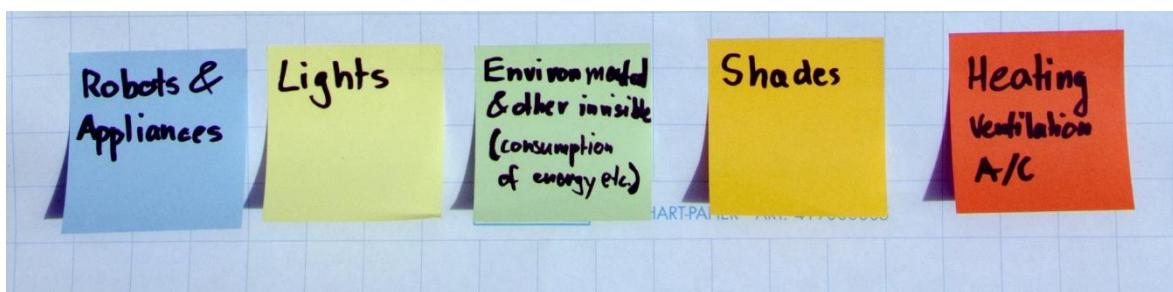


Figure 5: Functions Grouped by Color

The displayed events were then categorized into five groups represented by the five colors shown in figure 5. Further distinction of the events was made by cropping the edges of

rectangles which represent estimation-based automated actions, whereas explicitly triggered (by user) and non-recurring timed actions remained in their square form.

The selection of events – should an event be displayed on the prototype or not – was another important topic to discuss during the Lab Meeting. The tradeoff between providing the user with information beneficial to the user's understanding and overwhelming the user by cluttering the view is very important to be considered as soon as possible. Possible mitigation could include the possibility to customize certain types of events.

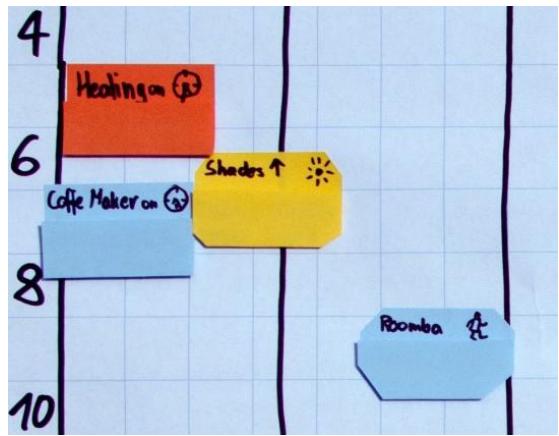


Figure 6: Smart Home Events

3.3 Informal Evaluation

In order to obtain feedback about the current prototypes and inform the Human-Computer-Interaction research team about the status of the prototyping work, a presentation was held at a weekly Lab-Meeting. After providing information about the general goals of the thesis and showing the prototypes to the members of the ZPAC Lab, they were encouraged to give feedback about the design of the prototypes and the proposed visualization.

The aspect of whether or not to show certain events was an intensive discussion; one user might be interested in details about his heating's actions, while the other just wants to be informed in case of malfunction or abnormal behavior. Also the classification of events that are flagged “visible” could be unclear when the effect of the action is only visible in the very moment the action is performed and afterwards invisible again. Another example could be the question if a user really wants to know why his shades are “back to normal” after a singular event. Because events are not displayed different, the distinction whether an action is visible or not, matters just for a continuative improvement. Concerning the selection of events, the most straight-forward solution to overcome this problem is to give the user the possibility to customize, which events he would like to have displayed on his smart home calendar.

Substantial design decisions were made from these discussions and immediately incorporated in the design of the prototypes to be evaluated by user study. The gathered input and decisions based on that discussions are described more thoroughly in the next chapter.

3.4 Design Implications for Paper Prototypes

Pictograms instead of multiple colors: The accumulated feedback from the informal evaluation led to certain minor improvements in the design of the calendar prototype and a complete redevelopment of the displaying of events. It was decided after due consideration not to visually distinguish the events by the color-grouped categories previously mentioned. Instead of previously having five colors that represent smart home events, there is now only one color for smart home events. Along with this improvement, the scheme of displaying events was changed as well. Instead of providing text and pictograms; it was decided to use pictograms only. One pictogram for the underlying cause of the event, an arrow to symbolize the causality and a second pictogram for the triggered action the smart home fulfills. Further explanation can be accessed by opening the post-it note which makes a written explication available.

The turning away from using multiple colors for events of different smart home categories has two major advantages: Understanding of these color distinctions would certainly not be self-explanatory, because there is no natural mapping available for the following example: “color blue implies Appliances and Robots”. Another major advantage of using the same color for all smart home events is having the other colors available for different information, for example calendars of individuals. On the other hand using one color constitutes this particular color as the “smart home color” which would be comprehensible to the users.

Aside from the event structure, there were a few other minor improvements; for example adapting the prototype dimension to a more convenient size for the following user studies. A flip-chart paper is of particular usefulness for presenting to a group of persons but a smaller prototype can be imagined easier to actually take place in the home of a participant.

4 Paper Prototypes

The created paper prototypes for the following user studies are described in this chapter. Besides the design of the prototypes, the aspect of event classification and event display is alluded to as well.

4.1 Design of the Two Prototypes

4.1.1 The Clock Prototype

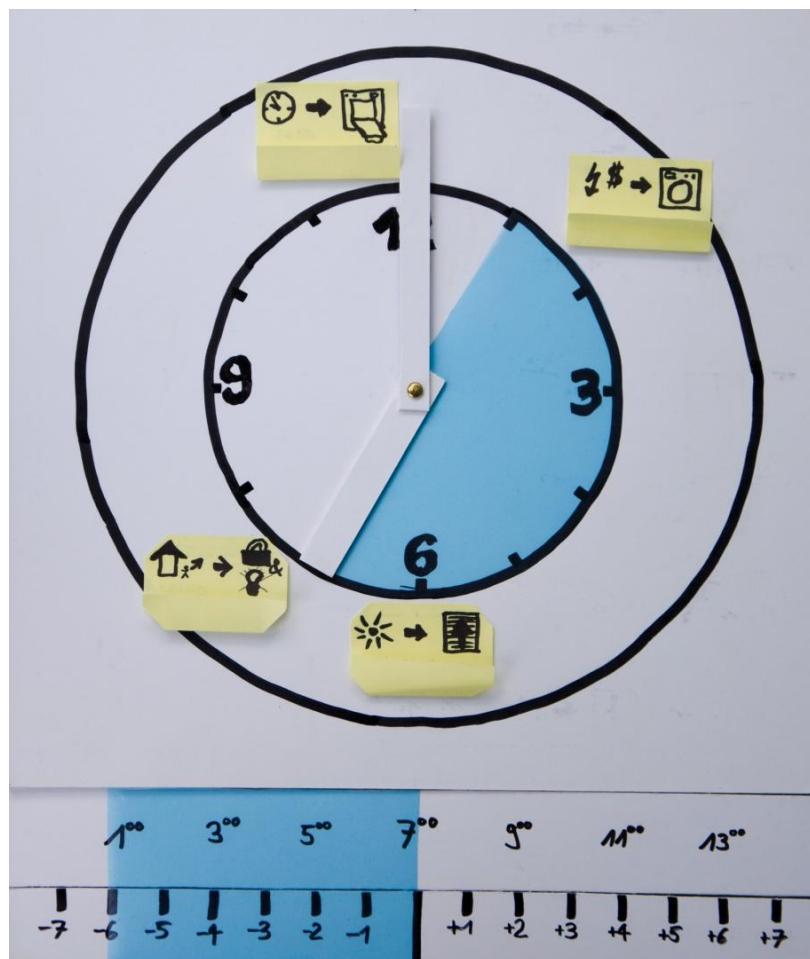


Figure 7: Clock Prototype for User Study

After taking the feedback from the informal evaluation into account, several alterations were made to improve the clock prototype before starting the user studies. The main modification consisted of introducing a fixed time span of six hours for the separation between past and future to make the interface more understandable for first-time users. The display of events is adjusted to the guidelines mentioned in the previous chapter.

4.1.2 The Calendar Prototype

The calendar prototype was further improved to reflect the feedback gathered during the preceding evaluation. It was decided to provide a one-day view as an entry point to the calendar and the week-view was not further developed in this phase, because the lessons learned from the one-day view are applicable for the other view as well. The design itself has – apart from being a little cleaner and tidier – not changed much, but the material was changed from paper to cardboard to ensure structural stability for the user studies.

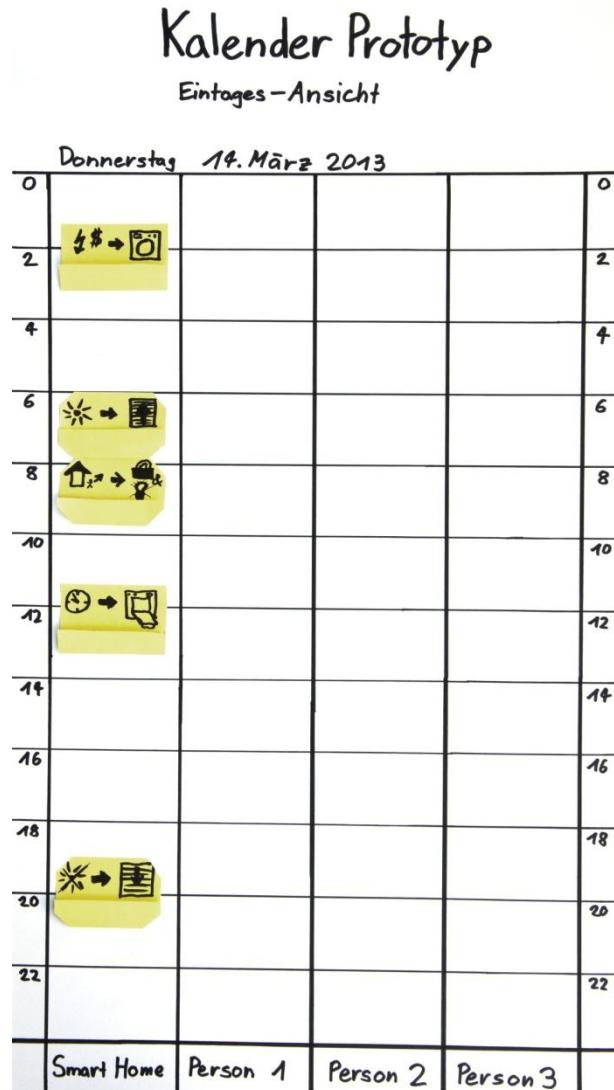


Figure 8: Calendar Prototype for User Study

4.2 Revised event classification

The revised event visualization described in the last chapter “Design Implications” were incorporated into the prototypes; only one color is used for smart home events and the events are distinguished by adjusting the shape of the event. Manually triggered events and events that are explicitly timed or require user focus are displayed in rectangular shape, whereas the shape of events that result from preprogrammed rules and sensor input is octagonal (the edges of the rectangular are cut off).

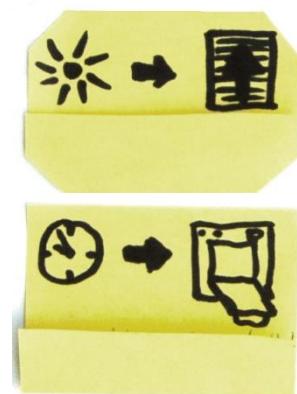


Figure 9: Event Shapes

5 User Studies

To test the suitability of the Paper-Prototypes relating to the improvement of intelligibility and understanding for users, there were six interviews conducted. Other goals to achieve were collecting indications for the following improvement towards the interactive prototype and gaining a reliable information basis to decide in favor of one of the tested prototypes

5.1 Personal Information about the Interviewees

The interviews were conducted with persons aged between 22 and 57 years, whereas four of the interviewees live in a house as a parent. One interviewed person lives at her parental home and one person lives in a flat with his girlfriend. Further details are depicted in the table below. Participants are referred to by their reference name.

Reference Name	Age	Living Situation	Profession
P1	51	House with family (16, 22, 23)	Primary school teacher
P2	22	House with family (16, 23, 51)	Trainee at major bank
P3	56	House with family (56, 23, 25)	Physical education teacher and kindergarten teacher
P4	56	House with family (56, 23, 25)	Education manager at sports association
P5	57	House with family (52, 23)	Police constable
P6	29	Flat tenant with girlfriend (29)	Service technician

Table 1: User Study Participants

None of the interviewed persons have extensive knowledge about smart-homes; their prior knowledge was limited to media coverage in the last few years and covered neither personal experience nor explicit technical knowledge.

5.2 Presented Prototypes

In the course of the first three interviews, there were two prototypes presented; the Clock-Prototype and the Calendar-Prototype. After three interviews a strong preference for the Calendar-Prototype emerged, so the Clock-Prototype was discontinued in favor of the Calendar-Prototype which was slightly improved to reflect the gathered feedback.

5.3 Setting of the User-Studies

The interviews were conducted in person by the interviewer; either at the interviewee's home or at the interviewer's home. All participants agreed to be videotaped to support the interviewer at transcribing the interview and to ensure no important details were accidentally omitted.



Figure 10: Still Image of recorded Video during an Interview

5.4 Feedback about the Clock-Prototype

The Clock-Prototype was regarded as convenient source of information about currently happening actions of the smart-home and as reminder for resulting daily routines. Unfortunately the participants needed substantial explanation to understand the functionality of the prototype because of the unfamiliar application of the Clock-Prototype.

The proposed separation between past/future of six hours was criticized by P2 and P3 of the three participants who were evaluating the clock prototype. They also regarded the obvious limitation to 12 hours as a problem. The participants proposed several solutions to overcome those problems for example having two clocks for the whole day (by P2) or to have a flexible time-frame (either backwards or forward) that can be adjusted according to current needs as P3 mentioned. Realization of those ideas could render the Clock-Prototype even more complex and constrict the familiarization

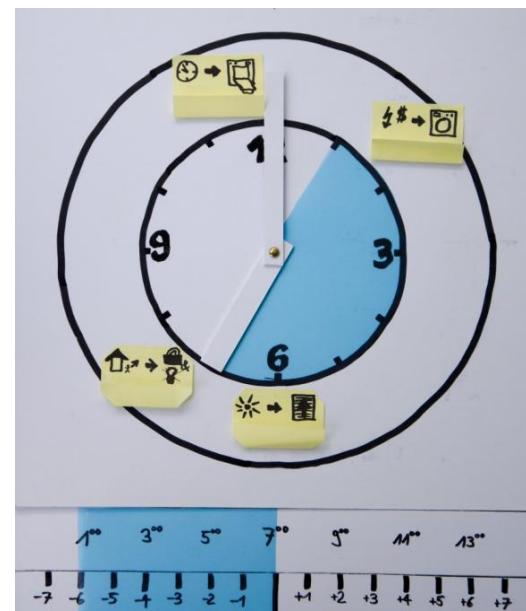


Figure 11: Clock Prototype for User Study

of the Clock-Prototype.

Separation between Past and Future

The concept of indicating the time-span of currently displayed past events by means of a time-bar seemed to bewilder the participants as it introduces more complexity to the design of the prototype and the information is merely redundant. Also the concept of separating between past and future events seemed to confuse, because all three out of three participants (P1, P2 and P3) recognized the blue layer as the “night mode” of the smart home system. This particular problem could be a result of badly chosen scenario to start the interview with. Because the scenario is tailored for the situation in the morning after getting out of bed, the past part is indeed apparently during the night. A possible solution to overcome this problem could be to use two different shades of the same color to distinguish between past and future events. The example above is picturing a scenario at 2 pm where the future part reaches till 8 pm and goes back to 8 am.

Even with this visualization problem sorted out, the Clock Prototype is very limited in its purpose and potential to improve the user's understanding of information about the smart home. Based on the feedback from the first three participants of the user study, the Clock-Prototype was discontinued in favor of the Calendar-Prototype.

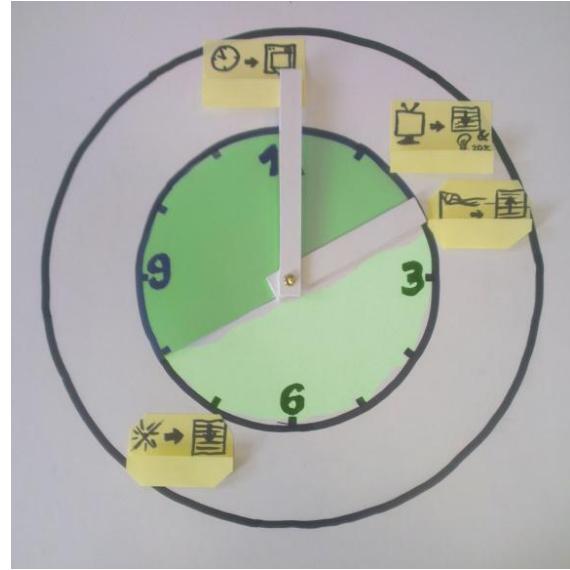


Figure 12: Possible Solution for Past-Future Separation

5.5 Feedback about the Calendar-Prototype

The Calendar-Prototype was considered to be more intuitive to understand compared to the Clock-Prototype because “everyone is familiar with the calendar as being a metaphor for time-planning” as P3 explicitly mentioned.

There can be more events represented on the calendar, without the view getting cluttered or confusing. By providing a clear indicator of the current time, which was incorporated by adding a red line, at-a-glance view of the current situation could be established.

Participants who were asked to give feedback about both prototypes especially mentioned the possibility of having the whole day available as an advantage in favor of the Clock-Prototype. Other advantages pointed out were the more accurate representation of the start-time of a certain event and that there is simply more space available which was specifically mentioned by P1.

All participants mentioned that they could benefit from such a calendar because it would support their daily routines.

5.5.1 Purpose of the Calendar-Prototype

The participants were asked to think about possible applications they could imagine the Calendar-Prototype to be useful for. There were diverse possible uses mentioned. Ranging from simply “knowing what the house does” by P2, to having peace of mind and not anymore having to remember the actions incorporated in the Calendar-Prototype, as P6 mentioned: “I don’t have to think about everything.”

P4 indicated his favorite use as: “With the proposed prototype there is no need for explicit

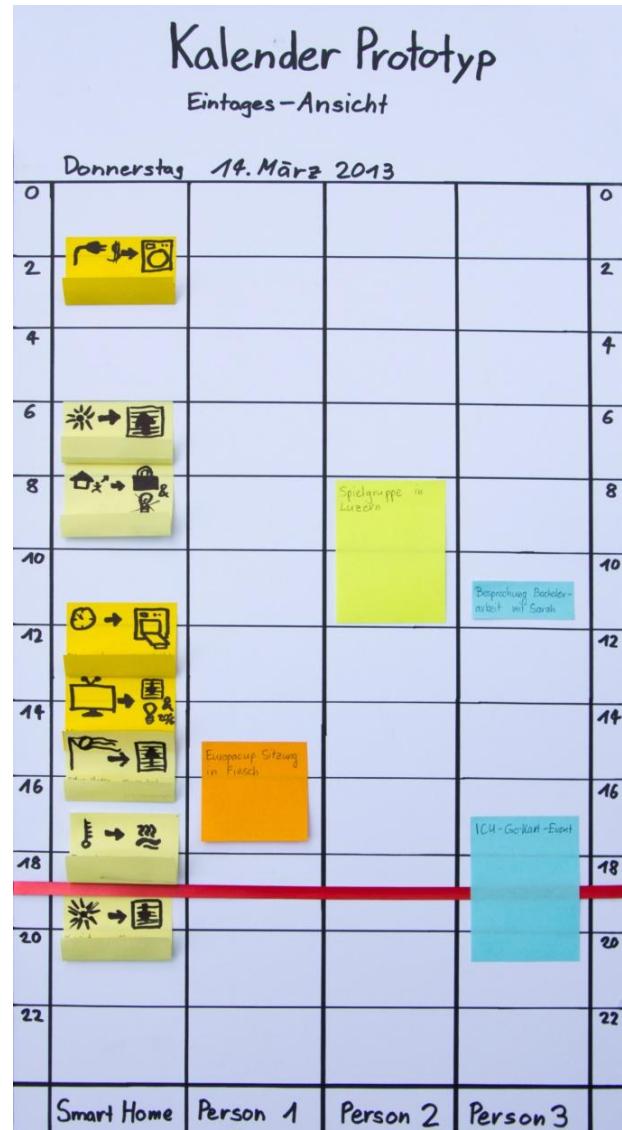


Figure 13: Improved Calendar Prototype after the first three Interviews

attention for automated things, but it could be checked if something is unclear."

Possible applications also included the personal calendars available on the Calendar-Prototype, for example P4 brought up the idea of planning lunch the day before. One could easily see if the other household members are at home according to their calendar. This particular use of the calendar presupposes the household members maintaining their personal calendars, because otherwise the presented information could be misleading.

5.5.2 Downsides of the Calendar-Prototype

Participant number two (P2) mentioned a privacy issue with displaying certain information; the prototype shows switching on the TV as a cause that triggers an action of the shades and light which can afterwards be seen by everyone on the Calendar-Prototype. The participant does not want the other household members to know if and when the TV was turned on.

Other possible problems mentioned by P4 and P5 were reliability and dependence on power. A loss of power would make it impossible to interact with the appliances and devices; so one participant proposed there being a manual override at each of the interacting devices.

5.5.3 Concerning the Placement of the Device

All participants favored a place where one usually is located at home; kitchen, living-room or corridor. They imagined the prototype to consist of a wall-mounted touch-enabled tablet which possibly could be picked up and used on the couch as well.

P2 and P5 also mentioned that they would like to be able to access the interface from their smart phones when they are outside of the house. Aware of five of six interviewed persons possessing a smart phone (3 Android, 1 iPhone, 1 Windows Phone 7); this could be a good opportunity to make the information available on as many devices as possible. The interface should differ as little as possible to ensure a consistent experience among the different devices.

5.6 Planned Improvements based on Feedback

Multiple participants would welcome a week-view or at least the possibility to switch several days back and forth to consult the calendar. P4 even mentioned that if there was just a one-day view of the present day the possible use he could imagine would be constricted because one important application – checking if other household members are at home

for lunch / dinner – would be impossible. The interactive prototype will have this function incorporated to give the users the possibility to adjust the displayed time-span but initially showing the one-day view.

Other promising ideas were for example a dashboard that displays alerts about appliances and systems that have problems or have some kind of material shortage. For example P1 and P5 mentioned they would like to be informed about the oil-level in their oil-tank for the heating before reaching a critical level. The same could be imagined for other applications. P5 mentioned his car, which instantly informs him about problems.

P4 explicitly mentioned that the main functions of the prototype have to be completely self-explanatory to be useful for him, as he is only willing to consult a manual or help for very special functions.

5.7 Visual Representation of the Events

5.7.1 Improvements after the first three Interviews

Before starting the first interviews, the preliminary prototype was shown to the members of the ZPAC Lab who could point out certain aspects of the prototype and give feedback about structure and content presentation. Based on that feedback the first idea of breaking down the displayed events of the smart-home into a variety of colors was dropped in favor of a much simpler scheme. The displayed events were just grouped by the underlying cause of the event; either explicitly triggered by a user or by a permanent rule. The visual distinction of those categories was then built into the prototype using different shapes for the events. The color used for displaying the events was the same, but after the three first interviews this idea did not carry out to be of much success because the different shapes were neither recognized nor understood by the participants.



Figure 14: Event Colors

The major improvement in the last three interviews, compared to the three first interviews was the replacement of the shapes as distinction for the two types of event-causes by two intensities of the same color (brighter / darker yellow). This representation turned out to be more understandable as P5 and P6 explicitly mentioned the intended breakdown-

structure. Their understanding was mainly based on intuitive distinction of the implications for users of the system. Darker yellow was considered to be for events that directly influence users, or as mentioned by P 5, involving interaction with a household appliance. Brighter yellow was associated with tasks the smart home system is doing with little or even without any user interaction. So the visual representation of the smart-home events displayed could be improved relying on user feedback.

5.7.2 Pictograms and Explanation

One property of the visual representation has remained unchanged since the first user-study – the display of smart-home events by two pictograms that represent the cause and resulting action and the possibility to make additional information available in a written form. All participants liked the preliminary presentation of the events just by pictograms because they are easy to understand and don't clutter the view. If a certain event is not understood at first sight, the additional information can be displayed. P2 explicitly mentioned that the pictograms raise interest in the events, whereas letters or digits would make it harder to understand.

This part of the Calendar-Prototype design will be incorporated in the final interactive prototype as similar as possible because the separation of pictograms and explanatory text has proven to be reliable based on all conducted interviews.

5.8 General Feedback

Along with specific questions about the prototypes the participants were asked about their calendar routines and their usage of appliances in their domicile.

Some participants mentioned that it is quite difficult to answer to such open questions and to talk about rather apparent details of the prototype such as the tabular form or the obvious colors of events.

5.8.1 Feedback about Calendar Routines

The questions about the participants' regular calendar routines raised various habits among the interviewed persons. There was only one participant who did not use any form of digital calendar. The other five persons all used their smart phones along with other calendars for business use or as kind of to-do-lists. Non-digital calendars were mainly used as shared calendars for mutual invitations to dinners and other activities or as long-term planning instruments.

Because of the possibility to set reminders for digital calendars which alert the affected persons through their smart phone, digital calendars are often used to store events that otherwise could be forgotten easily.

Another interesting point was that every interviewed person has at least two calendars they use on a regular basis. The main calendar was managed on the smart phone by five participants, so this calendar would be the easiest and most helpful to integrate to the calendar prototype. Because the participants mentioned to have the second calendar just for specific tasks, it would not make sense to include this particular calendar into the interface as well.

5.8.2 Usage of Appliances at Home

Participants mentioned a wide range from computers, tablets and smart phones to more traditional household appliances like oven, dishwasher and washing machine but also mentioned automatic garage doors and boilers. Those appliances support the daily life and have become important to the interviewees because they are simple to use and allow focusing on more important tasks in their daily routines.

6 Casalendar – Implementation of an Interactive Prototype

Based on the previously described user studies the conceptual design of the interactive prototype was started. The modeled functionality of the paper prototype will be incorporated in the interactive prototype, because the simulated interaction between the paper prototype and the users was confirmed to be working as designed. Minor design alterations will be made to improve clarity based on findings from the previous iteration.

6.1 Component Structure Draft

In order to create a system architecture draft, the components of the system were modeled in an interaction diagram which was refined later based on implementation details. The general structure is a traditional model-view-controller breakdown structure with the user interface being a browser page and embedded scripting functions communicating with the calendar server which provides the calendar content.

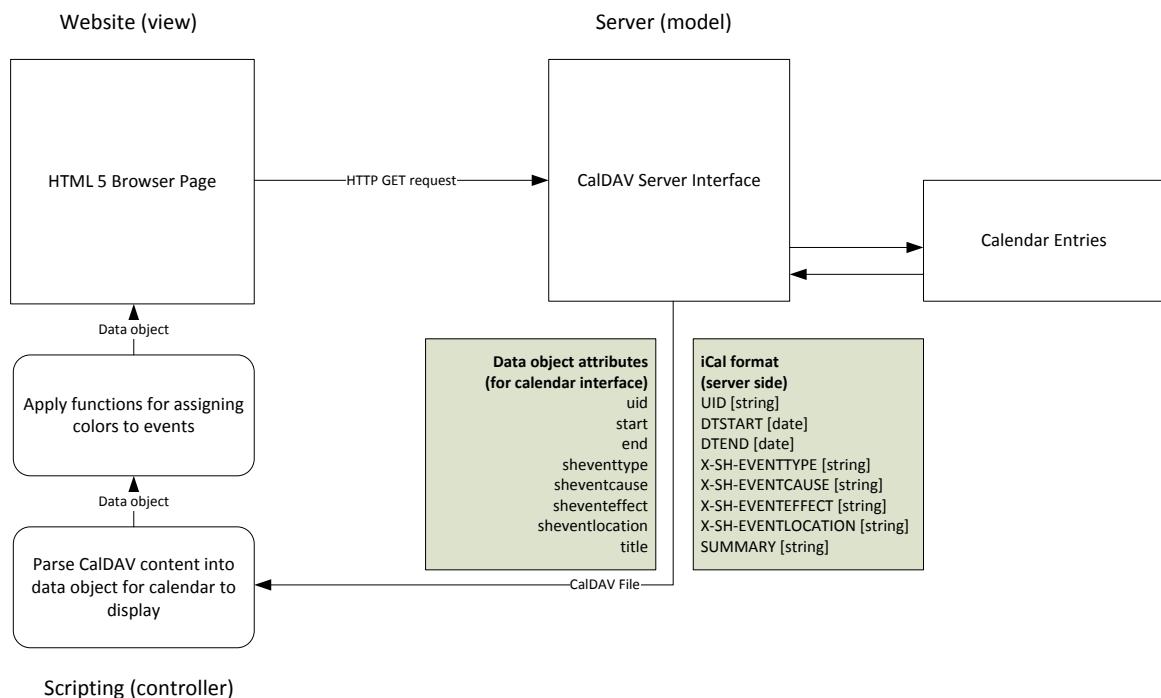


Figure 15: Component Structure Draft

The main component of the Casalendar system is the HTML 5 webpage representing the view for the user. This webpage consists of a general page structure and calendar events, the scripting part of the view, which serves as controller for user input and initiates the communication between view and data server and finally the calendar data server itself, which stores the calendar information.

6.2 Tools used for Development

Due to the possibility of running JavaScript and jQuery based web pages locally in any browser instead of having to compile the source code to an executable file, a simple text editor⁹ with syntax highlighting could be used to develop and edit the necessary program code. Either Firebug for Firefox¹⁰ or the built-in developer tools of the Chrome browser¹¹ were used to debug the written code. For implementing a proper version control system and code control system, GitHub¹² and the GitHub for Windows application were used. Apart from those code-centric tools the open source svg editor Inkscape¹³ was used to create or modify certain svg graphics.

6.3 Frameworks and Libraries

User interface design is mainly based on the jquery-week-calendar framework¹⁴, because it suits the design requirements for the task of presenting calendar entries to the user and takes responsibility for handling of date-related issues like splitting weeks up in the correct manner. This calendar plugin is based on jQuery and jQuery-UI for functionality and design purposes and relies on date.js, an open source JavaScript date library for date functionality¹⁵. Another library used in the Casalendar Prototype is JavaScript-Ical-Parser, which was used to gain insight into parsing iCal data and was rewritten in most parts for the purpose of this implementation¹⁶. To make the calendar interface able to react to multi-touch events, the hammer.js framework was included¹⁷.

6.4 Data Structure

The representation of the calendar event data is being done in two ways. On one hand the calendar data is in a form the calendar interface of jquery-week-calendar can work with and on the other hand the calendar data is formatted according to the CalDAV format described in RFC 4791¹⁸.

⁹ <http://notepad-plus-plus.org>

¹⁰ <https://getfirebug.com/>

¹¹ <https://developers.google.com/chrome-developer-tools/>

¹² <http://github.com>

¹³ <http://inkscape.org/>

¹⁴ <https://github.com/robmonie/jquery-week-calendar>

¹⁵ <http://www.datejs.com/>

¹⁶ <https://github.com/thybag/JavaScript-Ical-Parser>

¹⁷ <https://github.com/EightMedia/hammer.js>

¹⁸ Calendaring Extensions to WebDAV (CalDAV) <http://tools.ietf.org/html/rfc4791>

6.4.1 Data Structure for Calendar Interface

The data structure for saving event data is chosen according to the calendar framework. All calendar events are saved in a data object that contains an array of events which have certain properties. The properties of a certain event to be displayed in the calendar interface are the following.

<i>id</i>	unique identifier of the event
<i>uid</i>	user id in written form
<i>userID</i>	user id as a number matching the user array of the interface
<i>start</i>	start date and time in JavaScript date notation
<i>end</i>	end date and time in JavaScript date notation
<i>sheventcolor</i>	color of the event, either based on user, eventtype, eventcause or eventeffect ¹⁹

Table 2: Mandatory Event Properties

Whereas event properties in the table above are mandatory for every calendar event to be displayed, for smart home events there are additional properties depicted in the table below. The following properties only apply to smart home events. In the following part of the thesis, the acronym sh stands for smart home.

<i>sheventtype</i>	the high-level category the smart home event belongs to
<i>sheventcause</i>	trigger for smart home event
<i>sheventeffect</i>	action performed by the smart home
<i>sheventlocation</i>	(location of the smart home event

Table 3: Event Properties applicable to Smart Home Events

Having an event type value for each event is beneficial for the implementation because the assignment of colors to events can be parameterized in the iCal parser. Also the calendar interface could in a further step allow the user to apply filters to just display certain event types. A high level allocation to one of the eleven groups can be performed by adapting an already established classification from Hamernik et al. (Hamernik, Tanuska, & Mudroncik, 2012). The event categories can be found in appendix C on page 57, along with possible and implemented values of the previously mentioned eventcause and eventeffect attributes.

¹⁹ A complete list of the eventtypes, eventcauses and eventeffects is attached in appendix C

6.4.2 Data Structure according to CalDAV Specification

To ensure compatibility of the prototype with multiple servers, an implementation of the CalDAV standard was chosen as means to transport calendar entries. So the Casalendar smart home calendar is able to use any calendar server that implements the CalDAV specification²⁰.

```
BEGIN:VCALENDAR
BEGIN:VEVENT
UID:alice
DTSTART:20130507T150000Z
DTEND:20130507T170000Z
SUMMARY:testevent for alice
END:VEVENT
END:VCALENDAR
```

Code Example 1:
Event Structure for Personal Events

The CalDAV specification defines the structure of calendar object resources with certain key words separated by a colon. A basic structure as described in RFC 4791 can be found in Code Example 1 above. Besides the standard attributes listed in Code Example 1, the specification allows the use of “Non-Standard Components, Properties, and Parameters” according to section 5.3.3 of the RFC4791.

```
BEGIN:VCALENDAR
BEGIN:VEVENT
UID:smart-home
DTSTART:20130507T200000Z
DTEND:20130507T220000Z
SUMMARY: Shades close because it's getting dark
X-SH-EVENTTYPE:Shading
X-SH-EVENTCAUSE:Brightness
X-SH-EVENTEFFECT:ShadesDown
X-SH-EVENTLOCATION:Bedroom
END:VEVENT
END:VCALENDAR
```

Code Example 2:
Event Structure for Smart Home Events

Those non-standard parameters are used to store additional information for smart home events. While the exact name of the components can be arbitrary, all non standard components need to contain the prefix “X-“. The Code Example 2 includes a set of possible attribute values a smart home event could consist of.

²⁰ Calendaring Extensions to WebDAV (CalDAV) <http://tools.ietf.org/html/rfc4791>

6.5 Implementation Process

After evaluating various calendar frameworks and considering writing a new one from scratch, the following step included having a closer look at the jquery-week-calendar framework. This particular framework was developed by “robmonie”²¹ and released under the MIT license²² which allows the code to be copied, modified and distributed as long as the original copyright notice is included in all copies. After reading through the short documentation the source code itself was skimmed through. In consideration of the fact that the main JavaScript file contains over three thousand lines of code and the call hierarchy is rather complex, it took some time to get familiar with the framework’s operation.

6.5.1 Event Display

First changes to the framework included the way events are displayed on the calendar. The function to render events was changed to allow treating smart home events differently than personal events. Then the possibility to make additional information for smart homes available was added by providing a movable element that contains the description and is opened when the event pictograms are clicked.

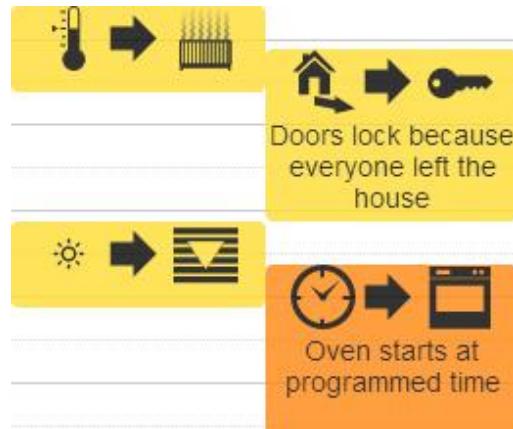


Figure 16:
Smart Home Events with Description

6.5.2 Parsing of Events

Having only tested the calendar with an array of dummy events, the next step will introduce a parser that fetches calendar events from a server, parses them into an array of events and returns the array to the calendar for display.

After trying several prebuilt parsing scripts, it was decided to adapt the closest matching one to the particular job it has to fulfill in this setting. Like the calendar framework, the JavaScript-Ical-Parser by “thybag”²³ is released under the MIT license²⁴. Although this parser was intended to provide a simple way of displaying calendar events from a calendar feed on websites, it could be modified to create an object containing the parsed events and

²¹ <https://github.com/robmonie/>

²² <http://opensource.org/licenses/mit-license.php>

²³ <https://github.com/thybag/>

²⁴ <http://opensource.org/licenses/mit-license.php>

passing the object to the calendar interface by using a callback function after parsing. Because at that point there were no credentials available to access a CalDAV server, a dummy file was used for testing of the parser.

The parser contains application logic besides of its main purpose. Its other purpose is to assign the calendar events their respective color; based on either the username assigned to an event or in case of smart home events depending on eventtype, eventcause or eventeffect.

6.5.3 Initialization Script

The advancing development required having an adequate number of events available for testing, so an init script was created, providing a set of test events. As the init script allowed to create a batch of events tailored to the actual day and surrounding weekdays, it facilitated rapid updating of the calendar events without manually changing the dates of the events every single day. This init script was further developed after creating more pictograms to have a larger variety of smart home events. All the used pictograms were either downloaded from a project page called “The Noun Project”²⁵, obtained from “Wikipedia”²⁶ or created from scratch using “Notepad++”²⁷ or the open source software

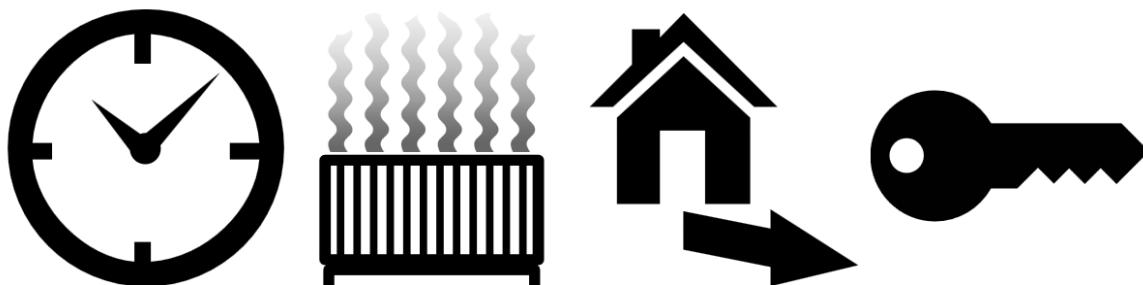


Figure 17: Examples for Pictograms – Clock, Heating, LeaveHouse, Lock

“Inkscape”²⁸. Every file retrieved from external sources is licensed under the “Creative Commons Attribution-Share Alike” license²⁹. The original owners of the pictures are referred to in appendix D on page 58.

After having access to the calendar server of the Department of Informatics of the University of Zurich, the init script could be adapted to allow uploading calendar events to the

²⁵ <http://thenounproject.com/>

²⁶ <http://inkscape.org/>

²⁷ <http://notepad-plus-plus.org/>

²⁸ <http://www.wikipedia.org/>

²⁹ <http://creativecommons.org/licenses/by/3.0/>

CalDAV server. The parser was updated accordingly to ensure communication with the calendar server. A certain specific problem was to poll multiple calendars; because the response time varies greatly and it cannot be predetermined which calendar resource returns its data last, the retrieval of the multiple calendar resources was solved sequentially. Unfortunately this solution is rather slow depending on the connection to the calendar server, but the overall response time stays below two seconds in most cases tested. The responsiveness of the calendar when first loaded is not of the utmost importance, because the device is designed to be always-on.

Initialization Script for Casalendar Test Events

current content of calendar (as iCal)	function result
smart-home (of Rizzo Family) Alice (Caroline Rizzo) Bob (Peter Rizzo) Carol (Carla and Stella Rizzo) Dave (Susan and Frank + their SmartHome)	Calendar entries at https://calendar.ifi.uzh.ch/smarthome/home/1111.ics are the following: BEGIN:VCALENDAR PROPID:-//davical.org//NONSGML AWL Calendar/EN VERSION:2.0 CALSCALE:GREGORIAN BEGIN:VEVENT DTSTART:20130528T0100Z DTEND:20130528T0300Z SUMMARY:Washing machine starts because electricity is cheap UID:smart-home X-SH-EVENTTYPE:Controlling of Appliances X-SH-EVENTCAUSE:PowerCost X-SH-EVENTEFFECT:WashingMachine X-SH-EVENTLOCATION:basement END:VEVENT BEGIN:VEVENT DTSTART:20130528T0600Z DTEND:20130528T0800Z SUMMARY:Shades open because its getting bright UID:smart-home X-SH-EVENTTYPE:Shading X-SH-EVENTCAUSE:Brightness X-SH-EVENTEFFECT:shadesUp X-SH-EVENTLOCATION:bedroom END:VEVENT BEGIN:VEVENT DTSTART:20130528T1100Z DTEND:20130528T1300Z SUMMARY:Oven starts at programmed time UID:smart-home X-SH-EVENTTYPE:Controlling of Appliances X-SH-EVENTCAUSE:Clock X-SH-EVENTEFFECT:Oven X-SH-EVENTLOCATION:kitchen END:VEVENT BEGIN:VEVENT DTSTART:20130528T2000Z DTEND:20130528T2200Z SUMMARY:Shades close because its getting dark UID:smart-home X-SH-EVENTTYPE:Shading X-SH-EVENTCAUSE:Brightness X-SH-EVENTEFFECT:shadesDown X-SH-EVENTLOCATION:bedroom END:VEVENT BEGIN:VEVENT DTSTART:20130527T0600Z DTEND:20130527T0800Z SUMMARY:Shades open because its getting bright UID:smart-home X-SH-EVENTTYPE:Shading X-SH-EVENTCAUSE:Brightness X-SH-EVENTEFFECT:shadesUp X-SH-EVENTLOCATION:bedroom END:VEVENT BEGIN:VEVENT DTSTART:20130527T1130Z DTEND:20130527T1330Z SUMMARY:Oven starts at programmed time UID:smart-home X-SH-EVENTTYPE:Controlling of Appliances X-SH-EVENTCAUSE:Clock X-SH-EVENTEFFECT:Oven X-SH-EVENTLOCATION:kitchen END:VEVENT BEGIN:VEVENT DTSTART:20130527T1730Z DTEND:20130527T1930Z SUMMARY:Heating starts because temperature is low UID:smart-home X-SH-EVENTTYPE:HVAC X-SH-EVENTCAUSE:Temperature X-SH-EVENTEFFECT:Heating X-SH-EVENTLOCATION:living-room END:VEVENT BEGIN:VEVENT DTSTART:20130527T2000Z DTEND:20130527T2200Z SUMMARY:Shades close because its getting dark UID:smart-home X-SH-EVENTTYPE:Shading X-SH-EVENTCAUSE:Brightness X-SH-EVENTEFFECT:shadesDown X-SH-EVENTLOCATION:bedroom END:VEVENT BEGIN:VEVENT DTSTART:20130526T0600Z DTEND:20130526T0800Z SUMMARY:Shades open because its getting bright UID:smart-home X-SH-EVENTTYPE:Shading X-SH-EVENTCAUSE:Brightness X-SH-EVENTEFFECT:shadesUp X-SH-EVENTLOCATION:bedroom END:VEVENT BEGIN:VEVENT DTSTART:20130526T1330Z DTEND:20130526T1530Z SUMMARY:Shades close because TV was powered on UID:smart-home X-SH-EVENTTYPE:Multimedia X-SH-EVENTCAUSE:TV X-SH-EVENTEFFECT:shadesDown X-SH-EVENTLOCATION:living-room END:VEVENT BEGIN:VEVENT DTSTART:20130526T1530Z DTEND:20130526T1730Z DTEND:20130526T2000Z DTEND:20130526T2200Z SUMMARY:Shades close because its getting dark UID:smart-home X-SH-EVENTTYPE:Shading X-SH-EVENTCAUSE:Brightness X-SH-EVENTEFFECT:shadesDown X-SH-EVENTLOCATION:bedroom END:VEVENT BEGIN:VEVENT DTSTART:20130525T0600Z DTEND:20130525T0800Z
delete content of calendar smart-home (of Rizzo Family) Alice (Caroline Rizzo) Bob (Peter Rizzo) Carol (Carla and Stella Rizzo) Dave (Susan and Frank + their SmartHome)	
generate new content and upload smart-home (of Rizzo Family) Alice (Caroline Rizzo) Bob (Peter Rizzo) Carol (Carla and Stella Rizzo) Dave (Susan and Frank + their SmartHome)	
fast-forward button^ delete all calendar contents and generate new content	

Figure 18: Initialization Script Frontend

The final version of the initialization front-end allowed the display, deletion and generation of new calendar content for the five available calendars. Event configuration, however, still had to be done manually. By providing easy-to-use functions, the description of events was designed to be as simple as possible.

During loading of the initialization page, variables for “year”, “month” and “day” are filled with the actual date values, so the functions for creating calendar entries can specify relative dates relying on today’s date. There is also the possibility to have for example the closest Tuesday in relation to the current date as a reference point instead of today. This way, scenarios tailored to differences between weekdays and weekend can be created.

In order to create smart home events, the following syntax has to be followed: start time, end time, text to be displayed, user name, event type, event cause, event effect and event location. The function in the second part of the code example creates a personal event for “bob” and takes place in one week, thus occurring seven days later than the smart home event created by the first function.

This initialization script provided the possibility to generate a lot of calendar entries investing rather little time and effort.

```
addEvent(new Date(year,month,day,8,00),new  
Date(year,month,day,10,00),'Doors lock because eve-  
ryone left the house', 'smart-home', 'Safety',  
'LeaveHouse', 'Lock', 'frontdoor');  
  
addEvent(new Date(year,month,day+7,22,00),new  
Date(year,month,day+7,24,00),'Champions League  
Match', 'bob');
```

Code Example 3: Functions for Event Creation

6.6 Calendar Scenarios for Expert Evaluation

After finishing the structure of the calendar interface, appropriate calendar-item scenarios needed to be created. Sarah Mennicken provided well-thought-out descriptions of fictive persons who live in smart homes, based on previous studies concerning smart home inhabitants. By reading the personas attached in appendix E, a general idea about the people’s lives was acquired, which then led to generating five weeks of calendar entries that could reflect their daily schedules.

Casalendar - The Smart-Home Calendar

Events for the SmartHome are displayed along with personal calendars of [Caroline](#), [Peter](#), [Carla & Stella](#).

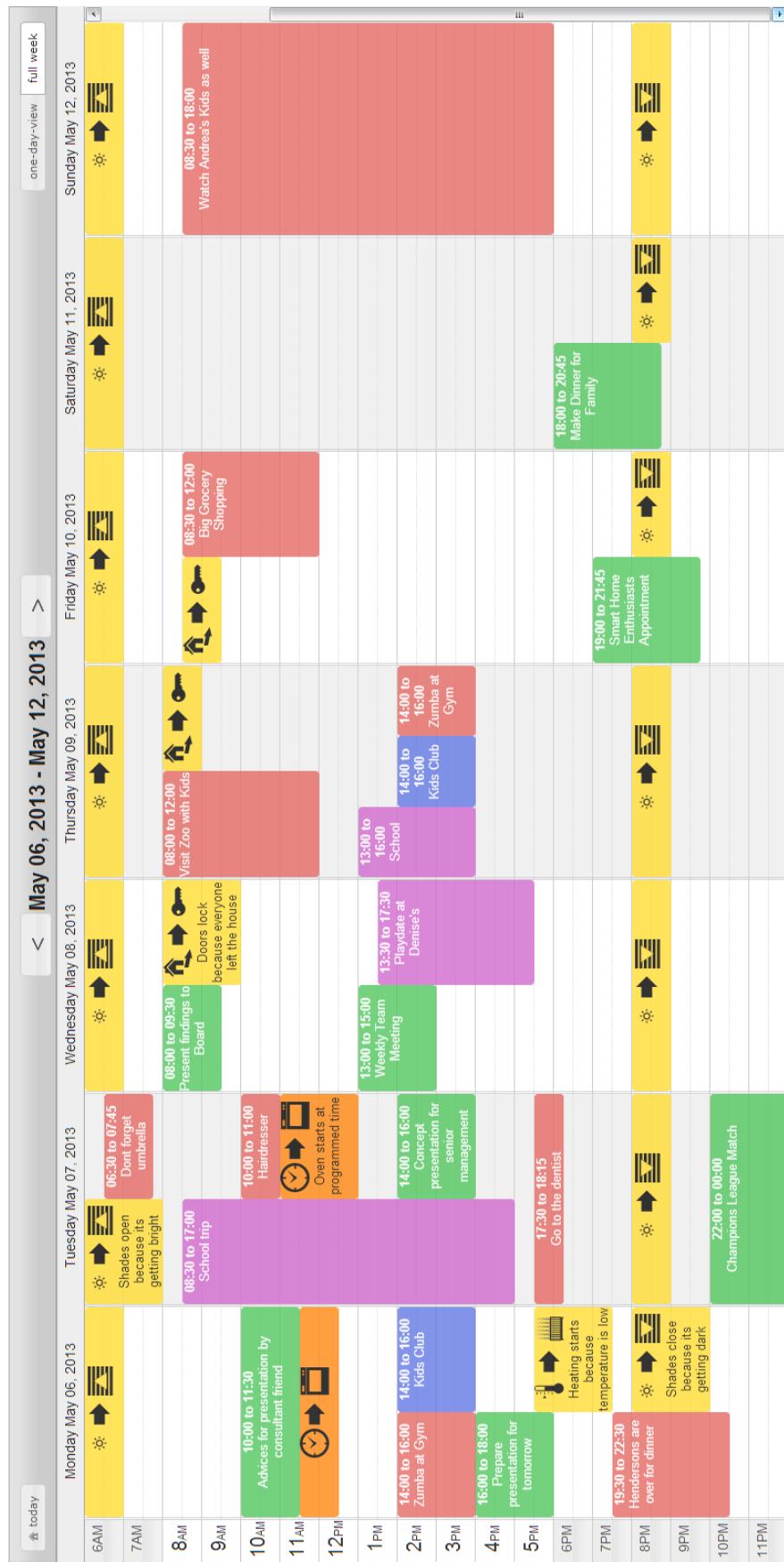


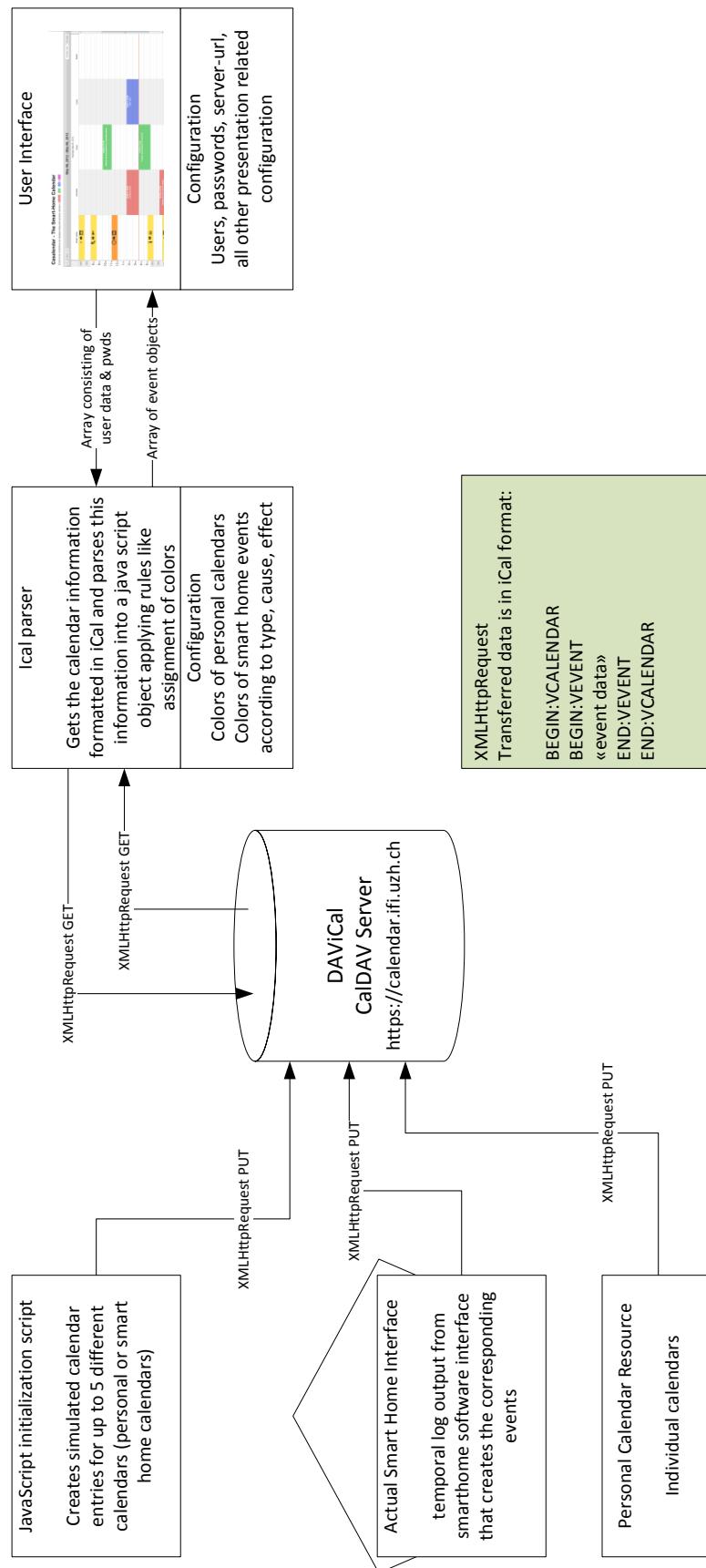
Figure 19: Calendar of the Rizzo Family Full Week View

6.7 Component Diagram

After completing the development of the Casalendar interface, a final component diagram concretizing the interaction paths between the used components was created. The components arranged on the left side provide the calendar server with calendar entries. In the current state, events are created by the initialization script but could later be provided by an actual smart home interface and corresponding personal calendar resources. The calendar server is represented by the DAViCal server of the informatics institute, but the Casalendar interface works with any calendar server that implements the CalDAV Standard³⁰.

In order to configure the Casalendar interface, certain lines of code have to be changed. On one hand the parser incorporates functions for assignment of event colors and ensures the events are provided to the user interface. The user interface includes all other settings that can be made. Besides the settings for connecting to the calendar server, all other layout and design specific settings can be configured in the user interface.

³⁰ Calendaring Extensions to WebDAV (CalDAV) <http://tools.ietf.org/html/rfc4791>

**Figure 20:** Final Component Diagram

6.8 Unsolved Issues

Some problems unfortunately could not be solved within the scope of this thesis.

The files containing the interface are on a different server than the calendar server and the communication with the server is built on XMLHttpRequests, so most browsers forbid this kind of connection due to their browser security model, because malicious code could be loaded from the remote site. A possible way to overcome this limitation would be using JSONP³¹ for data exchange, but this is not supported by the calendar server. The only reliable solution would be to provide a proxy through which the traffic to the remote server would be routed. So there would have to be a proxy script on the same server the interface is hosted, which fetches the calendar entries from the server upon request.

A possible workaround includes launching the browser with a flag to disable web security. In Windows this could be done by launching the browser from a command line; for example “chrome.exe --disable-web-security”, but this is not desirable although feasible for testing purposes. The solution used on the touch devices for the expert evaluation included adding the server address to the white listed “trusted sites” of the Internet Explorer browser.

The display of events could be further improved. Especially if there are lots of calendar events to be displayed. For example if three calendar events are arranged in the same time-slot, smart home events are not displayed correctly because there is insufficient space available.

Apart from those problems, there are more issues to address which are mentioned in the chapter about prototype improvement.

³¹ <http://www.json-p.org/>

7 Persona Supported Expert Evaluation

In order to evaluate the developed interactive prototype “Casalendar”, a persona supported expert evaluation was chosen. This method is rather experimental but could provide a possible workaround for evaluations due to the poor availability of smart home inhabitants for user studies. So the present expert evaluation does not only assess the interactive prototype but also tests the suitability of persona supported expert evaluations for user studies concerning smart homes.

7.1 Procedure

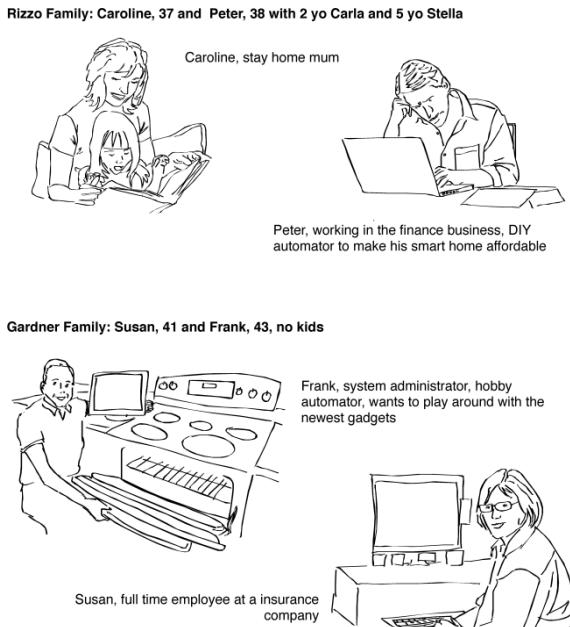


Figure 21: Pictures and Short Descriptions of the Personas Used

The participants – members of the ZPAC Team – were grouped in pairs and first given a questionnaire following the structure of a cognitive walkthrough. This first part of the evaluation was carried out by the participants on their own and targeted basic usability and feature matters. After finishing the first part of the evaluation, the participants were given a description³² of the person they will impersonate in the next parts. For the second task, the participants were asked to discuss with their partner whether they would consider buying the presented device or not. In the third and last part

of the evaluation, the participants were asked to put themselves in the position of a user who already possesses the device.

The device used for the tests was a VAIO Tap 20 Mobile Touch Desktop, a 20” tablet device running Windows 8. In order to bypass the browser’s same-origin policy, the server containing the interface was added to the Internet Explorer’s whitelist.

³² The persona descriptions are attached in appendix E on page 60.

7.2 Findings from Cognitive Walkthrough

The cognitive walkthrough brought up some important aspects of the interactive prototype that need to be improved. Especially concerning user interaction, some problems need to be dealt with; users expect such an interface to react to the accustomed multi-touch gestures like swipe and pan. The calendar view can indeed be swiped up and down to scroll to the early morning or late evening. At the beginning, the view is automatically set to the current time which besides is indicated by a red line. Regarding the red line indicating the current time, a participant mentioned that using a very similar shade of red for a person's calendar could be confusing.

Casalendar - The Smart-Home Calendar

Events for the SmartHome are displayed along with personal calendars of [Caroline](#), [Peter](#), [Carla](#) & [Stella](#).

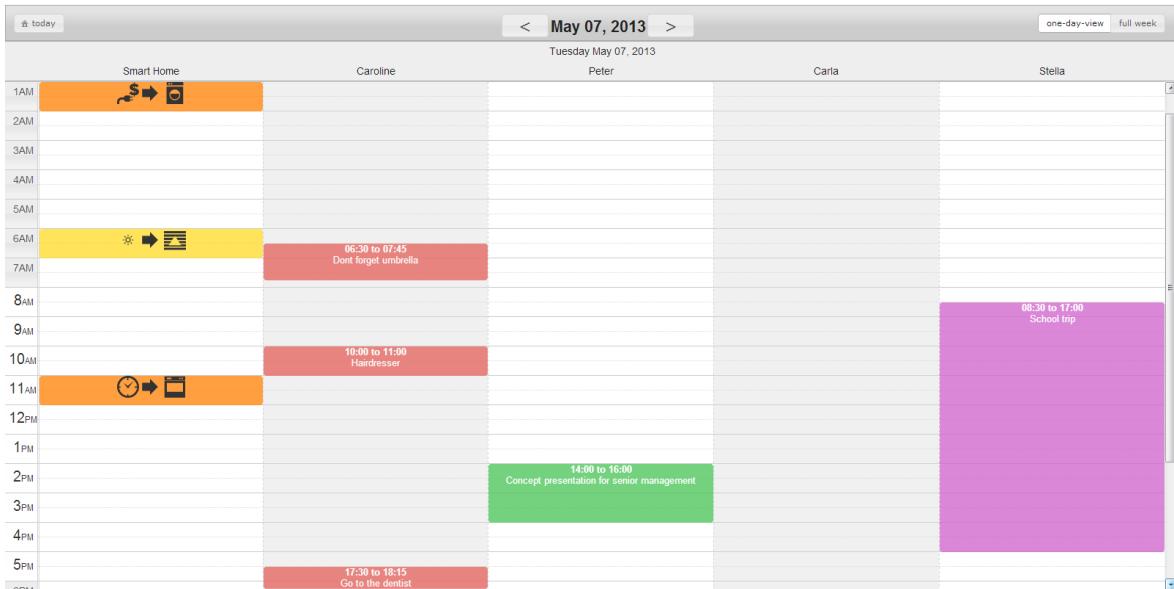


Figure 22: Calendar of the Rizzo Family showing one-day-view

To switch to the full week view, it is apparent according to the experts, that the button on the top right has to be tapped or clicked, the same applies to switching back to one-day-view. Changing the view to the next day or week by button presses can be frustrating, especially for persons who are accustomed to using tablets and smart phones and therefore are relying on their interaction knowledge that clearly includes swiping on the screen. The lack of having clickable dates in full week view to switch to a particular one-day-view was criticized as well the absence of means to navigate to distant dates.

While the possibility to unfold the labels representing calendar events was obvious for the paper prototype, the interactive prototype lacks of a visual clue that there is more information available than currently displayed. Adding a small arrow at the bottom right corner

of each smart home event would facilitate detection of the possibility to make the additional information visible.

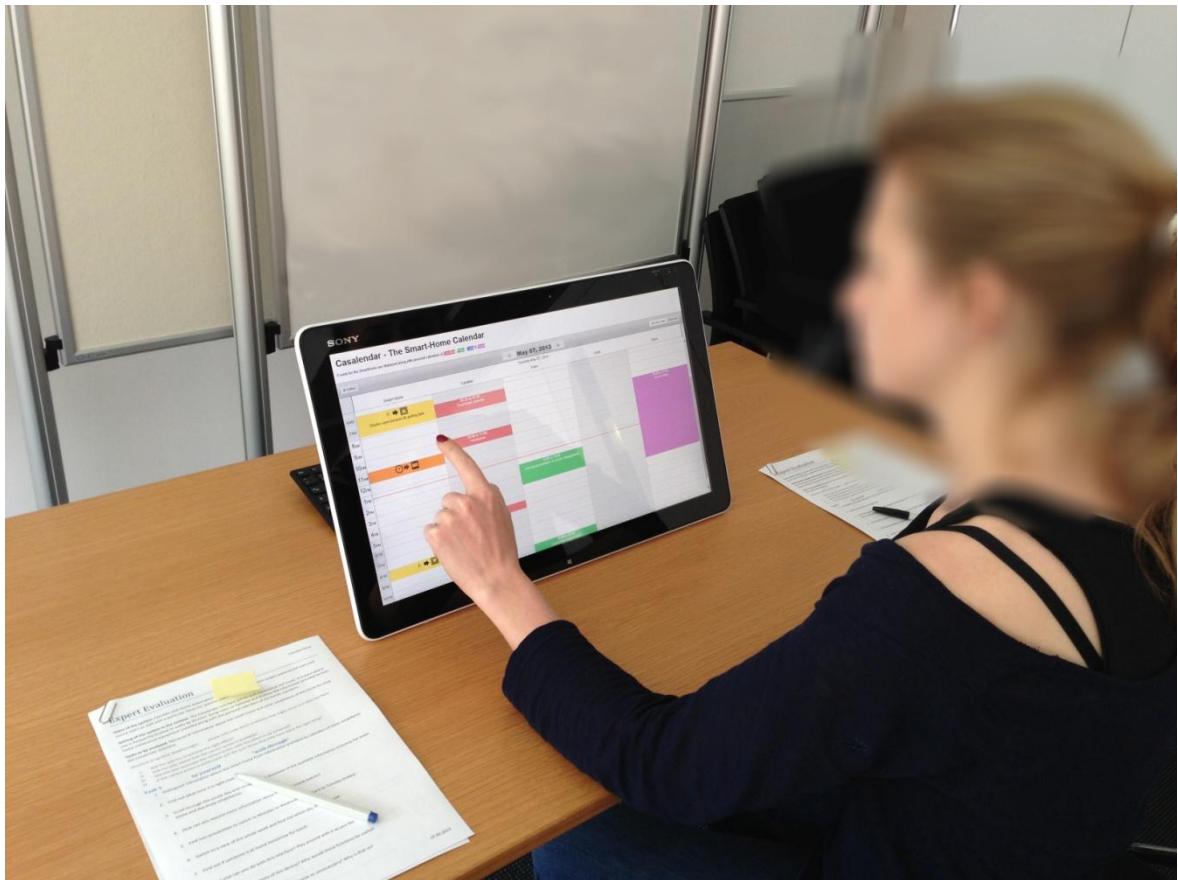


Figure 23: Situation of the Expert Evaluation

7.3 Findings from Discussions in Persona

After reading the provided persona descriptions very carefully, the participants tried to imagine how the persons they impersonate would react and argue.

Relying on the proposed discussion topics³³, the participants started to discuss whether the calendar device could support their lives if they would buy it. The following discussions were very informative concerning possible limitations of the device among other things.

7.3.1 Concerning Smart Home Events

The smart home specific part of the prototype was regarded as well-thought-out and making an appealing impression. Participants liked the pictograms for primary transport of information and welcomed the possibility to display additional information in case the rep-

³³ Discussion topics along with the expert evaluation protocol are mentioned in appendix F.

resentation by pictograms is unclear. But a certain drawback was stated because the availability of additional information to the collapsed smart home events is not visually apparent. Aside from smart home specific information display, there was a lot of feedback gathered about general calendaring aspects which is enlisted in the next clause.

7.3.2 General Calendaring Aspects

A planning function was mentioned to be a very important aspect of a calendar that supports families in their daily lives, so the device would have to offer some kind of scheduling function to be of substantial use for family coordination. For example one participant mentioned the children's events in the calendar; she would like to see at a glance, if the task of picking the child up is taken care of or if it is unassigned. If the task is already assigned, this should be reflected in the calendar view so that this information is clearly visible. This example leads to a main concern about the calendar; with the calendar events of family members often tied together closely, there absolutely has to be found a way to visualize connections between calendar events to improve the user experience.

The presented prototype is constricted in terms of manipulation of either calendar events or direct manipulation of smart home functions. So the possibility of scheduling events mentioned before is not possible in the current state of the prototype. This particular feature is focused on family calendar routines as opposed to providing the users with information about their smart home. Any means of control features or manipulation of calendar events is not planned for the scope of this thesis, but could be added in a future iteration.

Another problem occurring when using the device at home could include misinformation, because every family member has to maintain their calendar consistently, otherwise family members or the smart home and associated calendar could not be aware of certain events that will or have already happened.

7.3.3 Implications

The possibility of providing smart home information to users through usage of a calendar interface was affirmed by the participants, but the benefit for smart home inhabitants is limited according to the participants. As soon as more diverse information about the smart home matters is available, the users could increasingly benefit from the provided information. Favorite aspects about the Casalendar interface mentioned by the participants were the possibility to check if everything is in order and having an overview including the smart home information adjacent to the personal scheduling information.

8 Conclusion

In this chapter the findings from the previous sections are consolidated and discussed. Strengths and weaknesses are summarized and an outlook concerning future research is provided.

8.1 Discussion

The goal of this thesis is to elucidate on temporal metaphors to improve understanding of smart home information, especially for persons without strong technical background. By creating prototypes and constantly refining and evaluating them, both an understanding of the central issues to address and how to approach these issues were developed.

The chosen approach – using a traditional calendar interface and incorporate smart home related information – has proven useful in terms of elucidating the user about actions his home is performing. All users tend to find the information display for smart home events utilizing pictograms appealing and easy-to-understand. Therefore the improvement in intelligibility for actions and underlying causes concerning smart home can be approved.

The final evaluation showed that the interactive prototype in its current state does not comprehensively address the problems concerning improvement of understanding of smart home information. Users clearly want to have immediate control over the displayed information; also the diversity of displayed smart home events is too limited. The Casalendar prototype however provides an easy-to-use interface everyone can understand and certainly would be beneficial in the everyday life of a family living in a smart home.

By accommodating different components (family calendar and smart home calendar) into one design, there is a tradeoff between the two functions. Focusing too much on the personal calendars and related tasks eclipses the smart home functionality, which should be given prominence in favor of the Casalendar prototype. Smart home related aspects of the proposed system should therefore be made more apparent and accessible.

Temporal metaphor based interfaces can provide a more high-level overview to complicated systems like smart homes, hiding much of the involved complexity.

8.2 Future Work

In order to improve the Casalendar prototype, changes concerning event display, interaction and functionality can be taken into consideration.

8.2.1 Technical

Improving the prototype from a technical perspective to overcome the data exchange problem stated in chapter 6.8 would be required to deploy to diverse devices without extra configuration. The browser's same-origin policy allows JavaScript functions of the calendar interface to gather information from remote sources, if the request is carried out by a proxy script on the interface's server.

If the prototype is to be deployed "in the wild", reloading of events that changed in the meantime needs to be implemented to ensure the interface is always up-to-date. Also the time span from within the calendar events are loaded from the calendar server must be limited to avoid transferring large amounts of data, so the call to the calendar server could include just the week to be displayed at first sight. Further calendar data could be prefetched after page load, to ensure seamless switching to previous and next weeks or days. If the user wants to navigate to more distant points in time, the data could then be retrieved.

8.2.2 Interaction

In order to improve user interaction the functioning of the gestures need to be ensured. Due to competing event listeners, the swipe gesture only works on the top of the page in the current state of the prototype. Navigation could be further improved by making dates clickable in week view so that the one-day-view of the clicked day would be shown. The possibility of adding a date picker to choose dates more distant than two weeks could prove helpful in some situations as well.

In order to overcome the lack of a visual clue for additional information about smart home events being available, a small arrow at the bottom right corner of each smart home event could be added.

To improve clarity and at-a-glance awareness of the present situation, the possibility could be provided to gray out events that have already happened. Also the present date (the column for "today") could be made more visually distinguishable and the red line indicating the current time could be made thicker. The distinction between the smart home column and personal columns in one-day-view could be improved by adding symbols for the

home and the persons, also the color coding of the respective persons should match the top titles.

8.2.3 Functional

By integrating the Casalendar prototype into an actual smart home environment the breadth and depth of displayed information could be increased and tailored to the applications in-situ. If the interface would be installed after having dealt with traditional interfaces, more insights about suitability for improving user understanding could be gathered.

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Appendix A – Taxonomy for Event Classification

- Actors / Devices
 - Invisible or imperceptible
 - Heating
 - Ventilation
 - Air-Conditioning
 - Boiler
 - Irrigation System
 - Visible or Perceivable
 - (Smart) Appliances
 - Robots
 - Roomba
 - Lawn-Mower
 - Washing-Machine
 - Dryer
 - Fridge
 - Oven
 - TV
 - Stereo
 - Coffee Maker
 -
 - Lights
 - Shades

- Sensors
 - Environmental Sensors
 - Brightness
 - Weather, Outdoors (Humidity, Wind, Pressure, Rainfall, Dew Point, Temperature etc.)
 - Air Quality, Indoors (Temperature, Humidity, CO₂, O₂, CO etc.)
 - “Inhabitant-Triggered” Sensors
 - Presence Detectors
 - Cameras / Microphones
 - Buttons
 - Keypads
 - RFID
 - NFC
 - Security Sensors
 - Magnet-Contact Sensor
 - Doormat Sensor
 - Glass-Break Sensor
 - Ultra-Sonic Sensor
 - Photoelectric Barrier
 - Monitoring Sensors
 - Electric Consumption
 - Internet Usage
 - Wireless Transmission
 - Gas / Oil Consumption of Heating
 - Remote Access to Smart Home Components

Appendix B – User Study Protocol

- Participant 1 [TN1]

Papier Prototypen – Benutzerstudie

TN1

User Study for Paper Prototypes

1. Das Vorgehen des Interviews diskutieren, Consent Form erklären / lesen unterschreiben lassen, Vorgehen bzgl. Video erklären, Video starten.
Vielen Dank für die Bereitschaft bei dieser Benutzerstudie mitzumachen und mir weiterzuhelpfen meine Prototypen zu verbessern.
Mein Name ist Jonas Hofer und ich bin Student an der Uni Zürich, momentan im Bachelor. In meiner Bachelorarbeit geht es darum, ob und wie das Verständnis und die Nachvollziehbarkeit von Smart-Home Informationen anhand von zeitbezogenen Metaphern verbessert werden kann.
Diese Studie ist kein Test, es gibt absolut keine „falschen“ Antworten. Grundsätzlich wird mein Prototyp gefragt.
Bitte ungenannt negative Aspekte des Prototyps nennen, da ich herausfinden was eben nicht funktioniert am Prototyp. Um diesen dann zu verbessern.
Konzept Think aloud

2. Nach den persönlichen Infos fragen (Job, Alter, ob Haus oder Wohnung, Wohnungs situation (WG, Partner, Familie))
A. Frage wie Technologie erfahren die Person sich einschätzt (Welche Geräte sie benützen, PC, Smartphone etc. Was machen sie wenn Probleme auftreten?)

*Haus 51, Haus → Familie / Smart Home, PC, Smart Home
Wohnungshaus, Auto / E-Bike, Koffe, Koffer
Hauszug, Tisch, Stühle, Video, Telefon, Tischplatte*

3. Vorwissen bezüglich Smart Home?
A. Erklären lassen, was sie denken was das ist, vielleicht haben sie schon davon gehört
+ Nicht zu viel erklären, da dies ihre weiteren Antworten beeinflussen könnte

4. Den Uhr – Prototypen zeigen
A. Part 1
a. Beginnen mit dem Zeigen des Prototyps und der Frage was sie auf den ersten Blick erkennen können (generell)
b. Einstiegsfragen (Eisbrecher)
+ Nicht beeinflussen durch Nennen von einzelnen Aspekten

B. Part 2 (more general part)
a. Können Sie sich vorstellen ein solches Gerät zu Hause zu benützen?
+ Warum nicht?

*→ Einstellungen seien
→ Defekte Geräte anzeigen, Zustand messen*

5. Show the calendar prototype
A. Part 1
a. Beginnen mit dem Zeigen des Prototyps und der Frage was sie auf den ersten Blick erkennen können (generell)
b. Einfache Fragen (Eisbrecher)
+ Nicht beeinflussen durch Nennen von einzelnen Aspekten

*Ayala, viele keine Freizeit, platz für
Übersichtlicher und mehr Platz*

c. Detailliert fragen welche Teile des Prototyps sie erkennen können und was sie denken wozu dies dient.
(What is displayed and why is it situated where it is)
+ Probes: Farben, Formen, Piktogramme, Strukturierung Vergangenheit / Zukunft
Blau, Nichts mit

d. Was denken Sie, wofür der Prototyp nützlich sein könnte?
• Bei den Beispielen: wofür braucht man die Information?
+ Probes: Zeit ablesen, was noch?
*Gesetzte Funktionen wichtig
- Anmerkungen führen ⇒ ist Backofen programmierbar?
Gedächtnisstörung*

e. Wann könnte der Prototyp nützlich sein?
• Die Person erzählen lassen welche „Verwendungsszenarien“ bzw. „Verwendungszwecke“ sie sich vorstellen könnten
→ Erinnerungsstörung (sieht Morgen)

f. Zwei weitere Szenarien darstellen
• Guten-Morgen-Szenario (bereits seit Beginn dargestellt)
• Während des Tages (zwischen 8 und 16) → 12:00 oder 14:00
• Beim nach Hause kommen am Abend → 19:00
Nachmittag, neue Symbole

Papier Prototypen – Benutzerstudie

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b. In welcher Art könnte das Gerät nützlich sein? Was müsste anders sein, damit das Gerät nützlich ist?
*Zentral / defekt
„Telefonähnlichkeit“ an Türe
Briefkasten*

c. Was denken Sie, was Ihre Familienmitglieder / Mitbewohner zu diesem Prototyp sagen würden?
Familie

d. Wo im Haus / der Wohnung würden Sie das Gerät installieren?
• Wer würde sich für die Informationen interessieren?
+ Andere Personen, die im Haushalt leben? Gäste? Kollegen der Kinder, Nanny
• Wie in Nutzung integrieren?
Viele Uhr-Funktionen ⇒ Küchenbereich / Schreibtisch

e. Angemessene Menge an Informationen ersichtlich auf dem Prototyp?
*Fokus auf wichtiges
weniger Unwichtiges*

f. Was könnte man zusätzlich noch darstellen? Was würden Sie entfernen?
wissen welche ab Hostine - selbstszenen funktioniert

g. Wrap-up
wichtigste Peripherie

5. Übergang zum zweiten Prototyp

Papier Prototypen – Benutzerstudie

- B. Part 2 (more general part)
- Können Sie sich vorstellen ein solches Gerät zu Hause zu benützen?
 - Warum nicht? Warum schon – Mehrwert?

vielleicht abschalten mit Hobby

Funktionen

- In welcher Art könnte das Gerät nützlich sein? Was müsste anders sein, damit das Gerät nützlich ist?



- Was denken Sie, was ihre Familienmitglieder / Mitbewohner zu diesem Prototyp sagen würden?

praktisch, ihre Termine sichtbar

- Wo im Haus / der Wohnung würden Sie das Gerät installieren?
 - Wer würde sich für die Informationen interessieren?
 - Andere Personen, die im Haushalt leben? Gäste? Kollegen der Kinder, Nanny
 - Wie in Nutzung integrieren?

Papier Prototypen – Benutzerstudie

- g. Wrap-up
Diskussionen → synthetisieren

obwohl weniger Info

Gäste gehts nichts an?

7. Teilnehmer bezüglich ihrer normalen Kalenderroutinen befragen:

- Digital / analoge Klassentafel

Smartphone Agenda

Alibi korrigieren Wochentabelle (aber grosser Aufwand)

- Was für Infos befinden sich auf dem Kalender? / neben dem Kalender?

- Viel leichter ist Zusatzinformation verfügbar z.B. Eltern-Infozettel neben dem Termin für die Schule

- Wo befindet sich der Kalender?

- Wer führt den Kalender? Sind es evtl. mehrere Personen?
- Vergleich / Abschluss

- Welche möglichen Vorteile sehen Sie bezüglich der Prototypen? / Nachteile?

- Unterschiede Kalender / Uhr, Vorteile / Nachteile?

- Angemessene Menge an Informationen ersichtlich auf dem Prototyp?

Kalender ~~erfasst~~ muss anderes als eine Uhr
↳ nur Info keine Bilder

- Was könnte man zusätzlich noch darstellen? Was würden Sie entfernen?

→ nicht alle Termine von ihr sichtbar.

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Papier Prototypen – Benutzerstudie

- C. Welchen der beiden Prototypen finden Sie besser?

- Einzelne Aspekte, evtl. Beides für jeweils entsprechenden Zweck

→ Termine einbringen in Uhr ausser

→ Kalender bleibt mehr weiß mehr freigehabt, nicht kappt

- D. Allgemeine Fragen zu smarten Dingen zu Hause

- Gibt es in Ihrem Zuhause Dinge, die sie als "smart" bezeichnen würden?
 - Eventuell etwas, das kein elektronisches Gerät ist, aber sehr praktisch ist.
Evtl. Räume aufzählen, dann kommen sie vielleicht auf eine Idee
 - Evtl. Ofen, etwas vernetztes?

- Gibt es technische Geräte, die Ihnen wichtig sind im Alltag?

- Was haben diese Geräte für Vorteile und gegebenenfalls Nachteile?

Uhr nicht dargestellt

- Gibt es etwas, das Sie aus diesem Interview mitnehmen können?

- Gibt es etwas anderes, über das Sie Feedback geben möchten?

- Beim Teilnehmer herzlich bedanken für die Mitarbeit an der Studie

- Nach Emailadresse fragen, falls Teilnehmer interessiert ist, die Arbeit nachher zu lesen

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- Participant 2 [TN2]

Papier Prototypen – Benutzerstudie

TN 2 -> kälter zuerst

User Study for Paper Prototypes

1. Das Vorgehen des Interviews diskutieren, Consent Form erklären / lesen unterschreiben lassen, Vorgehen bzgl. Video erklären, Video starten.
 Vielen Dank für die Bereitschaft bei dieser Benutzerstudie mitzumachen und mir weiterzuholen meine Prototypen zu verbessern.
 Mein Name ist Jonas Hofer und ich bin Student an der Uni Zürich, momentan im Bachelor. In meiner Bachelorarbeit geht es darum, ob und wie das Verständnis und die Nachvollziehbarkeit von Smart-Home Informationen anhand von zeitbezogenen Metaphern verbessert werden kann.
 Dieses Interview ist kein Test, es gibt absolut keine „falschen“ Antworten. Grundsätzlich wird mein Prototyp getestet.
 Bitte nennen Sie negative Aspekte des Prototyps nennen, da ich herausfinden was eben nicht funktioniert am Prototyp, um diesen dann zu verbessern.
 Konzept Think aloud

2. Nach den persönlichen Infos fragen (Job, Alter, ob Haus oder Wohnung, Wohnsituation (WG, Partner, Familie))

A. Frage wie Technologie-erfahren die Person sich einschätzt (Welche Geräte sie benützen, PC, Smartphone etc. was machen sie wenn Probleme auftreten?)
 Proftil zum bei Büro, 22, Hochschule
 Schreibtisch häufig PC, Tablet (Schule), Seiten zum Anhören, Küchengeräte, TV zuletzt
 => bei Profil zuerst > problematisch > gefragt => fragen

3. Vorwissen bezüglich Smart Home?

- A. Erklären lassen, was sie denken was das ist, vielleicht haben sie schon davon gehört
- Nicht zu viel erklären, da dies ihre weiteren Antworten beeinflussen könnte

4. Den Uhr – Prototypen zeigen

- A. Part 1
 - Beginnen mit dem Zeigen des Prototyps und der Frage was sie auf den ersten Blick erkennen können (generell)
 - Einstiegsfragen (Eisbrecher)
 - Nicht beeinflussen durch Nennen von einzelnen Aspekten

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Papier Prototypen – Benutzerstudie

- c. Detailliert fragen welche Teile des Prototyps sie erkennen können und was sie denken wozu dies dient.

(What is displayed and why is it situated where it is)
 Probes: Farben, Formen, Piktogramme, Strukturierung Vergangenheit / Zukunft

Saugsauger (nicht nur Zähne/Brüderchen) weckt i. m. Kälte

Schlafsklau für Strom

- d. Was denken Sie, wofür der Prototyp nützlich sein könnte?

- Bei den Beispiele: wofür braucht man die Information?
 - Probes: Zeit ablesen, was noch?
 - = Wissenswertes was was wieder was machen muss
 - = Gute Sache um Strom/Weckende gern aber nicht komplexe in verschwommen

- e. Wann könnte der Prototyp nützlich sein?

- Die Person erzählen lassen welche „Verwendungsszenarien“ bzw. „Verwendungszwecke“ sie sich vorstellen könnten

*Abend > Morgen drückt
Vorherigen für nächsten Tag, mehr Zeit am Abend*

- f. Zwei weitere Szenarien darstellen

- Guten-Morgen-Szenario (bereits seit Beginn dargestellt)
- Während des Tages (zwischen 8 und 16) → 12:00 oder 14:00
- Beim nach Hause kommen am Abend → 19:00

gut wann wann zB bei Heizung steht dass das System schon etwas gegen Kälte macht

- B. Part 2 (more general part)

- a. Können Sie sich vorstellen ein solches Gerät zu Hause zu benützen?

- Warum nicht?

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Papier Prototypen – Benutzerstudie

- b. In welcher Art könnte das Gerät nützlich sein? Was müsste anders sein, damit das Gerät nützlich ist?
 a-a-glaue (Schlafzirkel) → Pillen zuerst überstellt (aber nicht nur auf zähne auswendig zu lernen)
 => nicht zu viel Information => zuviel schwierig
 => auch Darstellung was gerade JETZT passiert
 c. Was denken Sie, was Ihre Familienmitglieder / Mitbewohner zu diesem Prototyp sagen würden?
 cool oder zu kompliziert / etwas neues > soviel Geduld
 => einfacher
 => einfacher (am Anfang müssen)
 d. Wo im Haus / der Wohnung würden Sie das Gerät installieren?
 - Wer würde sich für die Informationen interessieren?
 - Andere Personen, die im Haushalt leben? Gäste? Kollegen der Kinder, Name
 - Wie in Nutzung integrieren?
 Wohlfühlreich (nicht Schlafzirkel)
 Nähe Eingang der Wohnung oder Küche => wo oft gehten viel
 e. Angemessene Menge an Informationen ersichtlich auf dem Prototyp?
 => nicht zu komplex "erstaunlich"

- f. Was könnte man zusätzlich noch darstellen? Was würden Sie entfernen?

- g. Wrap up

5. Übergang zum zweiten Prototyp

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Papier Prototypen – Benutzerstudie

6. Show the calendar prototype

- A. Part 1

- Beginnen mit dem Zeigen des Prototyps und der Frage was sie auf den ersten Blick erkennen können (generell)
- Einfache Fragen (Eisbrecher)

Nicht jedes / schwieriger zu erkennen nicht beeinflussen durch Nennen von einzelnen Aspekten

= Neuer Anfang => nicht salopp müssen positiv => besser kann man machen

ausdrücken da viele die die Welt sehr schätzen

komplekt => Gesamtausblick besser darzustellen

- d. Was denken Sie, wofür der Prototyp nützlich sein könnte?

- Bei den Beispiele: wofür braucht man die Information?
 - Probes: Zeit ablesen, was noch?

Überprüfen ob alles gut ist!

Erinnerungsfunktion => vorstellen wann am besten Ort

- e. Wann könnte der Prototyp nützlich sein?

- Die Person erzählen lassen welche „Verwendungsszenarien“ sie sich vorstellen könnten

- f. Zwei weitere Szenarien darstellen

- Guten-Morgen-Szenario (bereits seit Beginn dargestellt)
- Während des Tages (zwischen 8 und 16) → 12:00 oder 14:00
- Beim nach Hause kommen am Abend

> zuerst gut bei morgentlicher Zeit dann zurück zum Schlaf

Papier Prototypen – Benutzerstudie	Papier Prototypen – Benutzerstudie
<p>B. Part 2 (more general part)</p> <ul style="list-style-type: none"> Können Sie sich vorstellen ein solches Gerät zu Hause zu benutzen? <p>Warum nicht? Warum schon – Mehrwert?</p> <p>Aus praktischen Gründen, dann wahrscheinlich → wenn kompliziertes Gerät, sonst natürlich ↳ Zusatzfunktion</p> <p>b. In welcher Art könnte das Gerät nutzlich sein? Was müsste anders sein, damit das Gerät nutzlich ist?</p> <p>2 Uhren? keine Anstalts-Ausicht ⇒ Wäre frechheit wünschbar Zeitablauf nicht sichtbar</p> <p>c. Was denken Sie, was ihre Familienmitglieder / Mitbewohner zu diesem Prototyp sagen würden?</p> <p>↳ kein Zweck als kalender weil ungern (auf dem anderen Bild)</p> <p>d. Wo im Haus / der Wohnung würden Sie das Gerät installieren? ↳ gleich wie Kal.</p> <ul style="list-style-type: none"> Wer würde sich für die Informationen interessieren? <ul style="list-style-type: none"> Andere Personen, die im Haushalt leben? Gäste? Kollegen der Kinder, Nanny Wie in Nutzung integrieren? <p>atm, die es betrifft ↳ (Kinder auch)</p> <p>e. Angemessene Menge an Informationen ersichtlich auf dem Prototyp?</p> <p>praktisch; da nicht davorliegende Überflächung ↳ mehr auf denkt</p> <p>f. Was könnte man zusätzlich noch darstellen? Was würden Sie entfernen?</p>	<p>g. Wrap-up</p> <p>7. Teilnehmer bezüglich ihrer normalen Kalenderroutinen befragen:</p> <ul style="list-style-type: none"> Digital / analog → Tages-Lister → praktisch zum abstrakten Vergleich Sprachliche → Sprachliche → Erinnerungen / Erinnerungen Was für Infos befinden sich auf dem Kalender? / neben dem Kalender? <ul style="list-style-type: none"> Viel leichter mit Zusatzinformation verfügbar zB. Etappenziel neben dem Termin für die Schule <p>Erinnerungen → Dokumente / Dokumente</p> <p>c. Wo befindet sich der Kalender?</p> <p>↳ Smartphone → Platzsparend, kein Staubkörnig ↳ Tisch (Couch)</p> <p>D. Wer führt den Kalender? Sind es evtl. mehrere Personen?</p> <p>8. Vergleich / Abschluss</p> <p>A. Welche möglichen Vorteile sehen Sie bezüglich der Prototypen? / Nachteile?</p> <p>voll → besser darangestellt. ⇒ könnte aber schwierig B. Unterschiede Kalender (Uhr) Vorteile / Nachteile?</p> <p>groß klein leicht Platzsparend</p>

- Participant 3 [TN3]

Papier Prototypen – Benutzerstudie

TN3 clock first

User Study for Paper Prototypes

1. Das Vorgehen des Interviews diskutieren, Consent Form erklären / lesen unterschreiben lassen, Vorgehen bzgl. Video erklären, Video starten.
 Vielen Dank für die Bereitschaft bei dieser Benutzerstudie mitzumachen und mir weiterzuhelfen meine Prototypen zu verbessern.
 Mein Name ist Jonas Hofer und ich bin Student an der Uni Zürich, momentan im Bachelor. In meiner Bachelorarbeit geht es darum, ob und wie das Verständnis und die Nachvollziehbarkeit von Smart-Home Informationen anhand von zeitbezogenen Metaphern verbessert werden kann.
 Dieses Interview ist kein Test, es gibt absolut keine „falschen“ Antworten. Grundsätzlich wird mein Prototyp getestet.
 Bitte ungeniert negative Aspekte des Prototyps nennen, da ich herausfinden was eben nicht funktioniert am Prototyp, um diesen dann zu verbessern.
 Konzept Think aloud

2. Nach den persönlichen Infos fragen (Job, Alter, ob Haus oder Wohnung, Wohnungs situation (WG, Partner, Familie))
 A. Frage wie Technologie-erfahren die Person sich einschätzt (Welche Geräte sie benützen, PC, Smartphone etc., was machen sie wenn Probleme auftreten?)

Tschankbauer/Spijngoparkin, 56 Jahre, Haus mit Familie (55, 23, 28)

3. Vorwissen bezüglich Smart Home?
 A. Erklären lassen, was sie denken was das ist, vielleicht haben sie schon davon gehört
 – Nicht zu viel erklären, da dies ihre weiteren Antworten beeinflussen könnte

4. Den Uhr – Prototyp zeigen
 A. Part 1
 a. Beginnen mit dem Zeigen des Prototyps und der Frage was sie auf den ersten Blick erkennen können (generell)
 b. Einstiegfragen (Eisbrecher)
 – Nicht beeinflussen durch Nennen von einzelnen Aspekten

places teil und Zeitel > andes als bei Uhr

Papier Prototypen – Benutzerstudie

- c. Detailliert fragen welche Teile des Prototyps sie erkennen können und was sie denken wozu dies dient.
 • Bei den Beispiele: **wofür** braucht man die Information?
 • Probes: Farben, Formen, Piktogramme, Strukturierung Vergangenheit / Zukunft
 ↳ 2. Today

Zeit dazu bei Events

- d. Was denken Sie, wofür der Prototyp nützlich sein könnte?
 • Bei den Beispiele: **wofür** braucht man die Information?
 • Probes: Zeit ablesen, was noch?

siehe unten was eigentlich ist.

- e. Wann könnte der Prototyp nützlich sein?
 • Die Person erzählen lassen welche „Verwendungsszenarien“ bzw. „Verwendungszwecke“ sie sich vorstellen könnten

→ Zeit-Unterstützung
9h/3h
et-10/24
zufällig

- f. Zwei weitere Szenarien darstellen
 • Guten-Morgen-Szenario (bereits seit Beginn dargestellt)
 • Während des Tages (zwischen 8 und 16) → 14:00
 • Beim nach Hause kommen am Abend → 19:00

⇒ unbekannt verständlich

- B. Part 2 (more general part)
 a. Können Sie sich vorstellen ein solches Gerät zu Hause zu benützen?
 – Warum nicht?

ja, aber keine finanziellen Auswirkungen

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Papier Prototypen – Benutzerstudie

Papier Prototypen – Benutzerstudie

- b. In welcher Art könnte das Gerät nützlich sein? Was müsste anders sein, damit das Gerät nützlich ist?
 ↳ links steht sehr weniger Platz
- c. Was denken Sie, was ihre Familienmitglieder / Mitbewohner zu diesem Prototyp sagen würden?
 ↳ nur Uhr steht sehr weniger Platz
 ↳ wenn es vorhanden ist wird es genutzt
- d. Wo im Haus / der Wohnung würden Sie das Gerät installieren?
 • Wer würde sich für die Informationen interessieren?
 – Andere Personen, die im Haushalt leben? Gäste? Kollegen der Kinder, Nanny
 • Wie in Nutzung integrieren?
 ↳ Tag oder Woche, immer ein gut sichtbarer
- e. Angemessene Menge an Informationen ersichtlich auf dem Prototyp?
 ↳ Ausreichend, Berührungen ändern sich
- f. Was könnte man zusätzlich noch darstellen? Was würden Sie entfernen?
 ↳ Lüften des Hauses hinzufügen

6. Show the calendar prototype

- A. Part 1
 a. Beginnen mit dem Zeigen des Prototyps und der Frage was sie auf den ersten Blick erkennen können (generell)
 b. Einfache Fragen (Eisbrecher)

Nicht beeinflussen durch Nennen von einzelnen Aspekten

Sympathischer

Zeilige Metapher kann bei Kollegin weil Agenda/Kunstplatz

- c. Detailliert fragen welche Teile des Prototyps sie erkennen können und was sie denken wozu dies dient.
 (What is displayed and why is it situated where it is)
 • Bei den Beispiele: **wofür** braucht man die Information?

Probes: Farben, Formen, Piktogramme, Strukturierung Vergangenheit / Zukunft

- d. Was denken Sie, wofür der Prototyp nützlich sein könnte?
 • Bei den Beispiele: **wofür** braucht man die Information?
 • Probes: Zeit ablesen, was noch?

wenn dann alle wichtigen Infos anzeigen (2 Parkein "hier" "Ferien"

- e. Wann könnte der Prototyp nützlich sein?
 • Die Person erzählen lassen welche „Verwendungsszenarien“ sie sich vorstellen könnten

- f. Zwei weitere Szenarien darstellen
 • Guten-Morgen-Szenario (bereits seit Beginn dargestellt)
 • Während des Tages (zwischen 8 und 16) → 12:00 oder 14:00
 • Beim nach Hause kommen am Abend

5. Übergang zum zweiten Prototyp

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Papier Prototypen – Benutzerstudie

B. Part 2 (more general part)

- a. Können Sie sich vorstellen ein solches Gerät zu Hause zu benützen?
 - Warum nicht? Warum schon – Mehrwert?

\Rightarrow Vorteile "Warum brauchen" \Rightarrow privacy issue

- c. Was denken Sie, was ihre Familienmitglieder / Mitbewohner zu diesem Prototyp sagen würden?

- d. Wo im Haus / der Wohnung würden Sie das Gerät installieren?

- Wer würde sich für die Informationen interessieren?
 - Andere Personen, die im Haushalt leben? Gäste? Kollegen der Kinder, Nanny
 - Wie in Nutzung integrieren?

\rightarrow wie Uhr

- e. Angemessene Menge an Informationen ersichtlich auf dem Prototyp?

„nur wann viele damit angezeigt werden kann“

- f. Was könnte man zusätzlich noch darstellen? Was würden Sie entfernen?

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Papier Prototypen – Benutzerstudie

g. Wrap-up

7. Teilnehmer bezüglich ihrer normalen Kalenderroutinen befragen:

- A. Digital / analoge

Agenda / Unterrichtsheft

- B. Was für Infos befinden sich auf dem Kalender? / neben dem Kalender?
 - a. Vielleicht ist Zusatzinformation verfügbar z.B. Eltern-Infozettel neben dem Termin für die Schulfreizeit

- C. Wo befindet sich der Kalender?

immer dabei

- D. Wer führt den Kalender? Sind es evtl. mehrere Personen?

alleine

8. Vergleich / Abschluss

- A. Welche möglichen Vorteile sehen Sie bezüglich der Prototypen? / Nachteile?

Kalender auf einen Blick / schneller

- B. Unterschiede Kalender / Uhr, Vorteile / Nachteile?

für Freunde:
Wandkalender fix / variabel

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Papier Prototypen – Benutzerstudie

C. Welchen der beiden Prototypen finden Sie besser?

- a. Einzelne Aspekte, evtl. Beides für jeweils entsprechenden Zweck

D. Allgemeine Fragen zu smarten Dingen zu Hause

- a. Gibt es in Ihrem Zuhause Dinge, die sie als "smart" bezeichnen würden?
 - Eventuell etwas, das kein elektronisches Gerät ist, aber sehr praktisch ist.
 - Evtl. Räume aufzählen, dann kommen sie vielleicht auf eine Idee
 - Evtl. Ofen, etwas vernetzt?

- b. Gibt es technische Geräte, die Ihnen wichtig sind im Alltag?

- c. Was haben diese Geräte für Vorteile und gegebenenfalls Nachteile?

- E. Gibt es etwas, das Sie aus diesem Interview mitnehmen können?

- F. Gibt es etwas anderes, über das Sie Feedback geben möchten?

9. Beim Teilnehmer herzlich bedanken für die Mitarbeit an der Studie

- A. Nach Emailadresse fragen, falls Teilnehmer interessiert ist, die Arbeit nachher zu lesen

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- Participant 4 [TN4]

Papier Prototyp – Benutzerstudie

TN4 (mein Kalender)

User Study for Paper Prototype

1. Das Vorgehen des Interviews diskutieren, Consent Form erklären / lesen, unterschreiben lassen, Vorgehen bzgl. Video erklären, Video starten.
Vielen Dank für die Bereitschaft bei dieser Benutzerstudie mitzumachen und mir weiterzuhelfen meine Prototypen zu verbessern.
- Mein Name ist Jonas Höfer und ich bin Student an der Uni Zürich, momentan im Bachelor. In meiner Bachelorarbeit geht es darum, ob und wie das Verständnis und die Nachvollziehbarkeit von Smart-Home Informationen anhand von zeitbezogenen Metaphern verbessert werden kann.
- Dieses Interview ist kein Test, es gibt absolut keine „falschen“ Antworten. Grundsätzlich wird mein Prototyp getestet.
- Bitte nennen Sie mir negative Aspekte des Prototyps, nennen Sie, was ich herausfinden will, was eben nicht funktioniert am Prototyp, um diesen dann zu verbessern.
- Konzept Think aloud

2. Nach den persönlichen Infos fragen (Job, Alter, ob Haus oder Wohnung, Wohnungs situation (WG, Partner, Familie))
- A. Frage wie Technologie erfahren die Person sich einschätzt (Welche Geräte sie benützen, PC, Smartphone etc. was machen sie wenn Probleme auftreten?)

3. Vorwissen bezüglich Smart Home?
- A. Erklären lassen, was sie denken was das ist, vielleicht haben sie schon davon gehört
Nicht zu viel erklären, da dies ihre weiteren Antworten beeinflussen könnte

4. Show the calendar prototype
- A. Part 1
- a. Beginnen mit dem Zeigen des Prototyps und der Frage was sie auf den ersten Blick erkennen können (generell)
 - b. Einfache Fragen (Eisbrecher)
- Nicht beeinflussen durch Nennen von einzelnen Aspekten

- c. Detailliert fragen welche Teile des Prototyps sie erkennen können und was sie denken wozu dies dient.
(What is displayed and why is it situated where it is)
Probes: Farben, Formen, Piktogramme, Strukturierung Vergangenheit / Zukunft
→ instantiell

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Papier Prototyp – Benutzerstudie

- d. Was denken Sie, wofür der Prototyp nützlich sein könnte?
Bei den Beispielen: wofür braucht man die Information?
Probes: Zeit ablesen, was noch?

→ Sagen nicht davon direkt wissen

- e. Wann könnte der Prototyp nützlich sein?

- Die Person erzählen lassen welche „Verwendungsszenarien“ sie sich vorstellen könnten

Möglichen Planen am Morgen oder Vorbereitung

→ morgige Tage
Vorbereitung

- f. Zwei weitere Szenarien darstellen

- Guten-Morgen-Szenario (Bereits seit Beginn dargestellt)
- Während des Tages (zwischen 8 und 16) → 12:00 oder 14:00
- Beim nach Hause kommen am Abend

→ Wirkungsfälle
wie praktisch

- B. Part 2 (more general part)

- a. Können Sie sich vorstellen ein solches Gerät zu Hause zu benützen?

→ Wozu nicht? Warum schon – Mehrwert?

→ Wozu nicht, weil es Viele, oder wissen was
Funktionen hilfe / Entwicklung

→ war ich verträumt ⇒ unterschiedliche Seiten sind so schwer

- b. In welcher Art könnte das Gerät nützlich sein? Was müsste anders sein, damit das Gerät nützlich ist?

- c. Was denken Sie, was ihre Familienmitglieder / Mitbewohner zu diesem Prototyp sagen würden?

Würde es auch gut finden

→ ebenfalls der persönlichen Kalender nicht wichtig

→ wer ist zum Mitbringen ansonsten

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⇒ wissen über Anwend / Nutzen

Papier Prototyp – Benutzerstudie

Bei pers-kauf
⇒ verdeckt
ob passen ausreichend

- d. Wo im Haus / der Wohnung würden Sie das Gerät installieren?
• Wer würde sich für die Informationen interessieren?
Andere Personen, die im Haushalt leben? Gäste? Kollegen der Kinder, Namny
• Wie in Nutzung integrieren?
Schnell mal aus werden sie aufzieht

→ überzeugt diese gewählt

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Papier Prototyp – Benutzerstudie

- D. Wer führt den Kalender? Sind es evtl. mehrere Personen?

→ zogt hat niemand / besser Personen selbst

6. Abschluss

- A. Welche möglichen Vorteile sehen Sie bezüglich des Prototyps / Nachteile?

- B. Allgemeine Fragen zu smarten Dingen zu Hause

- a. Gibt es in Ihrem Zuhause Ding, die sie als „smart“ bezeichnen würden?
• Eventuell etwas, das kein elektronisches Gerät ist, aber sehr praktisch ist.
• Evtl. Räume aufzählen, dann kommen sie vielleicht auf eine Idee

- f. Was könnte man zusätzlich noch darstellen? Was würden Sie entfernen?
durchdringlich, automatische Dinge (Boiler-Nachtbeleuchtung) nicht auf Drucktyp
mehr die sicherheitsbedürfnisse (Türen verschließen) als Sonstig,

- g. Wrap-up

- b. Gibt es technische Geräte, die Ihnen wichtig sind im Alltag?

5. Teilnehmer bezüglich ihrer normalen Kalenderroutinen befragen:

A. Digital/analoge
↳ Papier (eigentlich auf dem Schreibtisch) → macht Synchronisierungsaufwand leichter
↳ auf dem Schreibtisch

- c. Was haben diese Geräte für Vorteile und gegebenenfalls Nachteile?

- B. Was für Infos befinden sich auf dem Kalender? / neben dem Kalender?
a. Vielleicht ist Zusatzinformation verfügbar z.B. Eltern-Infotext neben dem Termin für die Schule

Blatt mit Tagesprogramm

- C. Gibt es etwas, das Sie aus diesem Interview mitnehmen können?

7. Beim Teilnehmer herzlich bedanken für die Mitarbeit an der Studie

- A. Nach Emailadresse fragen, falls Teilnehmer interessiert ist, die Arbeit nachher zu lesen

- C. Wo befindet sich der Kalender?
in Agenda
Schriftlich ab.

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- Participant 5 [TN5]

Papier Prototyp – Benutzerstudie

TN 5
(nur Habuda)

User Study for Paper Prototype

1. Das Vorgehen des Interviews diskutieren, Consent Form erklären / lesen unterschreiben lassen, Vorgehen bzgl. Video erklären, Video aufnehmen.

Vielen Dank für die Bereitschaft bei dieser Benutzerstudie mitzumachen und mir weiterzuholen meine Prototypen zu verbessern.

Mein Name ist Jonas Hofer und ich bin Student an der Uni Zürich, momentan im Bachelor. In meiner Bachelorarbeit geht es darum, ob und wie das Verständnis und die Nachvollziehbarkeit von Smart-Home Informationen anhand von zeitbezogenen Metaphern verbessert werden kann.

Dieses Interview ist kein Test, es gibt absolut keine „falschen“ Antworten. Grundsätzlich wird mein Prototyp getestet.

Bitte nennen Sie negative Aspekte des Prototyps, da ich herausfinden will was eben nicht funktioniert am Prototyp, um diesen dann zu verbessern.

Konzept Think aloud

2. Nach den persönlichen Infos fragen (Job, Alter, ob Haus oder Wohnung, Wohnungs situation (WG, Partner, Familie))

A. Frage wie Technologie-erfahren die Person sich einschätzt (Welche Geräte sie benützen, PC, Smartphone etc. Was machen sie wenn Probleme auftreten?)

Polizist, 57, Males mit Familie

3. Vorwissen bezüglich Smart Home?

A. Erklären lassen, was sie denken was das ist, vielleicht haben sie schon davon gehört

– Nicht zu viel erklären, da dies ihre weiteren Antworten beeinflussen könnte

4. Show the calendar prototype

A. Part 1

a. Beginnen mit dem Zeigen des Prototyps und der Frage was sie auf den ersten Blick erkennen können (generell)

b. Einfache Fragen (Eisbrecher)

Nicht beeinflussen durch Nennen von einzelnen Aspekten
Artikel, Termine und was man in klar auf

c. Detailliert fragen welche Teile des Prototyps sie erkennen können und was sie denken wozu dies dient.

– Probes: Farben, Formen, Piktogramme, Strukturierung Vergangenheit / Zukunft
gibt darüber → Person betrifft

Seite 1 von 4

Druckdatum: Donnerstag, 28. März 2013

Papier Prototyp – Benutzerstudie

d. Was denken Sie, wofür der Prototyp nützlich sein könnte?

- Bei den Beispielen: wofür braucht man die Information?
 - Probes: Zeit ablesen, was noch?

e. Wann könnte der Prototyp nützlich sein?

- Die Person erzählen lassen welche „Verwendungsszenarien“ sie sich vorstellen könnten
Mitar 1 im Hause
Tagesablauf optimieren + Energieeffizienz

f. Zwei weitere Szenarien darstellen

- Guten-Morgen-Szenario (bereits seit Beginn dargestellt)
- Während des Tages (zwischen 8 und 16) → 12:00 oder 14:00
- Beim nach Hause kommen am Abend
Wieder sicher, was man aber auf
so

B. Part 2 (more general part)

a. Können Sie sich vorstellen ein solches Gerät zu Hause zu benützen?

- Warum nicht? Warum schon – Mehrwert?

b. In welcher Art könnte das Gerät nützlich sein? Was müsste anders sein, damit das Gerät nützlich ist?
andere Sachen beginnen Abend
positive Sachen beginnen Abend

c. Was denken Sie, was ihre Familienmitglieder / Mitbewohner zu diesem Prototyp sagen würden?
positiv empfunden, nur lokale da ist gut
wichtigst erneuerbarer Energieträger

Seite 2 von 4

Druckdatum: Donnerstag, 28. März 2013

Papier Prototyp – Benutzerstudie

D. Wer führt den Kalender? Sind es evtl. mehrere Personen?

Selbstarbeiten kann Termine eingeben

6. Abschluss

A. Welche möglichen Vorteile sehen Sie bezüglich des Prototyps? / Nachteile?

→ was passiert wenn etwas fehlt → Störungsfaktor
→ was passiert wenn etwas fehlt → Störungsfaktor

B. Allgemeine Fragen zu smarten Dingen zu Hause

a. Gibt es in Ihrem Zuhause Dinge, die sie als "smart" bezeichnen würden?

- Eventuell etwas, das kein elektronisches Gerät ist, aber sehr praktisch ist.
 - Evtl. Räume aufzählen, dann kommen sie vielleicht auf eine Idee
 - Evtl. Öfen, etwas Vernetztes?

Toröffner Garage
Wachsende Kinder programmieren

b. Gibt es technische Geräte, die Ihnen wichtig sind im Alltag?

c. Was haben diese Geräte für Vorteile und gegebenenfalls Nachteile?

weil es zu kompliziert ist → Kompliziert & Nachteil Angaben

C. Gibt es etwas, das Sie aus diesem Interview mitnehmen können?

neue Fiktionen / neue Ideen, Alles erhalten

D. Gibt es etwas anderes, über das Sie Feedback geben möchten?

7. Beim Teilnehmer herzlich bedanken für die Mitarbeit an der Studie

A. Nach Emailadresse fragen, falls Teilnehmer interessiert ist, die Arbeit nachher zu lesen

Seite 4 von 4

Druckdatum: Donnerstag, 28. März 2013

Papier Prototyp – Benutzerstudie

d. Wo im Haus / der Wohnung würden Sie das Gerät installieren?

- Wer würde sich für die Informationen interessieren?
 - Andere Personen, die im Haushalt leben? Gäste? Kollegen der Kinder, Nanny
- Wie in Nutzung integrieren?
zock waren interessant, vor allen Jungs

e. Angemessene Menge an Informationen ersichtlich auf dem Prototyp?

f. Was könnte man zusätzlich noch darstellen? Was würden Sie entfernen?
Unter kann unter Schreibtisch
sonstige Störungen werden verhindern
Statische Anzeigefläche
g. Wrap-up
der SIM für Otto verständliche Seite

5. Teilnehmer bezüglich ihrer normalen Kalenderroutinen befragen:

A. Digital / analoge

digitale Kalender
digitale Kalender für Schüler

B. Was Infos befinden sich auf dem Kalender? / neben dem Kalender?

- Vielleicht ist Zusatzinformation verfügbar zB. Eltern-Infotext neben dem Termin für die Schule

C. Wo befindet sich der Kalender?

Wohnungspfeilphuse

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- Participant 6 [TN6]

<p>Papier Prototyp – Benutzerstudie</p> <p style="text-align: center;"><i>TN6 (our klobus)</i></p> <h3>User Study for Paper Prototype</h3> <p>1. Das Vorgehen des Interviews diskutieren, Consent Form erklären / lesen unterschreiben lassen, Vorgehen bzgl. Videoaufnahmen vornehmen.</p> <p>Vielen Dank für die Bereitschaft für diesen Benutzerstudie mitzumachen und mir weiterzuholen meine Prototypen zu verbessern.</p> <p>Mein Name ist Jonas Hofer und ich bin Student an der Uni Zürich, momentan im Bachelor. In meiner Bachelorarbeit geht es darum, ob und wie das Verständnis und die Nachvollziehbarkeit von Smart-Home Informationen anhand von zeitbezogenen Metaphern verbessert werden kann.</p> <p>Dieses Interview ist kein Test, es gibt absolut keine „falschen“ Antworten. Grundsätzlich wird mein Prototyp getestet.</p> <p>Bitte ungenannt negative Aspekte des Prototyps nennen, da ich herausfinden will was eben nicht funktioniert am Prototyp, um diesen dann zu verbessern.</p> <p>Konzept Think aloud</p> <p>2. Nach den persönlichen Infos fragen (Job, Alter, ob Haus oder Wohnung, Wohnungs situation (WG, Partner, Familie))</p> <p>A. Frage wie Technologie-erfahren die Person sich einschätzt (Welche Geräte sie benützen, PC, Smartphone etc. Was machen sie wenn Probleme auftreten?)</p> <p>3. Vorwissen bezüglich Smart Home?</p> <p>A. Erklären lassen, was sie denken was das ist, vielleicht haben sie schon davon gehört</p> <p>* Nicht zu viel erklären, da dies ihre weiteren Antworten beeinflussen könnte</p> <p><i>davor gehört</i></p> <p>4. Show the calendar prototype</p> <p>A. Part 1</p> <p>a. Beginnen mit dem Zeigen des Prototyps und der Frage was sie auf den ersten Blick erkennen können (generell)</p> <p>b. Einfache Fragen (Eisbrecher)</p> <p>Nicht beeinflussen durch Herren von einzelnen Aspekten</p> <p><i>Hofer mit Uhrzeiten & wechselseitige Personen ⇒ kalender</i></p> <p>c. Detailliert fragen welche Teile des Prototyps sie erkennen können und was sie denken wozu dies dient.</p> <p>* Probs: Farben, Formen, Piktogramme, Strukturierung, Vergangenheit / Zukunft</p> <p><i>Vorlage Uhr Tagesschau ROT → gestrichelt hellgelb - Klaus selbst dunkel - Elterngebaude/Hausbesitzer - Personen Farbe</i></p> <p>Seite 1 von 4 Druckdatum: Donnerstag, 28. März 2013 Seite 2 von 4 Druckdatum: Donnerstag, 28. März 2013</p> <p>Papier Prototyp – Benutzerstudie</p> <p>d. Wo im Haus / der Wohnung würden Sie das Gerät installieren?</p> <p>• Wer würde sich für die Informationen interessieren? Andere Personen, die im Haushalt leben? Gäste? Kollegen der Kinder, Name?</p> <p>• Wie in Nutzung integrieren?</p> <p><i>Küche/Eingang, Küche interessant → Energiespar Wohlfühlen</i></p> <p>e. Angemessene Menge an Informationen ersichtlich auf dem Prototyp?</p> <p><i>Etwas gut genügt</i></p> <p>f. Was könnte man zusätzlich noch darstellen? Was würden Sie entfernen?</p> <p><i>+ Gänge</i></p> <p>g. Wrap-up</p> <p>5. Teilnehmer bezüglich ihrer normalen Kalenderroutinen befragen:</p> <p>A. Digital / analoge</p> <p><i>Smartphone + Kalender an Wand, oder meistens in Kopf + Gedächtnis ⇒ muss man nicht bei anderen Sorgen Sorgen</i></p> <p>B. Was für Infos befinden sich auf dem Kalender? neben dem Kalender?</p> <p>a. Vielleicht ist Zusatzinformation verfügbar zB Eltern-Infozettel neben dem Termin für die Schulese</p> <p><i>⇒ Seiten, die nicht nur wohn selbst beschreiben ⇒ Seiten die man vergessen könnte ⇒ Smartphone (Bsp 10)</i></p> <p>c. Wo befindet sich der Kalender?</p> <p><i>Geschäftl. ⇒ Laptop</i></p> <p>Seite 3 von 4 Druckdatum: Donnerstag, 28. März 2013</p> <p>Papier Prototyp – Benutzerstudie</p> <p>d. Was denken Sie, wofür der Prototyp nützlich sein könnte?</p> <p>• Bei den Beispielen: wofür braucht man die Information? * Probs: Zeit ablesen, was noch?</p> <p><i>wichtigste wenn automobilistisch, Anzeige praktisch Wolltum Heute Temperatur, Show wdh/wk → braucht man nicht unbedingt → Lukas</i></p> <p>e. Wann könnte der Prototyp nützlich sein?</p> <p>• Die Person erzählen lassen welche „Verwendungsszenarien“ sie sich vorstellen könnten</p> <p><i>→ wenn ausser Haus → ob Tiv abgeklemmt → anderen waren Gerät eingeschaltet</i></p> <p>f. Zwei weitere Szenarien darstellen</p> <p>• Guten-Morgen-Szenario (bereits seit Beginn dargestellt)</p> <p>• Während des Tages (Wochentag 8 und 16) → 12:00 oder 14:00 –</p> <p><i>spezielle Situationen, die nicht jeder Tag gleich → werden zusätzlich angezeigt</i></p> <p>B. Part 2 (more general part)</p> <p>a. Können Sie sich vorstellen ein solches Gerät zu Hause zu benützen?</p> <p>* Warum nicht? Warum schon – Mehrwert?</p> <p><i>ja: Mehrwert: kompakter, mehr an alles drüber müssen → Wochentag direkt zeigen Mehrwert</i></p> <p>b. In welcher Art könnte das Gerät nützlich sein? Was müsste anders sein, damit das Gerät nützlich ist?</p> <p><i>Raumtemperatur, Wetter über längere → Wochentag direkt zeigen Mehrwert</i></p> <p>c. Was denken Sie, was ihre Familienmitglieder / Mitbewohner zu diesem Prototyp sagen würden?</p> <p><i>wäre cool</i></p> <p>Seite 4 von 4 Druckdatum: Donnerstag, 28. März 2013</p> <p>Papier Prototyp – Benutzerstudie</p> <p>D. Wer führt den Kalender? Sind es evtl. mehrere Personen?</p> <p><i>Wochekalender beide</i></p> <p>6. Abschluss</p> <p>A. Welche möglichen Vorteile sehen Sie bezüglich des Prototyps / Nachteile?</p> <p><i>→ nicht wäre schlecht, sollte aber normal möglich sein ⇒ einfach Arten, hilft beim Stressmanagement in den Ferien (Saison Wahr)</i></p> <p>B. Allgemeine Fragen zu smarten Dingen in Hause</p> <p>a. Gibt es in Ihrem Zuhause Dinge, die sie als "smart" bezeichnen würden?</p> <p>* Eventuell etwas, das kein elektronisches Gerät ist, aber sehr praktisch ist. * Evtl. Räume aufzählen, dann kommen sie vielleicht auf eine Idee</p> <p><i>pum, Volumen PS3-PSP + Laptop Klebefolie Sticker</i></p> <p>b. Gibt es technische Geräte, die Ihnen wichtig sind im Alltag?</p> <p><i>Handy, TV, Klebefolie, Ladekabel</i></p> <p>c. Was haben diese Geräte für Vorteile und gegebenenfalls Nachteile?</p> <p><i>Wichtigen Stofflosser - nicht sehr effizient</i></p> <p>C. Gibt es etwas, das Sie aus diesem Interview mitnehmen können?</p> <p>D. Gibt es etwas anderes, über das Sie Feedback geben möchten?</p> <p><i>Wochekalender wäre schön bei Reservierkalender mobil wiederauf</i></p> <p>7. Beim Teilnehmer herzlich bedanken für die Mitarbeit an der Studie</p> <p>A. Nach Emailadresse fragen, falls Teilnehmer interessiert ist, die Arbeit nachher zu lesen</p> <p><i>→ Tageszeitungswahlsteuerung Stromablauf Smart → Auto wenn etwas nicht ok ⇒ wie bei Auto</i></p> <p>Seite 4 von 4 Druckdatum: Donnerstag, 28. März 2013</p>

Appendix C – Smart Home Event Types

EventCause

- Environmental Sensors
 - Brightness
 - Humidity
 - Wind
 - Pressure
 - Rainfall
 - Temperature
 - GasSensor
- InhabitantTriggeredSensors
 - MotionDetector
 - Camera
 - Button
 - Microphone
 - Keypad
 - RFID
 - NFC
 - LeaveHouse
 - TV
- SurveillanceSensors
 - MagnetContactSensor
 - GlassBreakSensor
 - DoormatSensor
 - UltrasonicSensor
 - PhotoelectricBarrier
- MonitoringSensors
 - ElectricConsumption
 - InternetUsage
 - WirelessTransmission
 - HeatingGasOilConsumption
 - RemoteAccessToSmartHome
 - PowerCost
- PseudoSensors
 - Clock

EventEffect

- Invisible
 - Heating
 - Ventilation
 - AirConditioning
 - Boiler
 - Irrigation
 - VideoCapturing
 - AudioCapturing
 - Lock
- Visible
 - Robots
 - Roomba
 - Scooba
 - LawnMower
 - Light
 - Shades
 - ShadesUp
 - ShadesDown
 - Stereo
 - TV
 - Oven
 - WashingMachine

EventType

According to Hamernik et al. [20]

- Lighting
- Shading
- Controlling of Appliances
- HVAC
- Safety
- Multimedia
- Health
- Kitchen
- Irrigation
- Clean
- Control

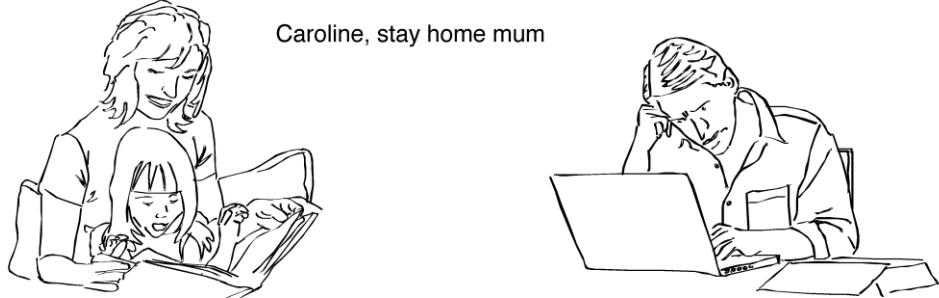
Causes, Effects and Types shaded grey are used in the Casalendar Interactive Prototype.

Appendix D – Sources for used Graphics

	arrow.svg	http://thenounproject.com/noun/arrow/#icon-No5581 by Naomi Atkinson
	Brightness.svg	http://thenounproject.com/noun/sun/#icon-No2660 by Adam Whitcroft
	Clock.svg	http://thenounproject.com/noun/clock/#icon-No3571 by Sébastien Desbenoit
	Heating.svg	http://commons.wikimedia.org/wiki/File:Heating-Radiator.svg by http://en.wikipedia.org/wiki/User:Inkwina
	LeaveHouse.svg	http://thenounproject.com/noun/house/#icon-No4766 by Yo Szezpanska
	Lock.svg	http://thenounproject.com/noun/key/#icon-No655 by Roger Cook & Don Shanosky
	Oven.svg	http://thenounproject.com/noun/oven/#icon-No3046 by Hakan Yalcin
	PowerCost.svg	http://thenounproject.com/noun/plug-in/#icon-No327 and http://thenounproject.com/noun/money/#icon-No2524 by Unknown Designer and Nathan Thomson respectively
	ShadesDown.svg	Own creation
	ShadesUp.svg	Own creation
	Temperature.svg	http://thenounproject.com/noun/temperature/#icon-No7810 by Ashley Reinke
	TV.svg	http://thenounproject.com/noun/television/#icon-No9002 by Cris Dobbins
	WashingMachine.svg	http://thenounproject.com/noun/washing-machine/#icon-No118 by Unknown Designer
	Wind.svg	http://thenounproject.com/noun/wind/#icon-No4252 by Ocha Avmu

Appendix E – Personas for Expert Walkthrough

Rizzo Family: Caroline, 37 and Peter, 38 with 2 yo Carla and 5 yo Stella

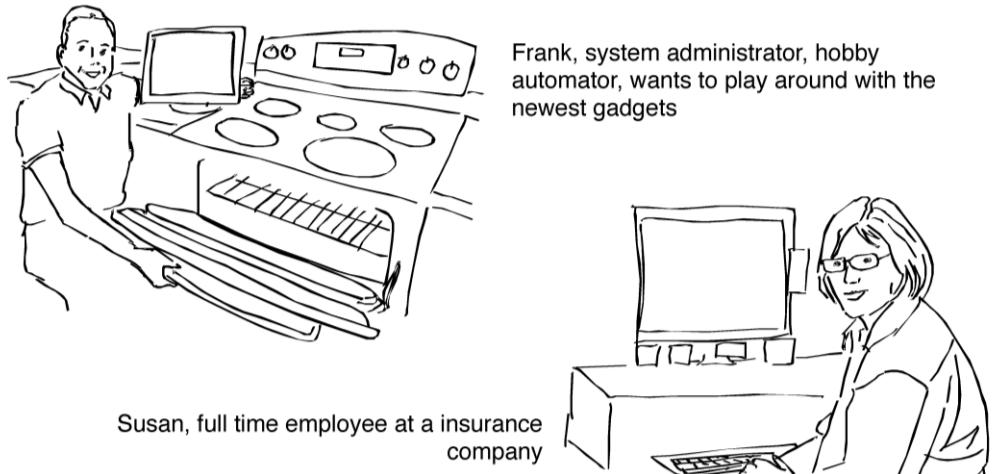


Caroline, stay home mum



Peter, working in the finance business, DIY automator to make his smart home affordable

Gardner Family: Susan, 41 and Frank, 43, no kids



Frank, system administrator, hobby automator, wants to play around with the newest gadgets



Susan, full time employee at a insurance company



Caroline is a stay at home mum to her two kids: Carla, 2 and Stella, 6. Together with her husband Peter they're all living in a semidetached house in a suburban area since 7 years.

Caroline used to work as a physician's assistant before the kids were born. Now she's dedicating her time completely to the household and the kids. Most of the times she's enjoying that she can stay at home and spent time with them.

She enjoys being very active, so she's doing a variety of sports. On Tuesdays and Thursdays she goes to the gym when Stella is at the school. Luckily they offer a "kids club" where Carla can play with other kids while her mum is doing Zumba. On the other days she tries to bike to the grocery shop or goes running either with Carla in a stroller or when her husband comes back home and can watch her.

Cooking is one of her hobbies, but in everyday life she actually has to handle it in a more practical way and preparing something quick, but still healthy - especially for the kids. To relax she enjoys watching a movie in the evening after she and her husband brought the kids to bed. At the moment they don't go out very often, but rather just enjoys when she has some time for herself and watch stupid TV shows.

Generally, Caroline likes the automation and is very curious about what her husband is creating to support their lives. But since she had some bad experiences, she is afraid of losing control of very basic features like turning the light on or off or opening the shades or be restricted by a machine. She considers the touch panel and the remote controls as an object for use, so she's not worried that she will break it physically, but afraid she might mess up the settings that took her husband so long to configure.

It's exciting to her when her husband tells her about all the stuff that you can do with automation, but actually, it conflicts a little with her appreciation for doing things herself and is also worried of losing the sense of accomplishment when everything is performed by machines.

Caroline doesn't have any technical training. She's from the generation that learned touch typing and a little bit of Word processing in her apprenticeship but that's all. Because she enjoys to stay in touch with her friends that don't live nearby she started using emails because their faster and more convenient than writing letters. She feels that she can get around with her skills but sometimes being a little bit to slow. Whenever she's in a hurry she wishes it would be a little bit easier for her. She would really appreciate if she could be a bit faster in those moments.

Half a year ago she got an iPhone, it's not the newest version because it's her husband's old phone. There are some apps she really enjoys using: e.g. Whatsapp, because it's almost like the texting she's used to but for free, the local public transit app, because she always forgets the schedule and she recently figured out that you can also see if a train is delayed and also there's a funny local weather app that gives a humorous touch to the weather forecast. Sometimes she's looking up the weather in her favorite vacation spot, not that it provides any real benefit to know that, but it's nice.

The biggest motivation to use the home automation is simply, because it's there and she has to. But also her husband's motivation is contagious sometimes. Caroline is very curious when he's trying new features and it's also exciting when there's new stuff in the home. In order to stay in control of her own home she's very keen on being aware of what he's doing, so at least she's not surprised when the controls in her home change. From time to time she has some ideas of how to change the automation or what would be cool to have and puts it on a paper wish list that Peter has a look at when he gets to it.

While Caroline doesn't have strong technical skills, she knows a lot about the everyday routines and dynamics of her household. She's the one who doesn't only have all the events and reminders in her and the family calendar but also in her head. She's still preferring the paper calendar because it's easier to access and Stella has her own column and starts putting in there when she wants to meet a friend. Her husband has all of his work and private appointments in his digital calendar on his iPhone. He also told her that she can access them on the touch panel but actually she prefers calling him, because usually they need to discuss to coordinate anyways.

Caroline Rizzo, 37

Experience Goals:

- feel comfortable and safe
- feel in control when necessary
- be pleasantly surprised
- not being bothered

End Goals:

- stay in the loop to be aware of problems before they become critical
- learn about opportunities for better support
- don't waste money/resources/time

Life Goals:

- raise the kids responsibly
- stay fit and healthy

Definition of smart:

Smart is what fits my routines and avoids unnecessary work.

Motivation:

Experiencing benefits increases interest in upgrades.

Challenges:

Experimenting and testing
Tension between comfort and control

Peter Rizzo, 38

Experience Goals:

- feel comfortable
- have fun
- stay informed

End Goals:

- stay in the loop to be aware of problems before they become critical
- be able to try the newest technologies
- reduce energy costs

Life Goals:

- raise the kids responsibly
- live a comfortable life
- be successful at work

Definition of smart:

It's not smart if I can do it better.

Motivation:

Smart homes save energy.
Modern homes are smart homes.

Challenges:

The challenge of planning for unfamiliar technology.
The challenge of getting high-level expert advice.



Peter Rizzo, 38

And also finding a "bug" in the home is sometimes really annoying. Because as he's not an electrician he doesn't know whether it's a hardware problem, something in the middle ware or really in his configuration. He spent many hours trying to fix the basement lights only to figure out that it's actually the motion sensor itself that is broken. Whenever his wife tells him an idea for the automation that would fit her everyday routines he's really keen on implementing it but it's difficult to find the time without drawing it from the quality time spending with the family. So often it takes a long time until he can actually make her requests happen.

Although Peter didn't have a professional education in a technical area he's has strong technical skills. Novel technologies have always been a hobby and he started some lightweight programming when trying to set up a website for their wedding 9 years ago. While his background is more in business he has to use a computer, phone and other technical devices also for work, so he feels very confident about these kind of skills. Ever since he became interested in home automation he also started learning more about sensors and is thinking about getting a prototyping kit to experiment with building something himself, although he's quite sure that he won't really find the time for it. He uses the digital calendar on his phone and on his computer because he always wants to have access to it wherever he is.

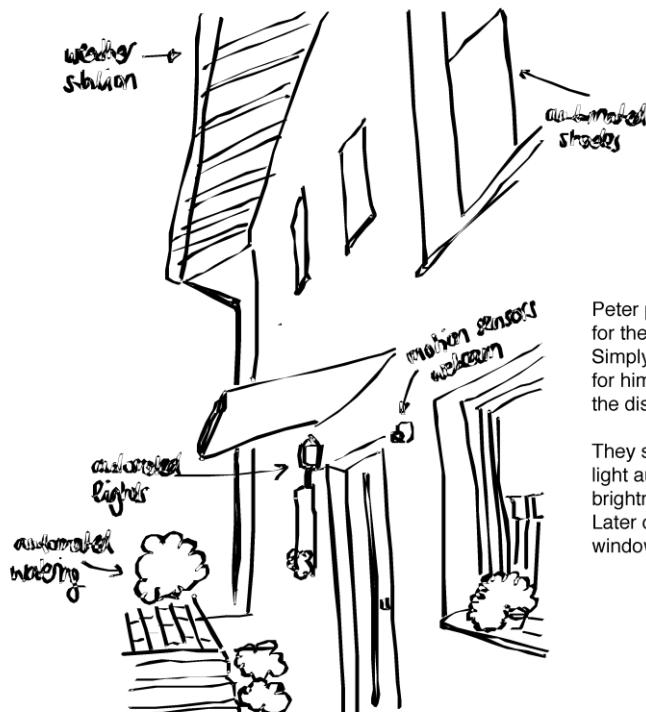
Peter's motivation to use the home automation was mainly because he got excited from his co-worker's stories and also the stories of his friends from the interest group. Now, he sometimes regrets to have spent money on maybe unnecessary features like the colored LED lights in the wellness area that they're never have the time to use, but he really does like that he can set the light intensity in the hallway based on the day/nighttime. Having a dimmer lights in the night is really nice, also if when Stella wanted to sneak into their bed room he didn't have to be afraid that she might fall. In his free time he enjoys having the entertainment systems connected with a NAS, so that he has access to all the media from almost any interface in the home. And when he cooks something on the weekend he can stream his favorite music to the kitchen.

Peter is working full time as a consultant in the finance business. Together with his wife Caroline and his two kids Carla, 2 and Stella, 6 he's living in a semidetached house in a suburban area.

Peter would like to spend more time on his hobbies gardening and photography, but he only has a little time for that on some the weekends or during holiday because in the evening he's often tired and wants to spend the remaining time with his kids. While the home automation "maintenance" is interesting it also became some sort of chore or responsibility for him that he sometimes would rather like to delegate. He also would like to be more active because he's staying seated almost the whole day having to work on the computer. So every once in a while he goes for a very early morning or late evening run.

He's very proud of his home since he and his wife did many things themselves. They're both quite talented when it comes to simple construction tasks. When they were planning to buy the semidetached home almost 7 years ago now they still had a lot of options because it wasn't build yet. Because of a co-worker he learned about home automation and got quickly excited about the potential functionalities it can enable – not so much about the high costs though. As he likes to do things himself plus he thought he could save some money doing the home automation himself he started spending much time online to do research on home automation technologies. He also signed up in an interest group forum and also started going to "real life" meetings with those people some of which he also became friends with and they're now sharing not only mere information about smart homes anymore.

Automating the home became quite a hobby for him, but actually sometimes it bothers him because he would rather have quick solutions for some problems.



Peter picked a central server solution for the "intelligence" of their home. Simply because it's easier to maintain for him and it was way cheaper than the distributed bus-system solution.

They started out by having shades and light automated based on motion and brightness sensors as well as timers. Later on they added sensors in the windows and a weather station.



Frank Gardner, 43

Frank is a system administrator(?) in a large pharmacy company. He actually used to be a electrician but then made this shift into the administration of IT. Together with his wife Susan he lives in a 4 room apartment in that they bought 2 years ago in one of the calmer neighborhoods of a medium size city.

Technology has always been Frank's hobby. Whenever he has time for it he spends his time researching new technology online, reading the IT paper magazine he subscribed to (and always wanted to change it for an eBook subscription on his iPad), or solders new gadgets in the hobby room in the basement. He simply loves playing around with the newest gadgets and automating the home has become much of a hobby for him. He knows that he should be more active for his health and his wife is trying to motivate him, but it's usually only on the weekend that he goes on a hike with her or a walk in the city.

Frank is very proud of what he installed in his home and he enjoys that he can play around with it – sometimes even playing tricks on his wife or guests by turning lights on or off. He dedicated a lot of time to the planning, but also into the installation. Due to his background of being an electrician he was able to do much of the electrical installation himself, but sometimes he didn't document it that well and thus making it harder to fix problems. When having problems with some sensors or actuators of a specific provider he goes online and posts his problem in an interest group forum. He also contributes and helps other people fix their problems when he can, but he never attended the meetings they organize. He feels like his wife wouldn't approve if he spends even more time on this stuff. He's very keen on giving her ideas a priority when spending time on configuring their home - maybe so she doesn't mind him spending that much time on it.

Whatever possible Frank tries to automate, starting with simple motion sensors to control the lights, having the vacuum cleaning robot connected to presence detectors in the home and having a sensor connected to their cat so that he can not only control it's only their cat coming into the apartment but also track at what time the cat eats its food and connected with a photo that's taken with the camera attached to the cat's food bowl. Not useful, but Frank finds it amusing to keep a blog with the sometimes very funny cat pics.

Frank was used to work as an electrician, but actually only for a couple of years, then he transitioned more into the IT sector. He started teaching himself how to program Java and then later C++ and also Python. First by reading books, later mostly with online sources. So, programming the home automation is not really a big deal for him, because it's mostly configuring things (besides the self made gadgets) but sometimes he wishes that he wouldn't have to use licensed software to be able to do that. Especially, since he feels that this software doesn't have a good usability and doing unnecessary work bothers him a lot. Actually, sometimes he would love to program his own configuration software. Also he considers it to be very frustrating when he's trying to fix a problem, but just can't find the actual cause of it. Is it a bug in his code? Is it the sensor that's causing the problem? Or is one of the wires not properly attached?

Home automation being Frank's hobby is the biggest motivation to automate more and more of the home. He first heard of it almost 20 years ago, but back then it was mostly for office buildings that needed to have central controls. But he was always fascinated by the idea of having advanced means of controls and the resulting comfort in his home. He probably would get rid of all the switches in the home but then he is afraid of upsetting his wife too much who doesn't understand what's the benefit of all that "smart home" stuff.

Frank Gardner, 43

Experience Goals:

- stay informed
- be able to make a lot yourself (DIY)

End Goals:

- learn about opportunities for new technologies

Life Goals:

- live a pleasant life

Definition of smart:

It's not smart if I can do it better.

Motivation:

Hacking the home as a hobby.

Challenges:

Experimenting and testing -> wife

Susan Gardner, 41

Experience Goals:

- feel comfortable
- not being bothered
- easy controls

End Goals:

- not being restricted in any way

Life Goals:

- live a comfortable life
- stay healthy

Definition of smart:

It's not smart if I can do it better.

Motivation:

Experiencing benefits increases interest in upgrades.

Smart homes save energy.

Challenges:

Automation doesn't re-invent the home; it just makes it more convenient.

Susan Gardner, 41

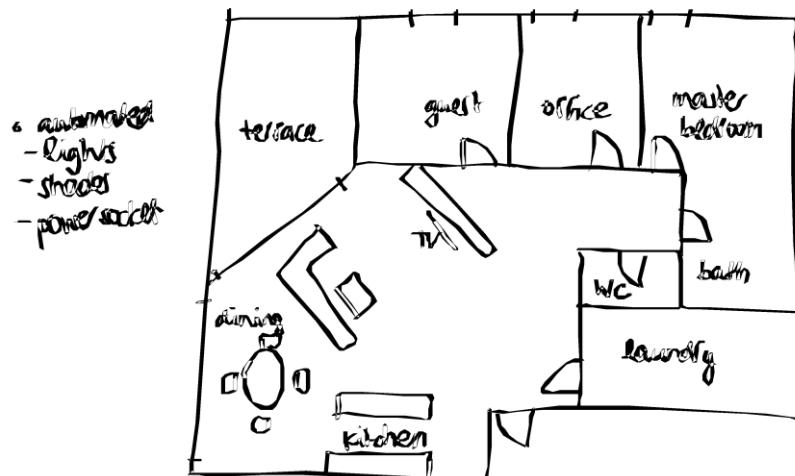
Susan is a full time employee at an insurance, she's working there for almost 8 years now. Together with her husband Frank she lives in a 4 room apartment in that they bought 2 years ago in one of the calmer neighborhoods of a medium size city.

Susan is a huge fan of being outdoors, that's also why she enjoys her plants on their big size terrace. But she would love to spend more time hiking on the weekends, so she trying to talk her "geek" husband into weekend getaways to the nearby mountains whenever she can. In general, she cannot really understand why her husband enjoys spending that much time in front of a computer. Susan is actually quite happy when she comes back home and doesn't have to sit in front of a machine anymore but can cook, read or meet her friends or talk to them on the phone.

Home automation is a huge hobby for her husband, that's why she's trying to accept that their home is sometimes somewhat a construction site and that there are some unexpected changes in how she has to control the shades or lights. But from time to time she wishes he told her or put up a sign or something, because she at least wants to know what's going on in her own home. At the same time she also had some ideas on what to automate, like the "iron off" function when the home detects that no one is present. Things like that she really appreciates because they make her feel safe and give her some peace of mind. And as long as she feels that she can control the main things in her home like the shades, lights and the doors it's ok for her when Frank is playing around a little with the home. Often she forgets the ideas she has, but every once in a while she talks to Frank about it in the evenings and he puts down her ideas in his online note taking app. So that he can get back to it whenever he finds time for it.

When studying business she also had to learn how to use some software applications. General ones like the Office Suite and also SAP. She feels confident in using them, but she simply doesn't enjoy sitting in front of a display they whole day. So when her husband showed her how he configures the shades in the home, it wasn't too difficult to understand but she didn't really see why someone can enjoy doing that like her husband does. Her husband can also control the home via his smart phone and he wanted to get her one as well, but she really doesn't feel the need to do so. When they're on vacation she likes to be able to check whether they turned off everything and whether the presence simulation works but for her it's fine to ask Frank and he can check on it and tell her.

Susan is not extremely motivated to actively configure the home automation simply because she doesn't want to spend her time dealing with more technology than necessary. But from time to time she has some ideas and sometimes she likes to fantasize about a home that makes her her cup of coffee in the morning, but it also feels to her that those things are all luxury wishes and that it might only make her lazy and that's something she doesn't want to be. At the same time, while being entirely unnecessary one of her favorite functions in the home is the automatic turning on/off of the christmas lights in the winter time. It's simply so welcoming and nice to come back home and see the lights on her way up without having to turn it one first and at the same time knowing that they will turn themselves off later and won't waste more energy in the night when no one can see them.



Frank decided to get a distributed bus-system solution for the flat because he wanted to have all options and also because he wanted to have the best reliability that is available.

They have a variety of building technologies automated.

The have automated lights based on timers and motion sensors, the shades are connected to brightness sensors and a weather station. The power sockets can be turned off, either individually or via an "all off" function.

They further have some gadgets installed, like the cat flap that only allows their cat to come in and the cat food logger, that takes a picture and records the time the cat eats.

Appendix F – Expert Evaluation Protocol

(Caroline)

Caroline Rizzo

Expert Evaluation

Users of the system: Families with Home Automation in their family home, system targets experienced users and novice users as well with a particular focus on "passive users".

Setting of the system in the context: The Casalendar interface will be wall-mounted at the house, in a place where one is frequently located or walks by (kitchen, living-room or hallway) and displays the information provided by their home automation equipment installed along with the personal calendars of the family members.

Tasks to be analyzed: Retrieval of information about the smart home and other inhabitants of the house by using the Casalendar interface.

Structure (Cognitive Walkthrough): please only note down problems that might occur and describe them

- I. Will the user try to achieve the right effect?
- II. Will the user notice that the correct action is available?
- III. Will the user associate the correct action with the effect to be achieved?
- IV. If the correct action is performed, will the user know that they have done the right thing?

Task 1

by yourself

"walk through"

1. Distinguish information about the smart home from information provided by calendars of other inhabitants.
- maybe I can distinguish (but, would be nice if smart home had an icon and the other ap. had an icon & to visually distinguish, red?)
2. Find out what time it is right now.
- It is 1:34 pm, But I had to look several minutes until I found the red line.
3. Scroll through the whole day and recognize the structure of the available information (columns for smart home and the three inhabitants).
- Same as (# 1).
4. How can you request more information about the smart home events?
- I clicked/touched on "Smart Home" But did not get any feedback
 - I then touched an individual Smart Home event and got text feedback under it (not sure what color coding means, I guess orange = electricity, yellow = lighting)
5. Find two possibilities to switch to Monday or Wednesday and back to Tuesday (today).
- Can find the May 07, 2013 ...
- But tried touching today and nothing happened.
6. Switch to a view of the whole week and find out which day it is right now.
- (Today) ~~should be more visually distinguishable~~
7. Find out if someone is at home tomorrow for lunch.
- (no).
8. What else can you do with this interface? Play around with it as you like.
- Would like to drag around events, But not sure how
 - Full week view (too much info), pls gray out events
 - (See above)
 - drag events...
 - want more types of smart Home events
9. What are the limitations of this device? Why would those functions be useful?
10. Which features are confusing, obtrusive or unnecessary? Why is that so?
- Put day of week on top in bold letters
- How does knowing Smart Home events affect routines in Household?

07.05.2013

Caroline Rizzo

➔ Please read your persona-files to get to know "you" a little better ☺



Task 2 consider to buy

with partner / in persona

"think aloud"

1. Discuss with partner whether you would buy the device for using at home or not.
2. Discuss with partner how you would use the device in your everyday life, how you would or wouldn't use it.
3. Can you think of a situation in which the device would be particularly useful?
4. Why would it be or wouldn't it be worth spending money on this device?

Task 3 user perspective

with partner / in persona

"think aloud"

1. Have a look at the interface. Describe in a few words what you see. Point out things that stick out to you (positive / negative)
2. What purpose do you think does the interface serve? What are actions you want to take with it?
3. What do you think the other family members would think about this interface?
4. Discuss with partner what you would like to have customized / added / removed

07.05.2013

Peter Rizzo

Expert Evaluation

Users of the system: Families with Home Automation in their family home, system targets experienced users and novice users as well with a particular focus on "passive users".

Setting of the system in the context: The Casalendar interface will be wall-mounted at the house, in a place where one is frequently located or walks by (kitchen, living-room or hallway) and displays the information provided by their home automation equipment installed along with the personal calendars of the family members.

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- I. Will the user try to achieve the right effect?
- II. Will the user notice that the correct action is available?
- III. Will the user associate the correct action with the effect to be achieved?
- IV. If the correct action is performed, will the user know that they have done the right thing?

Task 1	by yourself	"walk through"
1. Distinguish information about the smart home from information provided by calendars of other inhabitants.		
2. Find out what time it is right now.	<i>I) at first I looked for the watch (top right corner), then I swipe the red tile II) Yeah, but not on first glance what if it's 1am and you scroll down? Sru</i>	
3. Scroll through the whole day and recognize the structure of the available information (columns for smart home and the three inhabitants).	<i>No problem, it's basically task #1</i>	
4. How can you request more information about the smart home events?	<i>Click on them II) Right wands put a small arrow to indicate "more" info</i>	
5. Find two possibilities to switch to Monday or Wednesday and back to Tuesday (today).	<i>I) Tried to scroll left/right first, didn't work. Also no date picker (click date) III) scroll my touch screen, select date Didn't find the second way!</i>	
6. Switch to a view of the whole week and find out which day it is right now.		
7. Find out if someone is at home tomorrow for lunch.	<i>Carla + Caroline Task seems okay, but when is lunch time?</i>	
8. What else can you do with this interface? Play around with it as you like.	<i>Click around like Google Calendar...</i>	
9. What are the limitations of this device? Why would those functions be useful?	<i>Device or interface? I think there are some missed opportunities like tap, swipe...</i>	
10. Which features are confusing, obtrusive or unnecessary? Why is that so?		

Peter Rizzo

→ Please read your persona-files to get to know "you" a little better ☺



Task 2 consider to buy with partner / in persona "think aloud"

1. Discuss with partner whether you would buy the device for using at home or not.
2. Discuss with partner how you would use the device in your everyday life, how you would or wouldn't use it.
3. Can you think of a situation in which the device would be particularly useful?
4. Why would it be or wouldn't it be worth spending money on this device?

Task 3 user perspective with partner / in persona "think aloud"

1. Have a look at the interface. Describe in a few words what you see. Point out things that stick out to you (positive / negative)
2. What purpose do you think does the interface serve? What are actions you want to take with it?
3. What do you think the other family members would think about this interface?
4. Discuss with partner what you would like to have customized / added / removed

07.05.2013

Frank Gardner

Expert Evaluation

Users of the system: Families with Home Automation in their family home, system targets experienced users and novice users as well with a particular focus on "passive users".

part height variation

Setting of the system in the context: The Casalendar interface will be wall-mounted at the house, in a place where one is frequently located or walks by (kitchen, living-room or hallway) and displays the information provided by their home automation equipment installed along with the personal calendars of the family members.

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- IV. If the correct action is performed, will the user know that they have done the right thing?

Task 1

by yourself

"walk through"

1. Distinguish information about the smart home from information provided by calendars of other inhabitants.

✓

2. Find out what time it is right now.

Not very salient, easy to miss. Far away from date info.
No way to get precise time?

3. Scroll through the whole day and recognize the structure of the available information (columns for smart home and the three inhabitants).

Not sure what this means

4. How can you request more information about the smart home events?

tap

5. Find two possibilities to switch to Monday or Wednesday and back to Tuesday (today).

super not working

6. Switch to a view of the whole week and find out which day it is right now.

tap works but not super

7. Find out if someone is at home tomorrow for lunch.

Frank has 13:00 app't, but Susan is free

8. What else can you do with this interface? Play around with it as you like.

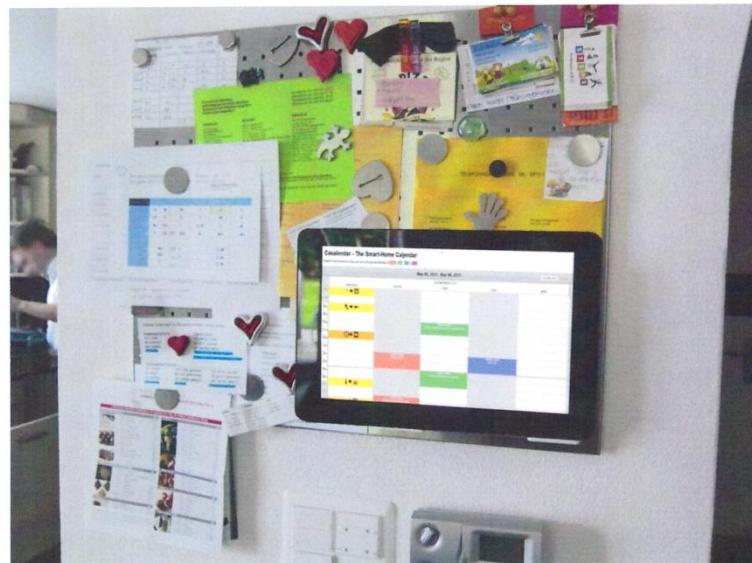
9. What are the limitations of this device? Why would those functions be useful?

Ability to schedule events

10. Which features are confusing, obtrusive or unnecessary? Why is that so?

Frank Gardner

- ➔ Please read your persona-files to get to know "you" a little better ☺



Task 2 consider to buy with partner / in persona “think aloud”

1. Discuss with partner whether you would buy the device for using at home or not.
2. Discuss with partner how you would use the device in your everyday life, how you would or wouldn't use it.
3. Can you think of a situation in which the device would be particularly useful?
4. Why would it be or wouldn't it be worth spending money on this device?

Task 3 user perspective with partner / in persona “think aloud”

1. Have a look at the interface. Describe in a few words what you see. Point out things that stick out to you (positive / negative)
2. What purpose do you think does the interface serve? What are actions you want to take with it?
3. What do you think the other family members would think about this interface?
4. Discuss with partner what you would like to have customized / added / removed

07.05.2013

Susan Gardner

Expert Evaluation

Users of the system: Families with Home Automation in their family home, system targets experienced users and novice users as well with a particular focus on "passive users".

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- III. Will the user associate the correct action with the effect to be achieved?
- IV. If the correct action is performed, will the user know that they have done the right thing?

Task 1 **by yourself** **"walk through"**

1. Distinguish information about the smart home from information provided by calendars of other inhabitants.

OK.

2. Find out what time it is right now.

Red line?

3. Scroll through the whole day and recognize the structure of the available information (columns for smart home and the three inhabitants).

I can only see 2 inhabitants? Ah. ok.

4. How can you request more information about the smart home events?

Click on the events

5. Find two possibilities to switch to Monday or Wednesday and back to Tuesday (today).

*1) arrows on either side of date - Wouldn't find the top
Swipe things*

6. Switch to a view of the whole week and find out which day it is right now.

*Correct day is highlighted, but not that
noticeable.*

7. Find out if someone is at home tomorrow for lunch.

*There doesn't seem to be anything in the calendar that
indicates this, but I*

8. What else can you do with this interface? Play around with it as you like.

See descriptions of home events

*does seem like
they have free
time around
noon*

9. What are the limitations of this device? Why would those functions be useful?

*Can't schedule calendar events for ppl
or home*

10. Which features are confusing, obtrusive or unnecessary? Why is that so?

Susan Gardner

- Please read your persona-files to get to know "you" a little better 😊



Task 2 consider to buy

with partner / in persona

"think aloud"

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2. Discuss with partner how you would use the device in your everyday life, how you would or wouldn't use it.
3. Can you think of a situation in which the device would be particularly useful?
4. Why would it be or wouldn't it be worth spending money on this device?

Task 3 user perspective

with partner / in persona

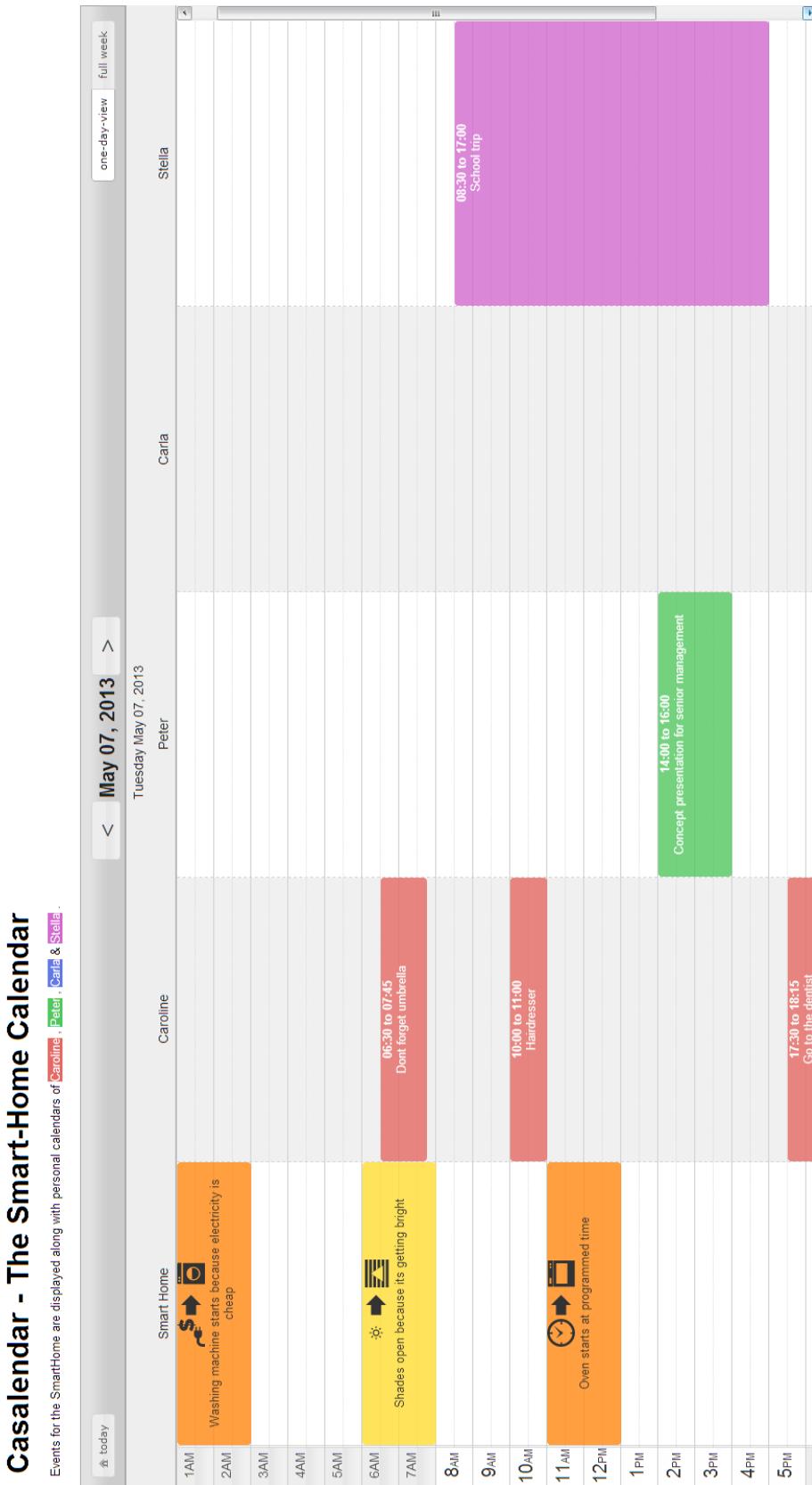
"think aloud"

1. Have a look at the interface. Describe in a few words what you see. Point out things that stick out to you (positive / negative)
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3. What do you think the other family members would think about this interface?
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07.05.2013

Appendix G – Full Page Screenshots

- The Rizzo Family – one-day-view



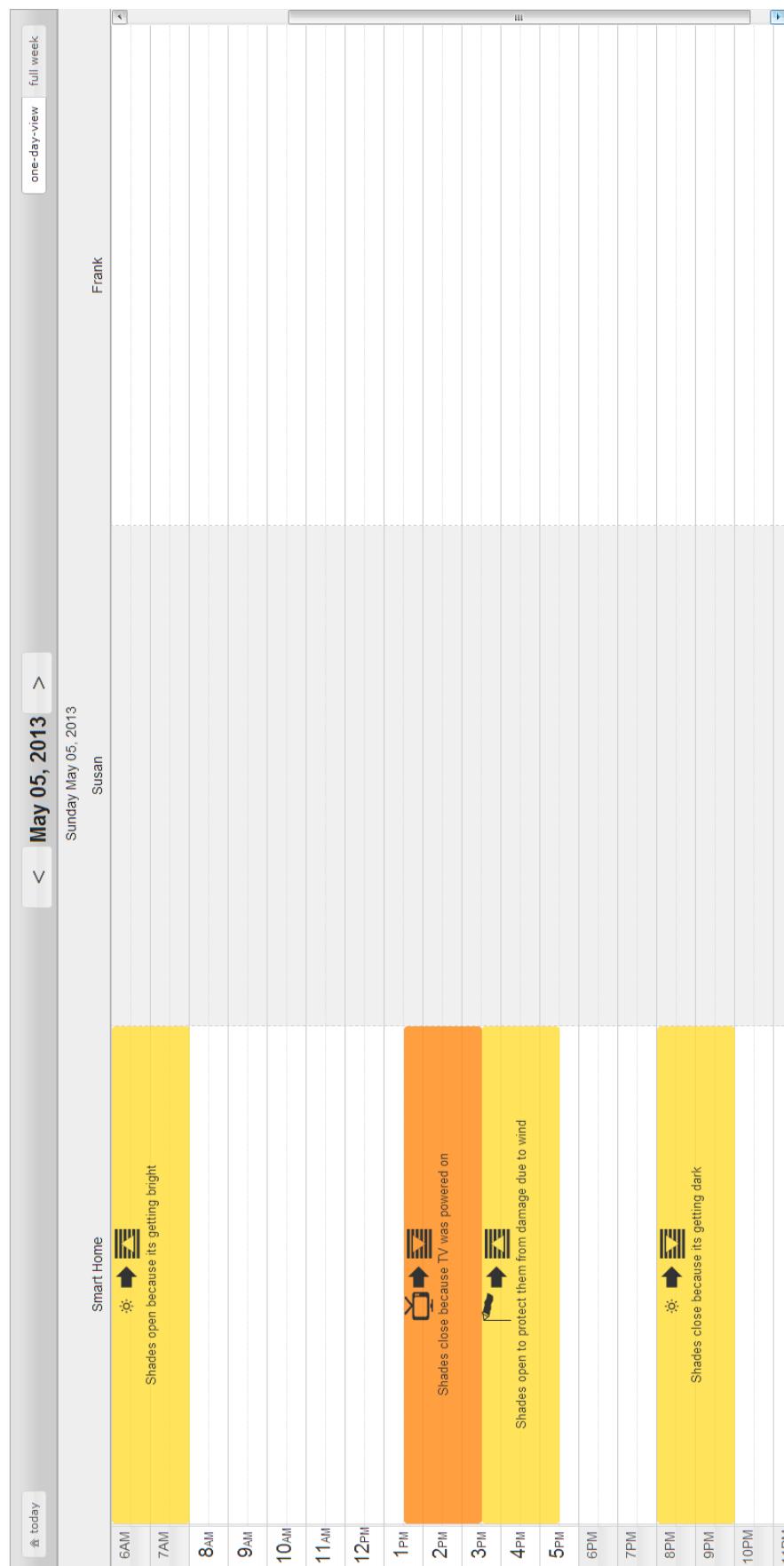
- The Rizzo Family – full week view

Casacalendar - The Smart-Home Calendar						
Events for the SmartHome are displayed along with personal calendars of Caroline, Peter, Carlé & Stella.						
At today						
Monday May 06, 2013	Tuesday May 07, 2013	Wednesday May 08, 2013	Thursday May 09, 2013	Friday May 10, 2013	Saturday May 11, 2013	Sunday May 12, 2013
6AM 7AM 8AM 9AM 10AM 11AM 12PM 1PM 2PM 3PM 4PM 5PM 6PM 7PM 8PM 9PM 10PM	6AM to 07:45 Shades open because it's getting bright 08:30 to 17:00 School trip 10:00 to 11:30 Advises for presentation by consultant friend 11:00 AM 10:00 to 11:00 Hairdresser. 10:00 to 11:00 Oven starts at programmed time 13:00 to 15:00 Weedy Team Meeting 14:00 to 16:00 Concept presentation for senior management 14:00 to 16:00 Zumba at Gym 14:00 to 16:00 Kids Club 15:00 to 18:00 Prepare presentation for tomorrow 17:30 to 18:15 Go to the dentist 19:30 to 22:30 Hendersons are over for dinner 22:00 to 00:00 Champions League Match	6AM to 07:45 Shades open because it's getting bright 08:30 to 09:30 Present findings to Board 10:00 to 11:00 Hairdresser. 10:00 to 11:00 Oven starts at programmed time 13:00 to 15:00 Weedy Team Meeting 14:00 to 16:00 Concept presentation for senior management 14:00 to 16:00 Zumba at Gym 14:00 to 16:00 Kids Club 15:00 to 18:00 Prepare presentation for tomorrow 17:30 to 18:15 Go to the dentist 19:30 to 22:30 Hendersons are over for dinner 22:00 to 00:00 Champions League Match	6AM to 07:45 Shades open because it's getting bright 08:00 to 12:00 Visit Zoo with Kids 10:00 to 11:00 Doors lock because everyone left the house 13:30 to 17:30 Playdate at Denise's 14:00 to 16:00 Zumba at Gym 14:00 to 16:00 Kids Club 15:00 to 18:00 Prepare presentation for tomorrow 17:30 to 18:15 Go to the dentist 19:30 to 21:45 Smart Home Enthusiasts Appointment 18:00 to 20:45 Made Dinner for Family	6AM to 07:45 Shades open because it's getting bright 08:30 to 18:00 Watch Andieas Kids as well	6AM to 07:45 Shades close because it's getting dark	6AM to 07:45 Shades close because it's getting dark

- The Gardner Family – one-day-view

Casalendar - The Smart-Home Calendar

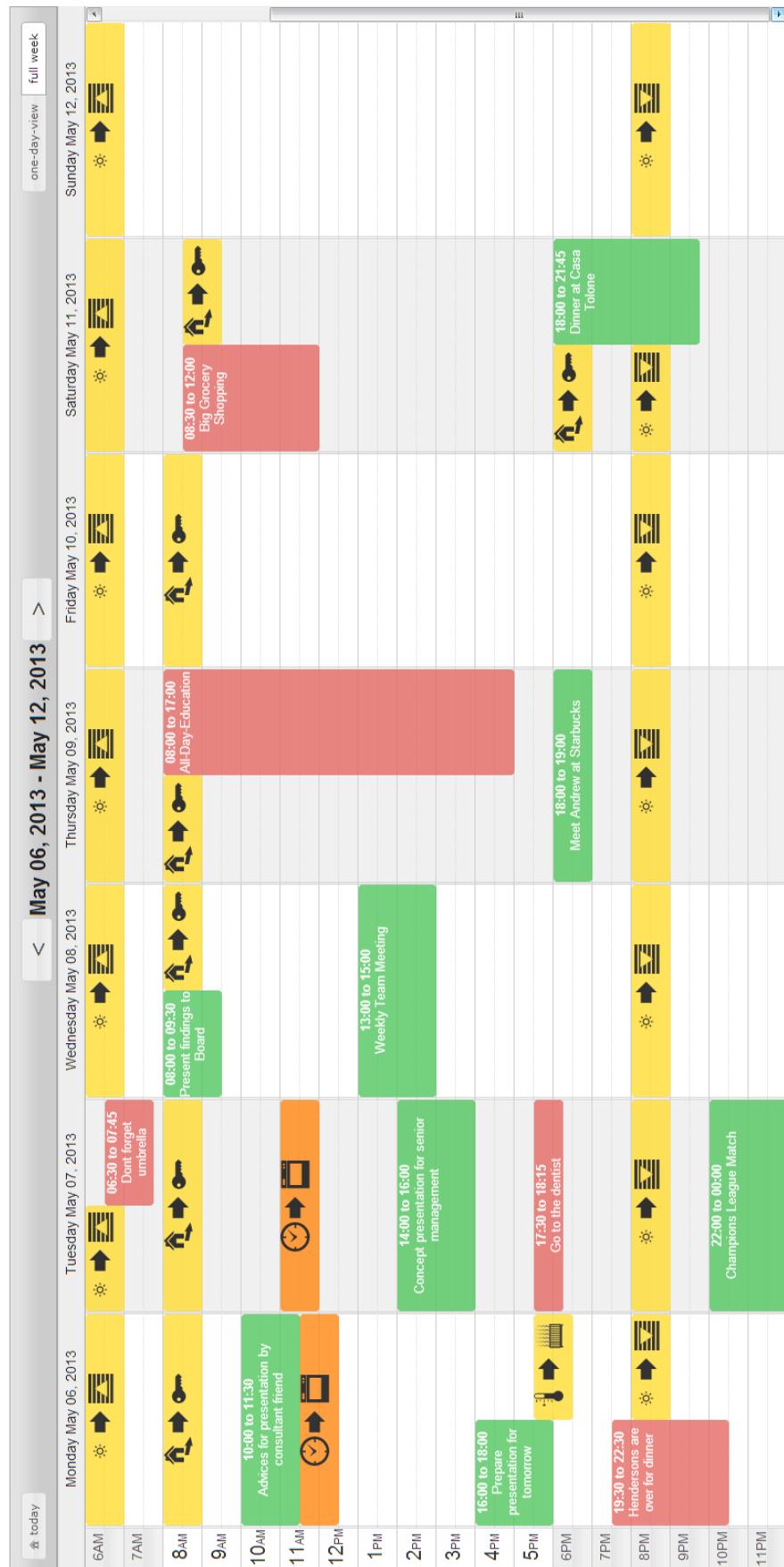
Events for the SmartHome are displayed along with personal calendars of Susan & Frank.



- The Gardner Family – full week view

Casalendar - The Smart-Home Calendar

Events for the SmartHome are displayed along with personal calendars of Susan & Frank.



Appendix H – Content of the delivered CD-ROM

- Abstract.txt Abstract of the thesis.
 - Zusfsg.txt German summary of the thesis.
 - Bachelor Thesis.pdf This document.
 - Casalendar.zip Zip-File containing the developed interface.

Eidesstattliche Erklärung

Der/Die Verfasser/in erklärt an Eides statt, dass er/sie die vorliegende Arbeit selbstständig, ohne fremde Hilfe und ohne Benutzung anderer als die angegebenen Hilfsmittel angefertigt hat. Die aus fremden Quellen (einschliesslich elektronischer Quellen) direkt oder indirekt übernommenen Gedanken sind ausnahmslos als solche kenntlich gemacht. Die Arbeit ist in gleicher oder ähnlicher Form oder auszugsweise im Rahmen einer anderen Prüfung noch nicht vorgelegt worden.

.....
Ort, Datum

.....
Unterschrift des Verfassers