HearMeFeelMe - Overview of trials and demonstrations

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1. Objectives of the trials
2. General service concept
3. Research activities.
4. Requirements for service concept
5. Designed service process in both countries: Finland and Spain.
HMFM Trials (Objectives)

- Objective: to design, implement and evaluate innovative ICT services and systems
  - Co-design with end-users, technology and research partners
  - Including also end-users in the design and evaluation processes
- User group: elderly people affected by the chronic condition of vision impairment
- Role of trials: Validate technology and service concepts in real settings for learning about adoption, created and experienced value for different stakeholders.
The general service concept

- The service is for identification of medicine packages and retrieval of medicine related information
- The user interface is audio- and touch-based
- It is implemented with Near Field Communication (NFC) technology which is a communication technology for transferring digital information contactless over a short range between objects
- Information is presented through audio interface using a speech synthesizer

Ibumax 400 mg
1-2 tablets 3 times a day…
Research activities

1. A service concept was defined in a co-design process together with the project partners.

2. An early prototype using a NFC-enabled PDA was created and evaluated with user studies in Finland and in Spain.

3. Experimental setups were created and evaluated in field trials in Finland and in Spain. A complete service covering the whole service chain from the pharmacy to the home of the user was implemented.
Requirements for the service concept

- Co-design process was carried out between 2009 and 2010.
- A set of **requirements for the service concept** were defined:
  - The distribution channel of the tags should **cover all medication** sold - both over-the-counter and prescription medicines.
  - **Quality and validity of the information** should be ensured.
  - The new service concept **should not dramatically change the delivery process of the medicines**.
  - The new service concept **should cover both daily medications and medications taken occasionally**, e.g. in the case of the asthma attack.
  - The service concept should cover **medicine in different formats**, e.g. liquid, powder, and pills.
  - The service concept should cover **medicines stored in different places**, e.g. kitchen cabinet and fridge.
  - The service concept **should not dramatically change the consuming process of the medicines**.
  - The service concepts **should not cause enormous costs for the medicine supplier or the end-user**.
  - The needed **components for the service** should be commercially available in a couple of years.
Service processes (general)

PRESCRIPTION

Doctor

Receipt

Dispensation

Pharmacist

Medicine + NFC tag

Monitoring

Patient/customer

Administration
Service processes  At the pharmacy:

Customer

Pharmacist

Finland

Spain

Access to the electronic receipt information with computer
Service process  At home:

1. Find the medicine package
2. Place package and reader near each other
3. Listen medicine name and instructions
4. Select correct medicine and quantity
5. Consume medicine
HearMeFeelMe - Pilots in Finland and Spain

Igone Idigoras Leibar, TECNALIA Research and Innovation

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1. Pilots schema
2. Pilot 1: Description, findings and conclusions.
3. Pilot 2: Description and findings.
4. Pilot 3: Description and findings.
5. Pilot 4: Description and findings.
6. Conclusions and next steps.
HMFM pilots schema

2009

User Study + Pilot 1 (Finland-Spain) BlindNFC

2010

Pilot 2 (Finland) PC-based reader

Pilot 3 (Spain) Personal medicine assistant

Pilot 4 (Finland) Tag and touch

2011
An early prototype using a NFC-enabled PDA was created and evaluated in the user study during the year 2009 in Finland and in Spain.
Blind NFC: prototype

- An early prototype using a NFC-enabled PDA was created and evaluated in an user study during the year 2009.
- The user study included user interviews, observations and usability analysis in laboratory settings.
**Blind NFC: participants**

- In Spain, individual interviews were carried out within two different user groups:
  - 17 people belonging to the ONCE association (Spanish National Organisation for the Blind). These users were blind or with severe deficiencies.
  - 10 elderly people contacted through the San Jorge Elderly People’s Centre in Santurtzi; people with slight hearing and/or visual impairment due to old age.

- In Finland, two groups of interviewees participated in interviews:
  - Eight elderly people living in at the area of Caritas village with varying level of problems with their sight.
  - Four younger visually impaired people who are members of the Finnish Federation of Visually Impaired (FFVI).

→ Thus, altogether 39 people in Spain and Finland participated in the user study.
BlindNFC: interview findings

- Elderly people are less homogenous group regarding their functional limitations than the people contacted through associations for blind
  - In Spain, the group of elderly people had also slight hearing impairments (3/10)
  - In Finland, several elderly interviewees had clearly decreased motor and cognitive skills
- People contacted through associations from blind were more used to mobile phones and computers than people from Elderly people’s centre and Caritas village
  - In Finland, all FFVI members used mobile phone actively and they had screen reader programs in their mobiles. They also used computers daily. One explanation is that they were younger than the other interviewees; average age 46,75 years.
  - In Spain, 8/17 ONCE group members used mobile phone and 14/17 computer whereas 9/10 used mobile and 0/10 used computer of Elderly people’s centre.
BlindNFC: interview findings

- The most of people interviewed had regular medications, both prescription medicines and over-the-counter products.
- In Spain, users usually managed their own medication by themselves, carrying out purchasing, storage, and self-administering.
  - However, it was found that 35% of the interviewees from ONCE group need help from other people, usually family members, to their medicine management.
  - People from Elderly people’s centre did not mention any problems with identification of their medicines.
BlindNFC: interview findings

- In Finland, almost all interviewees needed some support in their medication management.
- Procedures from medication management were identified:
  1. Person stores the medicine packages separately from others
  2. Person uses the slight remaining vision in identification
  3. Person is capable to read Braille text
  4. Person relies on other people
Blind NFC: usability test

- 27 people from Spain and 7 from Finland participated
- The users carried out a set of pre-determined tasks:
  - Task 1: Locating of NFC tags on medicine package
  - Task 2: Reading of pre-recorded tags
  - Task 3: Comparison between different voices
  - Task 4: Tag writing using self-recorded audio messages
- Users completed the first three tasks quite well, but the last task was clearly too demanding for several elderly testers, especially in Finland and ten users were not able or willing to complete the task. The reason was that the users were unable to locate the recording button on the PDA and pressing the button was also difficult.
Blind NFC: usability test findings

- The user’s were able to locate the NFC tag on the medicine package as soon as they knew what they were looking for.
  - Users commented that if the tag would always be in the same side of the box, it would help finding it.
  - Shape of a tag should be different from the shape of the package.
  - It was also found that thicker tags would be useful for blind people.
  - Strong contrast in colours would help people with vision impairments.
  - 32/34 found the task easy or very easy

- There were some problems related to reading the NFC tag.
  - Knowing the right touching angle and appropriate touching duration were sometimes problematic.

- The users completed the third task much quicker than the second task, which shows that the users were able to adopt the service use quite easily.
BlindNFC: usability test findings

- 52.9% of the users prefer computerized voice over natural voice due to the clarity. 26.5% preferred natural voice and 20.6% couldn’t decide which is better.
- In addition to audio information, information should also be provided as text, because visually impaired people can read it by their screen reader program.
- The option of recording tags was highly rated by the users, especially as a way of making reminders about medicine dosages.
- The users would find pre-recorded tags also useful, but they still would like to have the option of personalizing the messages.
Pilot 2: PC-based setup in Finland

2009

User Study + Pilot 1 (Finland-Spain)
BlindNFC

2010

Pilot 2 (Finland)
PC-based reader

2011

Pilot 3 (Spain)
Personal medicine assistant

Pilot 4 (Finland)
Tag n’ touch

Conclusions

1. Medication management as a priority
2. Most elderly people do not use mobile phones.
3. Elderly people were able to adopt NFC use quite easily.
4. Additional functions like reminders, dosage verification and medication plan information were also highly rated by users.
5. Blind people were more used to mobile phones
6. Blind people were able to adopt NFC use easily
7. Option of recording tags with personalized messages was highly rated specially by blind users
A PC-based experimental setup using a laptop computer with an external NFC reader was developed and evaluated in a field trial during the year 2010 in Finland. It included an application for pharmacists for tagging medicine packages.

Eight participants aged from 69 to 89 (average 78) participated.
PC-based setup: step one

Tagging the medicine package

Attach NFC (Near Field Communication) tag to the medicine package
Put medicine package on top of the NFC reader
Prescription information is written in local Pharmacy
PC-based setup: step two

Reading the medicine package

Touch NFC reader with medicine package and computer will read the medicine prescription aloud

OR

Touch Bluetooth NFC reader with medicine package and mobile phone will read the medicine prescription aloud
**PC-based setup: findings**

- The service concept was easy to comprehend.
- People with varying computer skills stated that the touch- and audio-based user interface is easy and pleasant to use.
- All users found the medicine information trustful and they did not see any information security threats for using the service at home.
- Usability problems:
  - Locating the NFC tag from the medicine packaging was problematic for a user who was both visually impaired and whose sense of touch was decreased. She had to learn where the tags were attached to each medicine package.
  - Strong contrast in colours of the NFC tag and the medicine package would have been helpful for some users.
  - Sometimes the NFC reader did not read the tag, because of the shape or material of the medicine package or the foil pill packs.
  - The speech synthesizer read the information sometimes too fast.
PC-based setup: findings

- Everyone in the trial said that the service could be useful and could help someone. However, the service was not something they personally needed. Users did not perceive any problems with their medication management.
- The cost or the trouble of supplying a new device was identified also as one reason not to adopt the service in our study.
- Users suggested that service could remind users for taking medications and, on the other hand, it could control and prevent them from overdose. Some users mentioned they would be willing to use it outside the study in the future especially if it would be modified to be more useful (reminders/control/mobility).
- It seemed that the users would prefer a mobile solution over stationary terminal (e.g. PC-based setup) to extend the usage to mobile situations. However, as the users stored the medication in a fixed location, benefits were also seen with a stationary solution that would always be placed with medication storage.
1. Medication management as a priority
2. Elderly people are very used to mobile phones.
3. Elderly people were able to adopt NFC use quite easily
4. Additional functions like reminders, dosage verification and medication plan information were also highly rated by users.
5. Blind people were more used to mobile phones
6. Blind people were able to adopt NFC use easily
7. Option of recording tags with personalized messages was highly rated specially by blind users
A PC-based experimental setup with a reading and writing capability for NFC tags with a touch-screen and affective user interface was developed and is being evaluated in a field trial during the year 2010 and 2011 in Spain.

- 4-6 caregivers (aged from 46 to 58) and 14 elderly people aged from 57 to 88 participated.
Personal medicine assistant: features

- Multimodal interaction
  - Audio: High value for users
  - Touch: Intuitive action
  - NFC (touch): Easily acquired concept
  - Graphics: Extra information channel for user

- Personalization
  - Adaptable to elderly people with different dependency levels
  - Configurable by changing parameters
### Personal medicine assistant

<table>
<thead>
<tr>
<th>Users</th>
<th>Functionalities</th>
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<tbody>
<tr>
<td>Elderly living at home</td>
<td>• Remind to take medications</td>
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<tr>
<td></td>
<td>• Help with medicine verification</td>
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<tr>
<td></td>
<td>- Expired medicines</td>
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<tr>
<td></td>
<td>- Medicines that do not correspond to take</td>
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<tr>
<td></td>
<td>- Medicines that have already been taken</td>
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<tr>
<td></td>
<td>• Read information about the medicine and prescription</td>
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<td></td>
<td>• Show next dose</td>
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<tr>
<td>Caregivers (Home helpers,</td>
<td>• Know the active medication plan of an user</td>
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<td>family)</td>
<td>• Introduce new medication plans</td>
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<tr>
<td></td>
<td>• Update existing medication plans</td>
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<td></td>
<td>• Track and control the medicine taking</td>
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## Personal medicine assistant trials

### Iterative development

<table>
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<th>Phase 1</th>
<th>Phase 2</th>
<th>Phase 3</th>
<th>Phase 4</th>
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<tbody>
<tr>
<td><strong>Participants:</strong>&lt;br&gt;• 6 home helpers&lt;br&gt;• Average age 51.2&lt;br&gt;• Basic education level&lt;br&gt;• Mobile users (basic)&lt;br&gt;<strong>Methodology:</strong>&lt;br&gt;• One day trial&lt;br&gt;• Questionnaire&lt;br&gt;• Test the assistant</td>
<td><strong>Participants:</strong>&lt;br&gt;• 6 elderly users&lt;br&gt;• Average age 69.6&lt;br&gt;• Active people&lt;br&gt;• High education level&lt;br&gt;• Mobile users&lt;br&gt;• Without memory problems&lt;br&gt;• Some of them are also caregivers&lt;br&gt;<strong>Methodology:</strong>&lt;br&gt;• One day trial&lt;br&gt;• Questionnaire&lt;br&gt;• Test the assistant</td>
<td><strong>Participants:</strong>&lt;br&gt;• 4 elderly users&lt;br&gt;• Average age 80.25&lt;br&gt;• Basic education level&lt;br&gt;• Staying at a nursing home&lt;br&gt;• Not mobile users&lt;br&gt;• With memory problems&lt;br&gt;<strong>Methodology:</strong>&lt;br&gt;• Two weeks trial&lt;br&gt;• Real medication plans&lt;br&gt;• Evaluation of the learning process&lt;br&gt;• Questionnaire</td>
<td><strong>Participants:</strong>&lt;br&gt;• 4 elderly users&lt;br&gt;<strong>Methodology:</strong>&lt;br&gt;• Three weeks trial&lt;br&gt;• Real medication plans&lt;br&gt;• Non supervised trials&lt;br&gt;• Questionnaire</td>
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*HearMeFeelMe*
Personal medicine assistant: Phase 1

• 6 caregivers (home helpers) from SSI
• All of them with basic educational level (non-university)
• Their average age is 51,2
• They provide different types of home care services:
  – 1 day/week: normally home cleaning service
  – 3 days/week: home cleaning, cooking, medicine control and help in more daily activities
• They attend about 5 users: Elderly people living at home and aged between 60 and 90 years.
• All of them are mobile phone users, but most of them don’t use computers.
Personal medicine assistant: Phase 2

- 6 elderly users participated in a test and interview in SSI
- All of them are active elderly people. They participate actively in older people’s associations.
  - Most of them have high educational level
  - 50% live with their family and the rest alone
  - Average age: 69.6 years (between 60 and 70).
- 4/6 with slight visual impairment due to age, and 1/6 with high vision impairment.
  - All of them use mobile phones and most of them are PC users.
  - 4/6 take several medications (3).
  - 2/6 are also caregivers, caring for a spouse.
Personal medicine assistant: Phase 3

- 4 elderly users at a nursing home.
- Their average age is about 80 years.
- Basic education level.
- All of them take a high number of medicines.
- Recent changes in their medication plan.
- All users require any home care service.
- One of them is blind.
- Only one of them uses a mobile phone, and no one uses a PC.
- They suffer memory losses and their motor skills are clearly decreased.
- Tests: During 2 weeks at breakfast time and supervised by a gerontologist from SSI.
Personal medicine assistant: Phase 4

- 4 elderly users living in their own homes.
- Basic education level (or varied)
- All users require any home care service.
- They regularly take a high number of medicines.
- They suffer memory loss.
- Tests: During 3 weeks at home and daily control by the home helper.
Personal medicine assistant: findings

- Interviewed caregivers agreed that the medicine assistant should be useful for people with Age Associated Memory Impairment (AAMI) or people with mild cognitive impairment symptoms.

- Caregivers also agreed that the medicine assistant should be very useful for them, for any caregiver. Medicine plan information and update facilities, medicine taking information and NFC tags with the prescription information are highly valorated by the participants.

- Caregivers emphasized that elderly people vary a great deal in their capabilities, limitations and experience with technology (very heterogeneous group) → Adaptability and flexibility of the system for different user levels should be essential. Configuration.

- Caregivers suggested to consider how to use the solution when the user uses a pillbox and not medicine packages → Option for pillboxes has been defined and should be also tested in 2011 in Spain and probably in Finland.

- Additional functionality would be highly appreciated:
  - Doctor appointments
  - Instructions for “complex medication” such as inhalers
Personal medicine assistant: findings

- Visual perception:
  - Difficulties to read some of the texts → Text windows have been enlarged and increase font size.
  - Bad contrast in some warning messages → Contrast has been increased changing from black to white text on red background.

- Audio information:
  - Difficulties to listen audio messages → Allow users/caregivers to adjust sound volume. Volume controls have been incorporated.
  - Speed of the speech too fast → Allow caregivers to adjust speed of the speech.
  - Lost of the beginning of the audio message → Include a warning signal or sound to get the attention of the user before starting the audio message.

- Multiple channels for important information have been incorporated: Text + Speech + Attentional cues:
  - Attentional cues such as blinking, highlighting, use of colour codes and warning sounds, can benefit to orient and capture the attention of elderly.
  - Colour codes have been added in medicine verification process. Red for errors and green for success.
  - Blink effect added to the reminder window.
Personal medicine assistant: findings

- **Touch Screen interaction:**
  - Some of the participants have problems in controlling fine motor movements and touch the screen more repeatedly → Detection and filtering of such effects has been added.
  - Sometimes participants do not touch the screen with enough force → Options to adjust touch screen sensibility should be considered and also a more rigid stand for the touch screen would reduce this problem.

- **NFC use:**
  - Participants understand very easy the NFC use concept and they adopt easily this interaction way.
  - Most of the participants use to let medicine package on the NFC reader. Sometimes the system repeats the information → Detection of the action of placing the NFC tag on the reader and retiring it back has been added.
  - Difficulties to understand instructions when an error was detected in the NFC tag reading process. → change message.
  - Sometimes NFC reader doesn’t read the tag due to the foil pill packs.
Personal medicine assistant: findings

- Participants in Phase 3:
  - They are more likely to get lost when using the system
  - Sometimes they don’t remember sequences of actions.
  - However, they tend to rely more on the assistant, and some ambiguous messages and instructions cause some misunderstandings and errors in medicine taking.
  - As much as possible, the solution should be based on procedures and information familiar to elderly.

in response to these findings:
- Step by step instructions: Medicines will be shown one by one instead of a list with all the medicine to take at same time
- Medicine verification and taking confirmation process will be simplified, more detailed instructions will be needed and confirmation button label will be changed: “I’ve taken the medicine” instead of “Yes” will be used.
- Repetition of the instructions or what the system is expecting from the user should be added.
- Messages have been reworked to provide clear feedback to the user about:
  - Task completion: Most of the users don’t realize when the process has finished. They need a more clear message.
  - Confirmation of a medicine: More clear messages to say “Yes this is the medicine” or “No don’t take this medicine”.
- Familiar and personalized names for medicines will be used and not only their commercial names. E.g. the pill for the headache
Personal medicine assistant: findings

- Some participants don’t understand the digital time format. Date and time formats have been modified: Adding the day of the week in text and changing the time format in the speech messages.
- All participants found the medicine assistant very friendly and they accepted it very well. Participants appreciate friendly messages such as “Good morning” and “Have a nice day”. Users replay and answer to the messages.
- Some participants feel offended by messages like “Congratulations! You did it well” These type of messages have been excluded and changed.
- Error detection and automatic recovery Detection of some system errors has been added including:
  - Critical battery level
  - NFC USB reader disconnected
  - Audio switched off
Pilot 4: Tag and Touch (Finland)

2009

User Study + Pilot 1
(Finland-Spain)
BlindNFC

Conclusions

1. Medication management as a priority
2. Elderly people are very used to mobile phones.
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6. Blind people were able to adopt NFC use easily
7. Option of recording tags with personalized messages was highly rated specially by blind users

2010

Pilot 2
(Finland)
PC-based reader

2011

Pilot 3
(Spain)
Personal medicine assistant

Pilot 4
(Finland)
Tag n’ touch
An application for attaching audio information to everyday items, such as food containers, using a mobile phone and NFC-tags, was developed and evaluated in 2010 in Finland.
Pilot 4: Tag and Touch (Finland)

- This was developed, because in BlindNFC user study the option of recording tags was highly rated by the users, especially a way of making reminders about medicine dosages. The users said that they would like to have the option of personalize the messages.

- Seven visually impaired people have used the device for two weeks in their home environment and they have encouraged to use the service for whatever they want.

- Preliminary results suggest that the service is really easy to use for blind people and the audio- and touch-based user interface concept is useful and it could be used for many purposes.