User Interface Design for a Social Call Centre System Aimed at Elderly

Nai-Chi Chen
Abstract

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The trend of an increasingly aging population all over the world has made the elderly care and their living arrangement become very important issues. Many elderly choose to live alone, but the accessibility to care and the safety are of concern to many of them. The caring devices for the elderly who live alone now are usually an alarm button and a machine like an interphone. This relies on the elderly to carry the alarm button with them. They can ask for care or help from the supporting organizations by pressing the button and talking through the machine.

The goal of the MonAmi project is to create a new generation of elderly home care devices by collecting many useful services that are developed with ambient intelligence technology to help elderly who live alone to feel safe and comfortable. The characteristic of elderly care system is that no matter how powerful the device is, it still need support from people E.g. to deliver food to elderly, to provide care...etc. How well the device can be supported by the other parts of the elderly care system will be the key to whether the home care device is successful or not.

The organizations behind the home care device in Sweden now are a huge system and the call center plays a very important role in this system. It is the mediator between the elderly, the caregivers and other sectors in the elderly care system. The requests from the elderly are all sent to the call centers first and then passed to the responsible people or organization.

In this thesis, field studies were conducted to reveal the interaction between the call center and other parts of the elderly care system, several new features are proposed to the future call center software to support the new generation of elderly home care devices like MonAmi project. Lastly a conceptual prototype of the future call center software is presented together with the operators from the call centers feedback on this software.
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1 Introduction

1.1 Introduction

The rapidly increasing number of the elderly population in Europe and other developing countries make the need of having technology to help the elderly more and more important. In 2050, a high percentage of the population in Europe will be over 80 years old. This large aged population raises issues such as how to maintain their life quality? How to provide physical and mental care? And what effects will this cause to the government and the society?

To the huge part of the aged population, nursing homes is not a good solution anymore and it is a very expensive solution to many people. Most family members do not have the time to take care of them either. To live alone has become a growing tendency for many elderly. According to researches, most of the elderly prefer to remain independent as long as they can. Elderly who live alone mostly have higher satisfaction for their life. The reasons for this is generally that they feel they have more control over their life, have more privacy and that they are able to keep their own place. However, even if they prefer to live alone, many of them have concerns about their physical limitation due to age or disease, and no one can help or know if something happens to them when they are at home.

Another research shows that the elderly who live alone are more likely to have contact with home help and food delivery services and less likely to have someone they could contact in emergencies or at night. In order to help elderly to live alone freely, safely and to help them keep in contact with our society, developing a complete solution for cooperation between technology and the support from communities and government is needed.

In recent years, the provision structure of the welfare service for the elderly in Sweden has changed a lot. In the past, the elderly welfare service was provided mainly by organizations run by the government. Now it has become more and more privatized which has led to an increase in the cost for the service.

1 UN Report- World Population Ageing: 1950-2050
2 Report from New York Times
The mode of organizing and managing municipal operations is influenced by private business enterprises in a way that makes it appropriate to talk about a 'companization' of public activities. Gun-Britt Trydegård 2004

This ‘companization’ is happening in all European countries, and due to this tendency, the cost of the elderly welfare service is raising which has led to concerns among some elderly who cannot afford to pay a fee that keep increasing. The MonAmi project’s goal is to use technology to improve the support already given by the elderly care service sector in order to help the elderly and people with disabilities to receive sufficient service from their home.

1.2 Background

The MonAmi project
MonAmi is a European project devoted to improving the situation for the elderly and for people with disabilities. It is a four year long project which started the first September 2006. The fourteen partners are from seven EU countries. The project coordinator is the Swedish Institute of Assistive Technology (SIAT). The aim of the MonAmi project is to gather useful and accessible services for elderly and people with disabilities who live alone and also to enable the mainstream actors (family, service providers, government,) to easily receive the status of the elderly or disabled and to provide necessary support.

The project can be divided into two parts. One part is the ambient intelligence system in the home of the elderly which will keep monitoring the house environment and help the elderly to contact people. The second part is the support provided from the mainstream actors, which will be the emergency call center or the caregiver center for the elderly. The second part will be the one to receive and react to the signals and alarms that are sent from the ambient intelligence system.

The elderly care system in Sweden now
The elderly home care model in Sweden is mainly constituted by municipality institutions, private homecare institutions and informal care from family members and volunteer organizations. The organizations that

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3 Gun-Britt Trydegård 2004
actually provide the elderly homecare are the elderly caregiver centers. Caregivers usually visit elderly based on a scheduling table. The call centers react to alarm signals from the alarm devices (Figure 2) from the elderly people's home and answer phone calls from elderly, caregivers, police, hospitals, and other sectors which involve elderly care services.

The call center mediates the events between elderly and caregivers. This includes transferring the needs from elderly to the caregivers, which happen after caregivers have finished a scheduled visit or to provide the information and connection between other sectors e.g. the police, the hospital etc.

The call centers can be roughly classified into three types: SOS call center (112), elderly homecare call center (Trygghetsjouren) and other private companies which support the alarm devices. The types of call center the elderly will contact will depend on the districts they live in. Elderly homecare call center (Trygghetsjouren) is specially for handling alarms and calls from elderly and support other organizations or roles which are related to elderly care e.g. caregivers, family of elderly, police etc. As for the SOS call center (112), to support alarms from the elderly is just one of the many types of events they need to deal with. Fire, ambulance and more emergency events are included in their work content.

Some districts (like Uppsala) may have their own elderly homecare call center (Trygghetsjouren) specially take care of the communication between the different sectors and roles of elderly care system and some other districts may use the SOS call center (112) as the mediator for the local elderly alarm system. One call center might handle the alarms from the elderly from more than one district or several call centers could share the workload from several districts.
The interface design of this thesis is for the software used by the operator at the elderly alarm call center. By investigating the operators’ desire, requirements and their working process I will come out with ideas about
how to make use of the power of the future elderly home care devices, like the MonAmi project, to help the operators support the requests from elderly better.

1.3 The connection with other part of the project

Another part of the MonAmi project is the device which provides ambient intelligence services in the home of the elderly. The users of this part of project are elderly, so the aspect of this part of project is from elderly people's point of view. My part of the project considers the needs for the people in the call center. Both sides will have some services that need support from each other. Basically, the two projects exchange the requirement from two sides and cooperate with each to archive those services.

1.4 Purpose and Goal

This thesis is a part of the MonAMI project for the call center. The jobs of a call center are:

- To receive the alarms from peoples' homes and answering the phone calls.
- To bridge care givers or nursing services to the home of the elderly if the call center receives an alarm sent or a call from them.

The purpose of this thesis will be to discover the requirements of the call center operators, figuring out what kind of information they need and what information that can be provided from the ambient intelligence service device in elderly homes. Based on these discoveries – I will come out with ideas about how to make use of the power of the future elderly home care device like MonAmi project to help the operators support the request from elderly better.

The goal I want to achieve with my design is to help the operators give better support to the elderly and other organizations of the elderly home care system.
1.5 Method Summary

The method that will be conducted is contextual design, which includes field studies in the call center and interviews with the future users for catching the user’s workflow and requirements, etc. Users will be involved in most of the phases of the development for refining the design and to do usability testing.
2 Limitations:

Time:
The project is in a very early stage of the design flow. In the preparation of the project, looking for organizations to cooperate with, contacting stakeholders and arranging time for activities of design research takes a large part of the project's time. However, the project began in mid-February and needed to be finished in the end of May. Contact and arrangement time took more than one month. The parts of result analyzing, report writing etc. are all to be compressed into a very short time period or are forced to be worked on in parallel.

The coverage of research subject:
I found out from the interviews that the type of call center to handle the alarm from the elderly change from municipality to municipality and that the way they cooperate with other elderly care sectors could be different as well. The software and hardware condition in different call center could also vary largely. It would help to gain a better understanding about how most of the call centers are like, if I were able to visit more call centers in different areas.
3 Method

The nature of the project

One of the parts of the MonAmi project for the elderly home is to create an ambient intelligence environment and the device that is installed in the elderly home is able to receive information of the environment in the house to send more information to call centers to help them understand the condition of the elderly. (E.g. Room temperature, entrance, lights etc.) Most systems for supporting elderly who live alone on the market now are alarm devices that only send out simple information to the call centers; the system of MonAmi is much more complicated and will change the workflow of the operator in the call center. To design a new interface that enables operators to easily work efficiently, it is necessary to understand the user's preference, original workflow, etc. So User Centered Design is chosen as the approach for this thesis. This approach will be explained below.

The Contextual Design

In the early days of software industry, the interests of engineers were to solve technical problems and to meet deadlines. People who built the software interface where usually programmers. They had limited understanding about users and when a conflict happened between interface usability and coding difficulty. When a conflict like this occurred the interface usability was usually the one to be sacrificed. Users had no other choice but to be forced to adapt the products. With the hardware of computers becoming more and more powerful and the competition between companies becoming more and more heated, industries finally noticed the importance of understanding how the need of the users should influence the hardware design. The User Centered Design (UCD) is a design philosophy and a process that involves users into each step in the design process. It believes the opinions from the people who are actually using the products are the key that leads to good design. By consulting with the users or potential users, designers can receive valuable design ideas and information. Compared to other design principles who give attention to work processes or tasks, UCD focuses on the user’s needs, goals, desires or motivations.

Because the MonAmi project will provide a huge amount of information

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4 Saffer, 2010 p86
5 Beyer&Holzblatt 1998
about the elderly and their home environment, to prevent the new design from providing overwhelming information to the operators in the call center, I will use contextual design. It is chosen as approach to catch the way the call center works now in order to develop the design for the new call center interface based on the knowledge gained during the observation.

The Contextual Design process consists of six main steps:

- **Contextual Inquiry**: Discovery of what the user really need, their goal and needs, desires and work process from their daily work.
- **Work Modeling**: Catch the work flow from the organization and use graphs to describe them and give suggestion to improve the processes.
- **Consolidation**: Put all the data gathered from interviews, observations...etc together to look for common patterns and take variations into account.
- **Work Redesign**: Use the result from the consolidation stage to come out with ways to improve work.
- **The User Environment Design**: Check the data about the user’s environment and try to make them to support the user’s work better.
- **Test with Customers**: Use prototype to test with customers and collect their feedback.

In this thesis, I went through almost all the steps, except the step of design user’s environment since it is not in the scope of this thesis. By interviewing with users (the operators in the call center), observing how they actually work, I collected the users requirement, their goals and their working process. The first two steps that is contextual inquiry and work modeling are fulfilled by field study (Chapter 3 and part of chapter 4). Then I analyzed the material I gathered from the field study and looked for patterns in their work and common problems. After the analysis, I tried to come out with ideas to solve those problems or to help users work more efficiently. This covers the steps of consolidation and work redesign (part of chapter 4 and chapter 5). In the end, I design a paper prototype based on the result of previous research and let the users to review it and collect their thought about it and this fulfilled the last step- test with customer (Chapter 6)

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6 Holtzblatt, K 2001
3.1 Interview and observation in the field

I visited two main types of call centers which were an elderly homecare call center (Trygghetsjouren) and a SOS call center (112) in Uppsala (Figure 3). The activities included a one day site visiting to have a meeting with stakeholders in the two call centers and around 16 hours of interviews, spread out over several days, with operators and observation of their daily work.

Before observing the operator working, an interview with the operator was conducted. The time for this interview was around 40 minutes and the goal of it was to understand their workflow, typical cases they handle every day, the goal of their work, etc. In short, the interview was for drawing the contour of how the operator’s work.

After having a general idea about the user’s work, the observation applies contextual inquiry. The advantages of using contextual inquiry in the observation is that by asking questions during the observation, I can retrieve the subject’s mental model more easily and more efficient⁷ Through the subjects’ explanation of the reason of their behaviors more details of the operators’ daily work can be revealed. The observer sits on the right or left

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⁷ Saffer, 2010, p. 86
side behind the operator to have a clear view of the operator's table without bothering their work too much.

Two interviews were made with the operators, each interview around 40 minutes. The observations were conducted several times in the two call centers during two months and every observation time was at least four hours.

**Participants Profile**

<table>
<thead>
<tr>
<th></th>
<th>Gender</th>
<th>Age (Around)</th>
<th>Work experience in call center (years)</th>
<th>Involve Activities</th>
<th>Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>male</td>
<td>40</td>
<td>17</td>
<td>Interview</td>
<td>SOS 112</td>
</tr>
<tr>
<td>2.</td>
<td>Female</td>
<td>40</td>
<td>20+</td>
<td>Observation</td>
<td>SOS 112</td>
</tr>
<tr>
<td>3.</td>
<td>female</td>
<td>30</td>
<td>3</td>
<td>Interview, Observation</td>
<td>Elderly emergency call center</td>
</tr>
</tbody>
</table>
The Desk Tour

Elderly homecare call center (Trygghetjou)

Except for the interview, a desk tour was taken before the observation to have an idea about the related hardware and aid they use that is not computer software. (Figure 4)

![Figure 4 Overview of the desk in the elderly alarm call center](image)

1. Incoming call information display (Figure 5): Each of the displays is for one phone line. There are three phone lines for three different groups: Police, Caregiver and Public (mostly elderly). The display shows the incoming call's information. E.g. the phone number of caller, time.

2. Telephone and speed dial device: Operators answer incoming calls through the telephone and call other organizations using speed dials.

![Figure 5 Close look of the phone call display](image)
3. Hardcopy contact information: Miscellaneous information. E.g. Spec of alarm device.

4. Microphone switch Alarm/telephone: The operators use a headset to talk to people call from the phone line and to the elderly who have pressed their alarm device. The switch is for them to change between these two channels.

![Pedal switch](image)

Figure 6 Close look of pedal switch

Pedal switch (Figure 6): The switch is for talking to alarm users, operators step on it and talk to the elderly. If they release the switch, they can talk through the headset to other people without being heard by the elderly. It allows operators to call other organizations to help the elderly and talk through the alarm device with the elderly at same time.
SOS call center (112):

Figure 7 Overview of the desk in SOS call center

1. Screen for showing map: This screen will show all the locations of the ambulances and fire trucks. It is mostly used for supporting 112 calls.
2. Screen shows incoming calls or alarms: The operator in the SOS call center will handle more than one type of calls or alarm. The different incoming events will be displayed in queues for different types of event. E.g. phone line for requesting ambulance, the elderly alarm, fire alarm etc.
3. Screen for showing detailed information: Most of the operation happens here. When the operator clicks the event in the incoming event queue in screen 2, the detail information will be shown on screen 3. The software will show a "work plan" to the operator that gives suggested handling steps. To call the organizations they need, writing documentation and to check former events are all handled on this screen.
4. Screen for other work: operators run the rest of the applications in here, email, word and so on.
5. Head set and its switch.
6. Keyboard and mouse for handling events: this keyboard is for screen 1-3.
7. Keyboard for hotkeys: the operator can use it to use hotkeys of the software for handling calls or alarm.

8. Keyboard for screen 4: an independent keyboard for operators to work on other things than to handle alarms or calls.
4 Results

4.1 The interview

Work process
The work process of these two call centers are similar. They answer the call or the alarm from the elderly and transfer the requests to other sectors. However, from the result of the interviews, these two types of call center still have some difference in the way they handles the calls.

First is the foundational difference between these two types of call centers. The SOS call center is not just for handling alarms from the elderly. The alarms from the elderly is one of many types of events which they need to deal with and they do not answer the calls from elderly, their families or other calls about elderly care issues like elderly alarm call center answer do. Operators usually support more than one type events.

Because of those reasons, SOS call center tend to look for more efficient ways to handle the alarms and play a very pure role as a request deliveryman. We can see this from their processes to handle alarms. Except for phone calls, they use SMS to send the information of request of elderly to caregivers and the caregivers need to reply the SMS to confirm they have received the text message. The software used in the call center will track if the caregivers reply to the SMS or not and it will notify the operator if they did not confirm after a particular time. This method saves a lot of time compared to calling caregivers every time the call center receive alarms, but this way decreases the chances for caregivers to inquire more information about the assignment. Unlike the elderly call center, caregivers are the only sector the SOS call center has contact with for issues regarding the elderly. The process of handling elderly in SOS call center is simpler – let the caregivers handle all the issues.

The purpose of the elderly alarm call center is specifically to work as a mediator between others sectors involved in the elderly care system. According to the interview I conducted, operators in this type of call center did not only handle elderly alarms, but also need to answer calls from the public, the police or the elderly. They tend to make different judgments than to just pass the request to the caregivers. The elderly alarm call center has
more interaction with all sectors related to the elderly care system. Except for the caregivers, they help elderly to access nurses for medical advices, help hospitals to get caregivers to bring elderly patients home, call ambulances when it is necessary and provide necessary information to the police. The participant of the elderly alarm call center mentioned that the caregivers now can update information of elderly as well. This would help the call center to receive more information about the elderly who have no alarm device at home and more details about elderly who do. This enables the call center to support other sectors better. E.g. now caregivers can add information into the database that an elderly will be away from home for two months and the operators will see this note when the hospital or police call the call center for looking for the elderly.

The strong points of SOS call center is they can handle emergency events very efficiently because they can reach other emergency resource directly, like ambulances or police. If an elderly need an ambulance, elderly alarm call center need to call SOS call center. For elderly alarm center, they have deeper connection with resource related to elderly care. They can provide more subtle service to elderly.

**Typical cases:**
The typical cases in these two call center is requests for care. Request for help to get to the bathroom, get up or go to the bed are the top three typical cases that was mentioned by the operator of the SOS call center. Social calls, which are the type of call elderly make because they feel lonely or just need someone to talk to, are one of typical cases in the elderly alarm call center.

**Rush Hours**
The rush hours for alarms or calls are:
- Early morning (5pm~8pm): Mostly for asking for help to get off bed.
- Lunch time (12pm~1pm)
- Early evening (6pm~9pm): For food delivery or help to go to bed

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8 Before the new system was used, the elderly alarm call center was the only side which could add information into the elderly alarm customer information database and the info was from the application of the alarm device. However, it is possible that elderly have care service but no alarm devices and now caregivers can add information about these types of elderly into the database too.
The workload in the rush hours is around: 20-30 alarms and 10-20 calls per 30 minutes in elderly alarm call center and 30-40 alarms per 30 minutes in SOS call center. Operators do not have a special workflow to handle alarms or calls during the rush hours. “We just try to keep it short” is what they told me.

**Difficulties**

Alarms which nobody answers or answers from elderly who are unable to be heard clearly are two of the difficulties mentioned in the interview. Another issue is the sound quality, some elderly mumble or speak from another room, the operators I interviewed wish they could have better sound quality from the elderly side. Elderly alarm call centers have separate systems for receiving calls and alarms. For the alarms, they have software for handling it, all the information about the alarm device owner will be shown on the screen when the operators check the alarm from them. However, for calls, they still use very traditional extension telephone system and they need to look for the callers' information in an online data base. For sending documents to other sectors, they hope to update to a more modern way than fax.
4.2 Field Study

Process of handling incoming alarm signal- Elderly homecare call center (Trygghetjouren)

<table>
<thead>
<tr>
<th>Actions of operator</th>
<th>Input and Output on computer</th>
</tr>
</thead>
<tbody>
<tr>
<td>A incoming alarm show up on the screen</td>
<td>All the incoming alarm events will be shown in a queue of the alarm handling software.</td>
</tr>
<tr>
<td>Clicks on the event in the queue.</td>
<td>The information about the alarm user will be brought up to the screen. E.g. name, address, simple information about the user, their caregiver contact info.</td>
</tr>
<tr>
<td>Switches headset to alarm mode and step on pedal to speak to the user.</td>
<td>Write down the summary of the alarm event for record, check alarm history...</td>
</tr>
<tr>
<td>Inquire for the need of the users and checking their</td>
<td>Add a label to the alarm about how it was handled.</td>
</tr>
<tr>
<td>Call other organizations according the user’s situation</td>
<td></td>
</tr>
</tbody>
</table>

There is software specially designed to receive the alarm signals. When the operator clicks on the alarm event in the queue of the software, all the information about the alarm device owner will be brought up to the screen. The operators can find the information they need very easily and they can call caregivers by only clicking their phone number on the screen.

The software of handling alarms provides several labels that represent typical reasons for why elderly press the alarm button and operators can use them when they input record for the alarm: Cancel caregiver visit, Fall, Door, No answer from the elderly, Mistake, Ask for care, Testing, Social, Talk to nurse, Technique, Help for toilette, Caregiver haven’t arrived.
The flowchart shows the general process on how operators handle alarms. There are three types of alarms – normal alarm, silent alarm and technique alarm. The normal alarm can be triggered by the elderly and they are able to answer the operator. The silent alarm is usually triggered when the status of something in the home change and operators do not get to talk to the elderly. The technique alarm is from the alarm device, triggered by for example low battery or testing.

### Process of handling incoming phone call- Elderly homecare call center (Trygghetsjour)

<table>
<thead>
<tr>
<th>Actions of the operator</th>
<th>Input and Output on computer</th>
</tr>
</thead>
<tbody>
<tr>
<td>An incoming phone call and the operator check the phone line display</td>
<td>Start a new call record and input the time of the call</td>
</tr>
<tr>
<td>Switches headset to phone line mode and press answer button of telephone.</td>
<td>Search for data in alarm customer database with the information they provide</td>
</tr>
<tr>
<td>Inquire for the need of the caller and ask their basic information</td>
<td>Input more info into the record of this call and add a label to the alarm about how it was handled.</td>
</tr>
<tr>
<td>Call other organizations if the case needs support</td>
<td></td>
</tr>
</tbody>
</table>

In this elderly alarm call center, they have no software to support the cases coming from phone lines. Unlike when the cases come from the alarm and the software will show all the information of the elderly when the operator receive the signal, the way operators handle the phone call is almost manually. They use a table in a Word file to keep things on track. The data they input to the word file is the same as the data they log in the alarm software. The information of the elderly, for example, address, the contact information of the caregiver who is responsible for, is all in an online alarm customer database (the alarm handling software uses this database as well) and operators can use an internet browser to search for the alarm device.
Process of handling elderly alarm through SMS messages in SOS call center (112)

<table>
<thead>
<tr>
<th>Actions of operator</th>
<th>Input and Output on computer</th>
</tr>
</thead>
<tbody>
<tr>
<td>A incoming alarm show up on the screen</td>
<td>All the incoming alarm events will be shown in a queue of the alarm handling software.</td>
</tr>
<tr>
<td>Clicks on the event in the queue.</td>
<td>The information about the alarm user will be brought up to the screen. E.g. name, address, simple information about the user, their caregiver contact info.</td>
</tr>
<tr>
<td>Inquire for the need of the users and checking their status now.</td>
<td>Write down the summary of the alarm event for record, check alarm history.</td>
</tr>
<tr>
<td>Send out SMS message that with elderly information to caregiver</td>
<td>If it is a simple case that can just send information through</td>
</tr>
<tr>
<td>Call the caregiver and make sure they have noticed or received the SMS message</td>
<td>If caregivers didn’t reply the SMS message in the time limitation, the system will show a message on the screen.</td>
</tr>
</tbody>
</table>

In the SOS call center, they usually use similar process like in elderly alarm call center to handle elderly alarm. However, in some simple cases, for example if elderly need help to go to the bathroom, they send information about the request of elderly through SMS message to caregivers.
5 Analysis of results

The ambient intelligence services of MonAmi project can provide large amounts of data about the condition of elderly and status of the environment of their home, it will be a big aid for organizations which provide care or services to elderly, like the call centers. However, what is the information they need and how will they want it to be provided, this should be considered from the operators' point of view.

We can come out with some design ideas from the general processes used in elderly alarm call centers now. One design idea is how to support or aid the typical cases, the other is to define new types of alarms or to help to simplify the handling process of the types of alarm that exist now.

We can find the typical cases from the labels that the operators use when they input alarm records:

- Caregiver hasn't arrived, Caregiver there: For some elderly or people with dementia, it is very common to forget that caregivers have visited them. The process of handling this now is that after receiving the request, the operator will call the caregiver who is responsible for the elderly and inquire about if the caregiver have visited the elderly, then they call the elderly again and explain to them. (Figure 8)

![Figure 8](image)

Figure 8 the handling process for elderly complain about they haven't receiver care now

The process can be simplified by adding a service to the MonAmi device in the home of the elderly which caregivers can sign in to when they visit the elderly. The data would be sent to the call center, then operators can just simply check the sign in record and tell whether the caregiver have been to there or not and solve the concern of the elderly directly. (Figure 9)
No answer from the elderly: If the operator receives an alarm, but no one answers from the alarm device, e.g., the elderly do not hear the alarm, they have lost consciousness or it is a silent alarm. The only way to solve this problem now is that the operator calls the caregiver to check the status of the elderly directly. However, caregivers are not always available immediately; sometimes the delay could cause very serious consequences. If it was possible to provide more information to the operators, they can help the elderly more efficiently. The information that would be useful to the operators in the call center could be: the location of the elderly, health status, e.g., pulse, blood pressure, body temperature, respiratory rate or even the information from a pacemaker.

Talk to the nurse: When elderly press alarm for this issue, the operator will call the nurse for them, then the nurse will call the elderly and talk to him or her. For telemedicine requirement, if the MonAmi device could provide a service that is able to collect health data of the elderly daily, the operator can download the data and send it to the nurse when they call him/her for the elderly. The nurses would have more data when he/she consult with the elderly.
6 The Paper prototype

The Paper prototype is inspired by the software that is used in the elderly alarm call center of Uppsala and the information collected from my field study. Except for designing an interface supporting the new features of the services of MonAmi ambient intelligence device, the new design will also consider the need of call centers in the future.

The new features to support MonAmi project:

- Caregivers sign in record: Simplify the process of handling questions about whether caregivers pay visit to forgetful people or people suffering from dementia.
- Track location: Show location of the elderly in the home. Help operators make better decisions when they receive silent alarm or calls, alarms nobody answer or unclear answers.
- Vital stats: showing pulse, breathing rate, body temperature. Providing operators more information for decision making when they receive calls or alarms nobody answer or unclear answers.
- Elderly health history data download: The service of ambient intelligent device at elderly home can collect the health data of elderly for long-term. E.g. blood sugar record, blood pressure record…etc. Operators can download those data and send it to a nurse when elderly call or use alarm to request operators to access a nurse for them.
- New alarm signals: The ambient intelligence can detect people’s movement and the sensors in the home give many clues about the person’s condition and send out more silent alarms:
  - No movement alarm: If an elderly does not move for unusually long, an alarm will be sent to the call center.
  - Toilet Idle: If an elderly does not use their toilet for unusually long, an alarm will be sent to the call center.

The needs that I found in the field study:

- Taking phone calls into account: The alarms and calls are handled in two different systems and the operators really wish they could have a better way for handling phone calls. Because of this, in my design operator will be able to handle alarms and calls in the same system.
- Caregiver’s schedule: Operators wish they could have access to the caregivers’ schedule so they more easily can answer questions from the
elderly who are waiting for a caregiver's visit. Combined with the new feature of the caregiver sign-in system, operators could expect to have information about when, where and who the caregiver should be.

6.1 The Basic layout:

The basic layout of the interface shows the important elements of the work of the elderly alarm call center and it contains the major roles and the information flow between them. The three important roles in the elderly alarm system are: The call center – operators, the customers – elderly and the people who actually give the care – the caregivers. The important events are incoming alarms/calls and unfinished alarms/calls. The whole screen is divided into five areas for showing information of them (Figure 10):

1. Queue of incoming alarms/calls: The incoming alarms/calls will be placed in here according incoming time.
2. Queue of unfinished alarms/calls: The alarm/calls that have been answered but operators have not finished inputting record of them.
3. Information of elderly: Information about the elderly who send the calls/alarms. Operators can find the location, vital stats of the elderly, the history of using the alarm and they can download the health data of elderly in here too.
4. Information of caregiver: The information of the caregiver who is responsible for taking care of the elderly. Their contact information, their schedule and sign-in record of their regular visiting.
5. Record of alarms/calls: Operators will input the reason the elderly call or use alarm and how they handle it.

When operators click the alarms/calls in the queues in area 1 or 2 or the old alarm records, the detail information will be shown in Areas 3-5.
Except for the information about the three roles displays in the area 3-5, they display the information about relationship and the interaction between them.
Area 3 – the elderly: Showing the elderly information and the information of the interaction between the elderly and the call center- the call/alarm history.
Area 4 – the caregiver: Showing the information of the relation between the elderly and the caregiver. E.g. who is the caregiver for the elderly, when he or she should visit the elderly, what kind care the caregiver is providing...etc.
Area 5 – the call center: Here will be displayed the interaction between the call center and elderly – the reason the elderly call or use alarm, and the interaction between the call center and caregivers – how the operator handle the event and what the operator did with the caregivers. (Figure 11)
6.2 The features

Integrating phone call handle process into the design:
To integrate the process of handling the phone call, the new event message is designed in a way that will show up in the two queues of alarms/calls. From the field study, I have learned that it is very common that call centers use different phone numbers to classify their callers. At the same time, which phone line the caller use is an important clue for operators to help them to prioritize calls. For example, except 112, the SOS call center answers calls from many other different phone numbers for different purposes. Some of them may be dedicated to people calling because their pipes are leaking. In elderly alarm call center, they have three phone numbers for police, caregivers and the public. The new design will label the phone calls with “Police”, “Caregiver” or “Public” to indicate which phone line the call came from. The priority of the elderly alarm call center is alarms first. For this reason, there will be a telephone icon in front of the event message if the event is from phone line so operators can prioritize their work efficiently.
When the call center receives an event from the phone line detailed information will be shown in area 3-5. In area 3 the “Case type” field will show the information about the event.

The “Case type” field can tell the operator whether it is an event from the phone line or an alarm and what kind of alarm or from which phone line. The incoming phone number will show up in the “Phone number” field of the basic information part. Operators can input the name of the caller and the system will search related information and show it in the other fields. E.g. call history, in charge caregiver information ... etc.

Figure 12 Four different incoming events

Features related to the elderly:
The new features regarding elderly which can be supported by the future elderly home care device are:

- **Vital stats:** With this addition, operators can get a rough idea about the elderly’s health condition. This will also provide them with more information when they cannot talk to the elderly. The display provides a traffic light like indicator (Figure 13, Figure 14) to give an efficient way
for operators to determine the status of the elderly and the actual numbers are shown behind the indicator for further judgment.

![Image of vital stats with red and yellow lights indicating danger and abnormal]

Figure 13 Vital stats of elderly in red (dangerous) and yellow (abnormal) lights

![Image of vital stats with green light indicating normal]

Figure 14 Vital stats of elderly in green light (normal)

- **Location tracking:** The main difficulty to incorporate this feature into an interface is how to show the target’s location without having the house floor plans from every home care device owner. It is possible to draw the floor plan in the system, but it would be impractical, to obtain thousands of users’ floor plans and building those plans into the system, would require a lot of work and not to mention might intrude on the right to privacy.
The abstract map:
To solve the problem with successfully incorporating locating tracking, I came out with the idea of using an abstract map (Figure 15). By extracting the common locations of all the houses and use circles to represent them, it would be possible to show the location without using real house floor plans. The following question would be how to show the target’s location on map. It is possible the target is not in a particular room and many house have two locations together or connected together. The solution of this is to use a color to show the relative position of the target and the locations around him or her. Except for the spot where the target is, other spots that are close to the location of the target will appear in color too, and the color cover range will be decided by how close the spot is to the target. E.g. the target is in the corridor which is close to the kitchen and the bedroom (Figure 16)
Figure 16 The map is showing location of the target

- **Health history data download:** Operators can choose health record of the elderly for a period of time and download and send it to the nurse for the elderly who need medical consulting.

Figure 17 The interface for downloading health history data
**Features relate to the caregiver:**

- **Caregiver sign-in record:**
  Operators can see the caregiver's visiting record. When he/she arrived, when he/she finished and what kind service he/she provided during the visit. (Figure 18)

![Caregiver sign-in record](image1.png)

*Figure 18 The caregivers' sign-in record in the elderly place*

- **Caregiver schedule:**
  The caregiver's pre-decided schedule is displayed here and also shows her progress so far. (Figure 18)

![Caregiver schedule](image2.png)

*Figure 19 the schedule of the caregiver named Anna*
6.3 Meeting with the operators:

After the paper prototype finished, it was shown to the operators in the elderly alarm call center and their management. The purpose of this meeting was to introduce the design, explain its functions and to collect the feedback from the participants. Except to gather what they thought about the prototype, there were also some questions I wanted to be clarified during this meeting. These questions were:

- How important the “alarm code” is for the operators for their decision-making when handling alarms?
- Can they understand the concept of the abstract map that is used to show the current location of the elderly?
- Is there any information missing from the tables?

General Feedback

For the data display labeled incoming call, participant prefer to show the actual name of the organization which is calling if the caller’s phone number is in the system, rather than to just show which phone line (Police, Public, Caregiver) they are using. Because there are many different organizations which use those phone lines, some of them may use a phone line they are not supposed to use so the operators prefer to see which organization is calling. The operators also prefer the incoming alarm to show the alarm type in text as well. The participant gave a very good suggestion about the elderly alarm/call history part. They suggested that the operator can click each row of the record to see the detailed info of the former event. The operators think the sequence of the areas of the caregiver information (Area 4) and call center documentation (Area 5) should be exchanged. The reason for this is that they usually start inputting the notes about the event when they are on the phone and then call the caregivers. The display sequence of “elderly info”, “documentation” then “caregiver info” is more fitting for their workflow.

The questions

- How important the “alarm code” is for the operators for their decision-making when handling alarms?

The reason to raise this question is because the interface of the software they are using now (Figure 20). The design seems more alarm-oriented. Most of the information is shown in alarm base. The alarm code is the code
for each type of alarms. E.g. alarm code (1234): the alarm device is going to out of power. In the software they use now, it shows alarm code in the incoming event in the queue and in the detail information of the alarm after operator click the event too. It looks like very important information for operators. However, the feedback of the participants shows that they do not use the alarm code for decision making. They do not need the system to show it all the time.

![Image](image.png)

**Figure 20** the look of software that the elderly alarm call center is using now

- **Can users understand the concept of the abstract map?**
  The participants’ reaction to the abstract map was a bit confused at the beginning when it was displayed, but they understood the concept immediately once I told them the color show how close the location is to the target. The participants thought this feature would be useful. When a silent alarm is triggered, like a door alarm, the operator can check if the elderly is still in the house or; in case of a fire, they can help the police to locate the elderly. However, they thought that for most of the cases that the elderly alarm call center handle have no need to know the exact location of elderly. “If it is something so urgent, I think it is mostly handled by SOS,” one of the participants said.
Missing information for the tables

For the first prototype, to miss some necessary display information is very common, especially for the headers of tables on the interface. However, the participants seemed satisfied the headers for most of tables. They only mentioned a need to add a “Note” header into the elderly call/alarm history in the table where the event is summarized.

Participants gave very positive feedback about the whole design. They were very happy to see that the new design integrates the phone calls into the system and that the information they needed for work were all available on the screen directly with no need for more clicking. The participant thought the feature that would be the most useful was the one that would help the call center keep track on the caregivers. All the participants felt that what the new generation elderly home care devices can do is beyond their imagination.
7 Discussion/Conclusions and future work:

The MonAmi project is a European project. The device will be used in different environments and will be supported by different elderly care system. Some countries hope to use the devices in nursing homes and the users of this software could be nurses. This research is only based on the environment in Sweden. Future work could be to investigate the elderly care system in other countries and to adjust or upgrade the base of the model built in Sweden.

The Future work
The future work would be to refine the prototype according to the feedback collected from the operators and conduct usability evaluation to how well the users actually understand the design. Among many features, I believe the feature of showing location will be needed to be tested alone because the concept is not common in most systems.

There are several things which could be added into the design in the future. Add hotkeys into the interface, further features for the information provided about the caregivers, trying a new way to assist to input text or use the special hardware to give more efficiency to handle alarms and calls.

Hotkeys is a part that I did not take into account for the first prototype. For the operation in a busy call center, the hotkeys can add speed by letting the operator move the cursor less frequently to save time.

Another future feature that could be added is to give further information about the locations the caregivers will visit. In the prototype now, it simply shows the caregiver’s schedule and his or her progress so far. To be able to show the locations on the schedule on a map and to provide an estimated time between each location or to show the caregivers who are around a given location would be helpful for the operators and would enable them to dispatch the cases more appropriately to the caregivers.

Use of other ways to input might help to increase efficiency. Like speech recognition software to catch the keywords when operators are talking. There are researches conducted in a traffic incident handling center\textsuperscript{9} that tried to use

\textsuperscript{9} Ronnie Taib1, 2006
digital handwriting input and speech recognition. These two methods can catch keywords when operators talk on the phone or when the operators write down notes and search for it in the system.

Except to put effort on refining the design, some hardware can be helpful as well. One is a special type of mouse (Figure 21) or keyboard (Figure 22, Figure 23) with many extra buttons that user can define by themselves. This type of mouse is usually made for playing strategy computer games, the users face similar condition – too little time and too many buttons need to be clicked. So, combining the hotkeys in the software and the customizable buttons on the mouse, operators might find themselves to be able to handle events faster.

Figure 21 The mouse for strategy game in the market

Figure 22 Special keyboard 1
Another future field study could be to investigate how the caregivers work. This study mainly focuses on how the call centers work and what they need for their work, but the caregivers is the role that actually provides the service. How they interact with elderly and arrange their work would be another great aspect for a designer to come out with a service that provide better communication between the caregivers and the operators at the elderly care system.

**Conclusion and Discussion**

It is impossible to achieve a successful elderly home care by only focusing on the elderly. Most of the services need other organizations support. Through this research we can see how the call center supports the device nowadays and it provides some ideas for the future elderly home care device from the call center’s point of view. The elderly home care device of the MonAmi project is totally different and much more powerful than the device in use now. It could penetrate the users’ home very easily, it is expectable there would be many ethical concerns raised by this type of device. How we provide services without violating the users’ privacy is an important aspect which needs to be carefully considered.

During this study, I found people who work in the elderly care system has no idea how they could use the device from the MonAmi project to help their
work. As a researcher, I believe what we can do is to conduct more studies for every link in this system and for the interactions between them. With that knowledge we can propose a new elderly home care system robust enough to support the future home care device. How well the connection between every link is will be the key to create a successful elderly home care system.
8 Reference:


Ronnie Taib1, Yu Shi1, Eric Choi1, Fang Chen1, Matthew Sladescu2, Nhan Phung2 (2006) Multimodal User Interface Facilitating Critical Data Entry for Traffic Incident Management, 1) Interfaces, Machines And Graphic Environments (IMAGEN) National ICT Australia 2) School of Information Technologies, University of Sydney


9 Appendix

Question list for call center operator interview:

1. Could you tell me what events you handle every day? What does a "normal day" look like?
2. Could you tell me your workflow E.g. what you do after you receive a phone call? Describe some typical "cases".
3. When is the busiest time in a day? How heavy workload is it? E.g. how many cases do you need to handle in 15 minutes?
4. Do you use a different workflow when you are very busy? How is it?
5. Except through phone calls, how do you receive cases?
6. Who do you communicate with? About what?
7. What are difficult parts of your work? What are important problems? In general? In the use of your technical support systems?
8. What is quality in your work? What is important to achieve?
9. What do you think that is the most important characteristic of software built for a call center?
10. What do you think about the software you use for your work now? What are the features you like? And features you don't like? Why?
11. Are there things you would like to change? In the organization? In the work processes? In the technical support systems? How would you like it to be?