J.F.M. Molenbroek et al. (Eds.)
IOS Press, 2011

doi:10.3233/978-1-60750-752-9-80

Computer Based Information Gathering

Norman ALM[a,1], Kenny MORRISON[a], Peter GREGOR[a], Nick HINE[a], Sian JOEL[a], Katrina HANDS[a] and Marja H. VAN WEEREN[b]
[a] *School of Computing – University of Dundee, Dundee, UK*
[b] *Landmark Design BV, Rotterdam, The Netherlands*

Abstract. Toilets and toilet habits are perceived as a taboo subject that people may be reluctant or embarrassed to talk openly about. In the past, appropriately designed Computer Based Interviews have been shown to encourage more honest answers to sensitive questions than other forms of interview, and can be more interesting and engaging that filling out a paper questionnaire. This chapter presents Dundee University's role within the Friendly Restroom project which was primarily to provide Computer Based Interviews and other computer-based requirements gathering tools to be used to elicit toileting requirements of elderly people. Dundee University also investigated the feasibility of using Virtual Reality technologies, such as 3D environments and 360 degree panoramas, to support this information and requirements gathering.

Keywords. Computer Based Interviews, Toilets, Virtual Reality, Information Gathering

1. Introduction

An important part of the Friendly Restroom (FRR) project was to ensure that the designs produced met the real needs of potential users, and that users were involved throughout the project in sharing their experiences, giving their views, and helping guide the design process. One novel method of gathering the views of users which was employed was the use of computer-based interviews (CBIs). The project developed a number of CBIs and other novel information gathering tools.

The CBI has a 30 year history and has been shown to elicit revealing results. Due to its nature, the computer, unlike its human counterpart, is not judgmental, never bored, or impatient and does not become embarrassed. Because of this, people being interviewed about potentially embarrassing subjects often find a CBI to be pleasant, and easy to use. They often report they feel more empowered than in a face-to-face interview resulting in a greater number of answers and information of a higher quality [1,2,3,4,5].

The CBI team at Dundee University has many years experience in using this method as a tool for gathering information. Their experience includes interviewing primary school children, university students, scientists, people with alcohol problems,

[1] Corresponding Authors: Applied Computing, University of Dundee, Dundee DD1 4HN, UK; E-mail: [nalm, kmorrison, pgregor, nhine, sjoel, khands]@computing.dundee.ac.uk

patients and staff at a secure psychiatric institution and parents of children with behavioral problems [6,7,8,9,10].

2. Computer Based Interviews

Given the sensitive and possibly embarrassing nature of discussing toileting needs with strangers, it was decided to apply CBI to this task within the FRR Project. Using a computer-based approach also offered the advantage of easily including multimedia material into the interviews, and allowing for the possibility of delivering interviews remotely, over the internet. What was not clear at the outset of the project was how much cultural differences between the participating countries would affect the degree of embarrassment felt by participants in discussing toileting needs. In the event, we found that a stronger determining factor here was age, with older participants who we worked with being quite at ease discussing this subject, without the need for any account to be taken of sensitivities in this area. However the use of CBIs might still be of benefit, where the population of participants is more uneasy about discussing these subjects than the participants we worked with.

The first CBI to be developed was web-based and consisted of two parts. Firstly an interview was developed which primary and secondary users could access directly. Secondly a translation tool was created which allowed the partners in the FRR project to translate an original English questionnaire version into their language, and which ultimately would allow users from other countries to complete the questionnaire in their own language directly.

2.1. CBI Interface

The system allowed the user to select their language of choice from a menu of flag symbols. The interface was designed so that the user's attention was drawn to the centre of the screen, as the page was framed by a border. The interface also had a menu at the top of the page which allowed the user to see instructions on how to use the CBI as well as an option to return to the beginning of the questionnaire. The interview took a linear approach, with each screen showing one question at a time. Once the user selected their answer for that question from the page, another page was shown until the last question of the interview.

At the end of each section in the interview, the user was shown a next section screen. This allowed the user to be informed of how far through the interview they were. In addition, by splitting the CBI into sections the questionnaire was in more manageable groups for allowing differing presentational choices e.g. the number of buttons could vary between one section and another or there could be multiple choices.

At the end of the interview the user could see the answers they entered. The user could print a hard copy of these answers for their records. If the user had made an error in these answers, there was an option to add comments in a text box which could note the error, or the user could choose to go back to the page of the error and re-enter the correct answer, overriding the original. Once the user submitted their answers they were stored on a central database on the web server.

2.2. Translation Tool

The Translation Tool had three options:

- Allowing the user to translate the master questionnaire into the language of their choice
- Allowing that translation to have multimedia added to it
- Allowing the user to see the interview making use of that translation

The user had the ability to translate the master questionnaire from English into another language. The process of translation could be done in sections and did not need to be done all at once. The user had the ability to add images (jpeg or gif format) to the translation. The interface for this process showed the series of questions from the translated questionnaire and allowed the user to select an image from their own system which they could upload to the server. The image was then associated with the question or answer decided upon and was positioned, when shown, against it (Figure 1). The option to only allow jpeg and gif uploads was made in order to limit the size of the files which could be uploaded. However, the tool could be adapted so that more file types could be included e.g. higher resolution images, sound clips, or other multimedia files.

The user was able to test and view the text they translated by using the User option of the Translation Tool. This User option of the tool acted very much as the user CBI does, with sections, one question per page and a view results page.

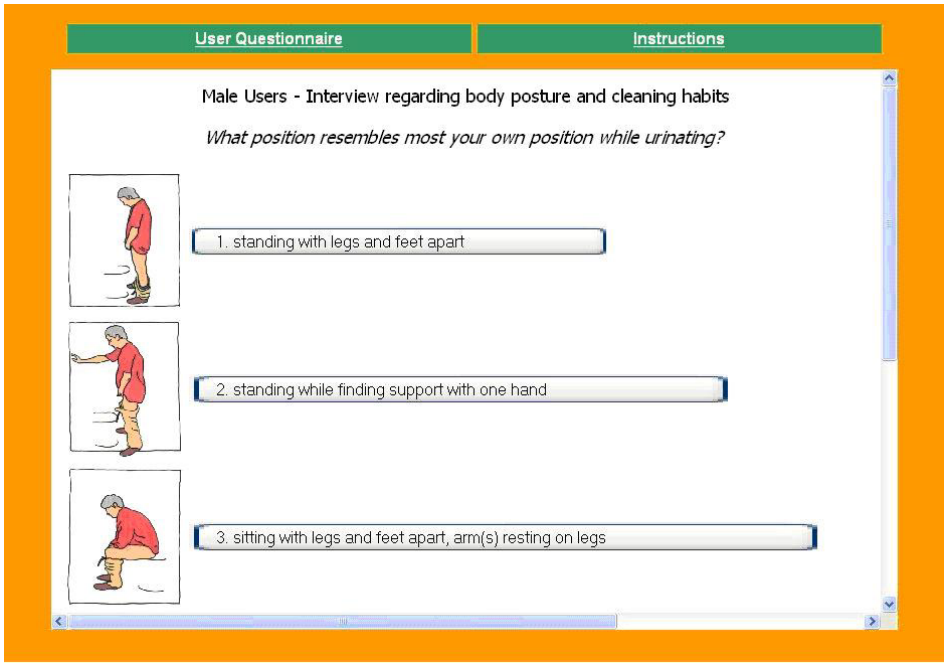

Figure 1. Interview with pictures. Questionnaire content and drawings from Landmark Design BV

3. User Trials and Focus Groups

Dundee University performed user-trials of the web-based CBI and two focus group discussions relating to the interviews and their graphics were also held. Data was produced on the attitudes of older people to a computer based interview on rest room requirements.

3.1. CBI User Trial:

The CBI trial was performed in a cybercafé for older people in Airlie, a small village is Scotland. The participants' age range was between 50 – 70, with one individual over 70. Eight persons participated in the trial and each completed 63 questions. The health problems that participants listed were back pain, pain in their fingers, hands and feet, and some eyesight problems.

The main points gathered from the CBI included: most persons found that it was often, or sometimes, the case that the toilet was hard to flush, the wash bowl too high or too low or that there wasn't anywhere to put a walking stick or personal belongings. The most popular toilet adaptations were grip bars, an emergency button and a place to put walking sticks or personal belongings. These findings were similar to those that were received using the paper questionnaire.

3.2. CBI Focus Group:

The first CBI Focus Group was held at Dundee University. Five elderly people attended the group which consisted of a demonstration of the various types of CBIs available, a discussion about the CBI demonstrated, alternative CBIs that might be feasible and a discussion of issues about toilets and recommendations for improvements.

The group members preferred the inclusion of photos in the interview rather than multimedia or simple text. This particular group commented that they liked to have an open discussion but understood that computer based interviewing could be useful for shyer people. Some felt uneasy about using a computer, the touch screen was preferred to the keyboard, "I'm no typist" was one response. A large font size was preferred

The conclusions reached were that with this group of participants, the CBI was less essential than expected. The conversational discussion of the focus group allowed for more information to be elicited than could have been gained from the CBI. In the CBI trial the findings were in keeping with the results from the paper-based equivalent and very similar responses were given.

3.3. FRR Graphics Focus Group:

A second focus group was held, also in the cybercafé in Airlie to discuss the graphics that were to be used in the CBI's. The graphics were produced by Landmark Design, an FRR partner based in The Netherlands. For this focus group there were six participants, whose ages ranged from 60 to 75. Initially, there was a demonstration of the graphics and then a discussion on their acceptability. After this the group easily got into a discussion about their recommendations for improving toilet access and usability, making use of the picture as prompts occasionally.

The consensus was that the pictures were acceptable, and helpful to the discussion, but they could be improved for more general acceptability by making the characters into humorous cartoon type figures (e.g. teddy bears). This would have the effect of making the material less personal. The use of humor was recommended as a way to

make possibly embarrassing material more comfortable to discuss. Some felt that the pictures could be a little less explicit but the overall opinion was that they had been well done and were very thorough. The point was made that the group knew each other very well, and so felt at ease discussing these matters in the group setting. A group of strangers might not do so well, and possibly individual interviews would be better.

4. Standalone Computer Based Interviews

Dundee University first designed and developed a predominantly text based computer based interview on rest room requirements which could be accessed from a website and which automatically stored results for subsequent analysis. An authoring and translation tool, which was accessible from a website, was also developed. This tool enabled partners to remotely construct interviews and produce translations of the interview in their own language. Field work with potential users identified the need for a version of the interview that could be run in a standalone format with no need for a good internet connection. This could be run from a laptop and taken to homes where internet access is not available.

A version of the standalone interview incorporating illustrations was produced (Figure 2). It stored the results of the interview into a text file on the computer's hard disk. A dynamic version of the standalone interview was also completed which can retrieve the interviews constructed using the web-based authoring and translation tool. The standalone versions of the interview were developed using Macromedia Director.

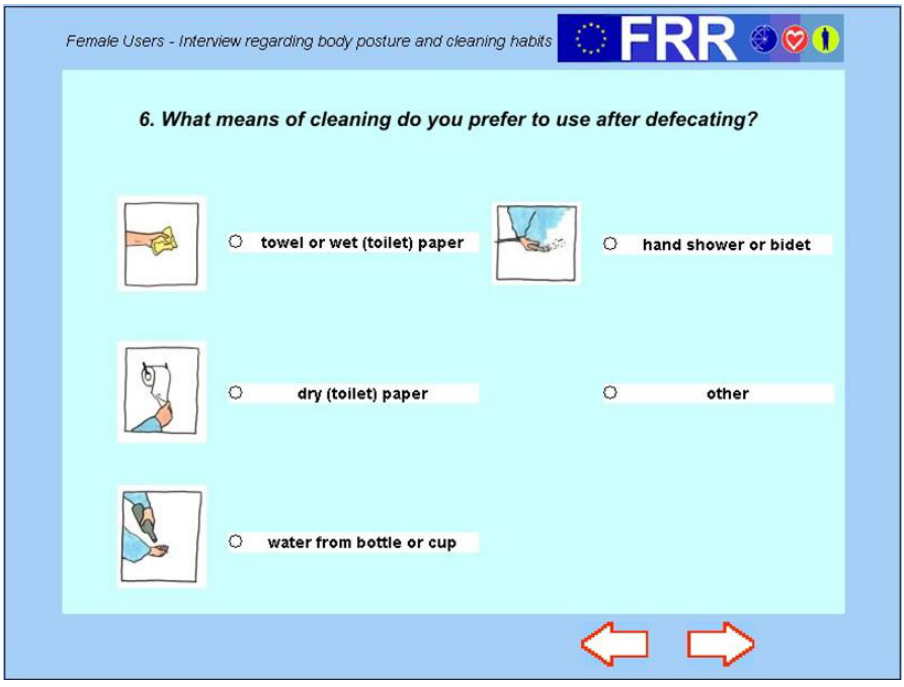

Figure 2. An example question from the standalone CBI with pictures

5. Information Gathering and Virtual Reality

After completion of the web-based and standalone CBIs, an investigation was undertaken to determine the feasibility of using Virtual Reality (VR) technologies to support our information and requirements gathering. It was decided that these technologies should be web-based. The FRR project consortium consists of partners spread across Europe. Using the internet would make it easy to demonstrate, distribute and use the interviews. The VR software was designed to be easily accessible from any computer with an internet connection. The continuing increase in bandwidth size, broadband networks, desktop processing power and reduction of costs mean that the capabilities of the internet are rising and using 3D and VR based web-technologies over the internet will become more and more feasible.

5.1. 360 Degree Panoramic Views

Initial investigations focused on web-based 360 degree virtual reality representations of rest room environments (Figure 3). These enabled users to explore at will, and assisted in eliciting their views and comments on existing and proposed future provision. This software was designed to be used for requirements gathering and receiving user feedback about prototypes. It had a facility for recording the user's comments on an onscreen 'notepad' as they looked around the various parts of the rest room. The part of the room they were looking at was automatically noted. The user's path through the tour was also automatically recorded. Navigation was by using the mouse to 'move' around the 360 degree environment. Red 'hotspots' could be clicked on to get a close up, or to go into another room (Figs. 3,4). Users' comments were stored on a central server database.

These 360 degree panoramas were created by 'stitching' together a sequence of digital photographs (Figure 5). Digital photography editing software was used to perform the 'stitching'. The digital photographs were taken by a camera placed on a tripod that was positioned in the centre of the scene. There was about 25% overlap from each image to the next. To produce 360 degree panoramas where it is then possible to pan up/down through 360 degrees a camera with a fish-eye lens had to be used. The resultant stitched image was stored in jpeg format to keep download times down.

The original 360 degree panorama software provided zoom in/out buttons. However, after initial evaluations, it was decided to remove this facility because the tour became more difficult to use, since the image became unfocused when zoomed.

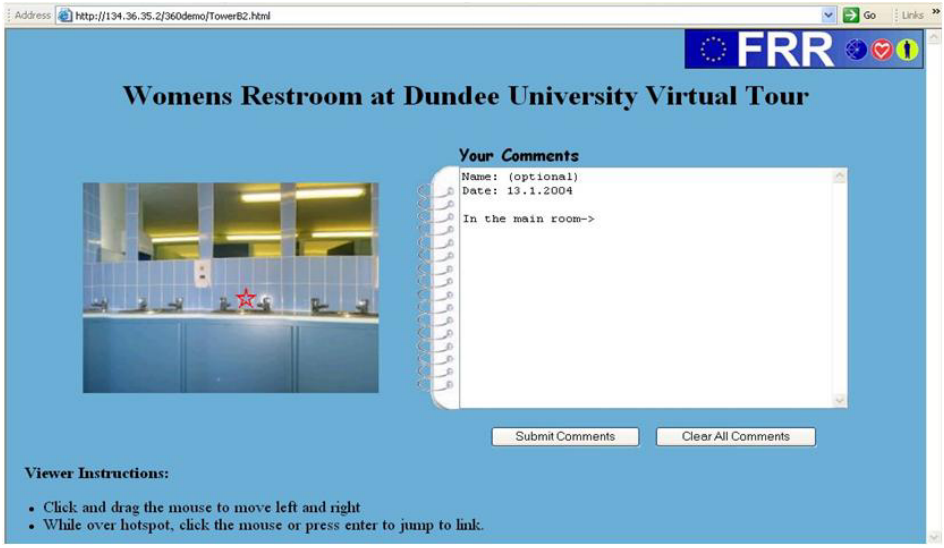

Figure 3. The 360 degree panorama – the star represents a 'hotspot'

Figure 4. Close-up 'hotspot' of a sink

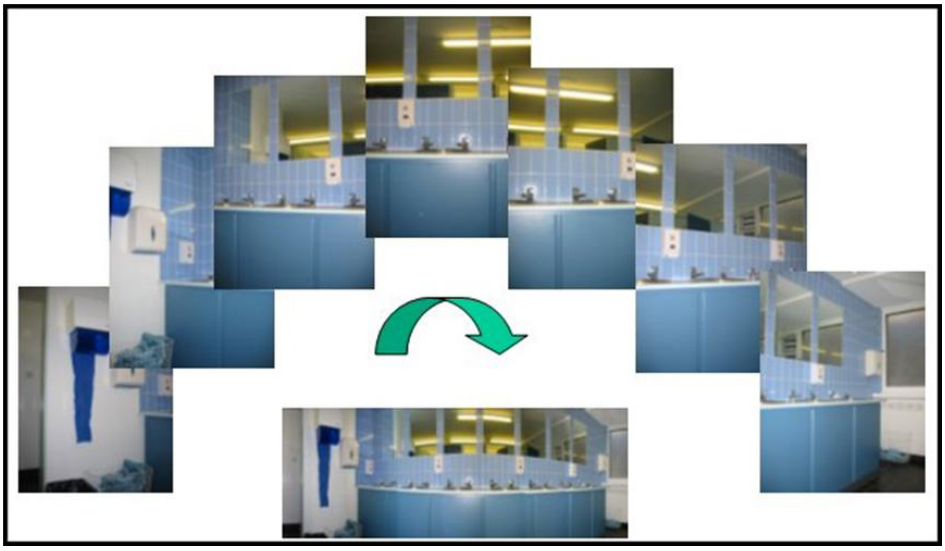

Figure 5. Image 'stitching'

5.2. 3D Virtual Reality Scenes

Following the 360 degree panoramic views, an investigation was carried out of other web-based VR technologies. This included 3D environments where the user can feel immersed within the scenes. A web-based 3D environment tool was developed. Using this tool, the user is presented with a 3D VR environment (Figure 6) and was free to move around within this scene. Navigation was by using the computer keyboard arrow keys. As well as being able to move freely, the user could also make comments and notes about the scene within the actual environment itself by writing/drawing on the walls or floor (Figs.7, 8, 9 and 10). To perform this action, the user first clicked with the mouse on the desired wall. Comments were then entered by keyboard typing or freehand writing using the mouse. Standard paint/drawing functions were also available e.g. shapes, line-drawing, erasing etc. Although the user could draw/paint within the environment, the layout of the environment itself could not be changed. This tool provided a novel way of obtaining user-feedback, although it was not clear what would be the possible advantages/disadvantages of such a system. Therefore a small pilot study was performed where the use of a more traditional paper-based interview was compared with the interactive environment. Scenarios using a virtual onscreen notepad were also included for comparison.

5.3 VR Pilot Study

There were twelve user evaluations performed. The twelve users rated their level of computer experience somewhere between intermediate and expert. Five users were between 18-25, five users between 26-35 and two users were between 36-60. There were six females and six males.

The users participating in the task were presented with a small 3D VR environment consisting of a 'living room' scene and were asked to imagine they were browsing a

virtual catalogue. The users were then asked to select one item from the scene that they liked and one item that they didn't like. They were instructed to record their selections and make some comments about what they liked/didn't like about their selected items.

There were four different methods for recording selections and comments and the users were asked to work through them in the order below. The expectation was that as they worked their way through the methods, the user was gradually becoming more immersed within the scene when recording their information.

- *Method 1* - Paper/pen (M1) - A traditional method of recording information
- *Method 2* - Onscreen notepad (M2) (Figure 11) - An onscreen virtual notepad beside the 3D scene. The users could type onto the 'notepad'
- *Method 3* - Notepad on the wall (M3) (Figure 12) - A virtual notepad on one of the walls within the scene itself. The user clicked on the notepad to begin typing onto the 'notepad'
- *Method 4* - Drawing/writing on the floor/walls (M4) - The user could write/draw on the walls or the floor of the scene. The user selected a wall by clicking on it. Alternatively the user could click on the floor and view the scene from a top-down angle (Figure 10)

After completing the four methods the users were asked to complete a questionnaire.

The user evaluations were split into four groups. The evaluations were performed individually:

- *Group 1* - The users were asked to work through the methods in the order above. Method 4 including an option to type using the computer keyboard as well as other paint/draw functions (four users)
- *Group 2* - Again the users worked through the methods in the order above. Method 4 had the ability to type using the keyboard removed (four users)
- *Group 3* - The same as the 2nd group, however the users were asked to work through the methods in reverse order to that listed above (2 users)
- *Group 4* - The same as the second group, however the task was performed using a tablet PC, a notebook computers where it is possible to write on the screen display using a special-purpose stylus) (two users)

Using M2 and M3, the users are asked to type onto a virtual notepad, and upon reaching M4, Group 1 continued to type i.e. they immediately looked for a blank space on the wall and used the type function from the paint options and tended to ignore the option to draw within the scene. It was decided to remove the ability to type using the keyboard from M4 for Group 2. While not having been told this, Group 2 expressed the feeling that they missed being able to type after using M2 and M3. For Group 3 the methods were used in reverse order i.e. the users had not been asked to do keyboard typing when they first arrive at M4. No comment was made by Group 3 about typing until they reached the notepad methods when they commented on how much easier it was to type than to write freehand. Group 4 used the tablet PC with stylus and seemed to find M4 much easier to record their feedback, however one user did comment that they 'found it difficult to write fluently with the stylus'.

The users were asked which method they preferred overall. M2 was preferred by 9 users and 3 users preferred M4. All the users highlighted the fun aspect of M4. Although M2 was the overall preference there was a consensus that ideally some combination of M2 and M4 would be the desired option, the users could use the onscreen notepad and still be able to use the drawing capabilities of M4 if they desired.

5.3.1. Observations for Each Method

Method *1* - 'Paper/pen'

Nothing of any note.

Method 2 - 'Onscreen notepad'

Users had no problems with this method. One user who preferred M2 commented on the fact that they 'liked being able to look around and type at the same time'.

Method 3 - 'Notepad on the wall'

Nearly all the users expressed a dislike of having to find the notepad on the wall in M3. Although, when they do find the notepad they intuitively know what to do, one user commented that 'it looks obvious what it is, and what it's for'. The majority of users comment that it is not apparent what the advantage of having a notepad on the wall as opposed to at the side of the scene. One user suggested more notepads spread throughout the virtual room but then suggested that this would make the scene seems messy. 3 users suggested a virtual post-it note system – where comments could be written and then 'stuck' to the selected items. A couple of users suggested signs to where the notepad is within the scene.

Method 4 - 'Paint/write on the walls'

A few users expressed confusion when they tried to draw on the furniture in the scene, or select objects by clicking on them. Most users have a play about first, they realize they can 'start again' with a blank canvas. However, during the study the male users were more likely to use the paint abilities freely, all the male users didn't feel or worry that they were vandalizing the scene as they realized they were in a virtual environment. The 3 users who were reluctant to scribble or paint on the walls were all female. One female user said they 'didn't like writing on the wall' as they felt they were vandalizing although they said they would use such a system for virtual decorating. Another female user said they enjoyed drawing and making patterns but would rather use typing to convey their thoughts. Although one of the male users who used the typing when beginning M4 mentioned that he noticed the painting functions, it just that he 'doesn't want to draw'. One user commented on how much they 'enjoy writing all over the walls'.

When using M4, only one of the users referred to an object using the drawing features e.g. by circling them or drawing arrows – the other users tended to look for the biggest blank space on the wall and record their comments there. Initially some of the users had some confusion when coming out of the 3D scene to the static 2D view used for drawing/writing in M4. They initially thought they were still in a 3D environment, although they were soon able to adapt.

5.3.2. User Suggestions/Comments About M4

Many users commented on the virtual graffiti aspect and suggested having a spray paint effect added to M4 to make the graffiti more realistic. A few users suggested that M4 may be most enjoyed by children and teenagers. There was a suggestion of a virtual classroom where there could be virtual chalk and a blackboard within the class. It could also be used as a shared environment or a virtual forum and could see previous users' comments/artwork. Symbols such as ticks/crosses could be used or different ink colors e.g. green (positive) or red (negative)

5.3.3. Questionnaire Results

There were three attitude style questions, within the questionnaire that was given after the task, where the users were asked to rate from 1(negative) to 7(positive).

Q1. How would you rate the usability of each method?
Q2. How helpful would you rate each method as an effective tool used for information gathering?
Q3. How would you rate each method as being enjoyable to use?

M1. Paper/pen
M2. Onscreen notepad
M3. Notepad on the wall
M4. Drawing/writing on the floor/walls

Table 1. A table of averages for each question and each method

	M1	**M2**	**M3**	**M4**
Q1	4.6	5.8	4.2	4.4
Q2	5.0	6.0	5.0	4.4
Q3	2.8	4.8	4.3	5.7
Total:	12.4	16.6	13.5	14.5

M2 scored the highest overall. M4 scored highly for enjoyment as opposed to M1 which scored very low.

5.4 Conclusions

The onscreen notepad was found to be the most usable and most helpful information gathering tool. The users can view the scene and record their feedback simultaneously and also view the scene and their comments side by side. The enjoyable aspect of drawing on the walls of the scene was clear from users' spontaneous comments. A combination of the onscreen notepad and scene-drawing ability might be a good choice. However, it was not clear whether the ability to draw within the scene would actually benefit information gathering.

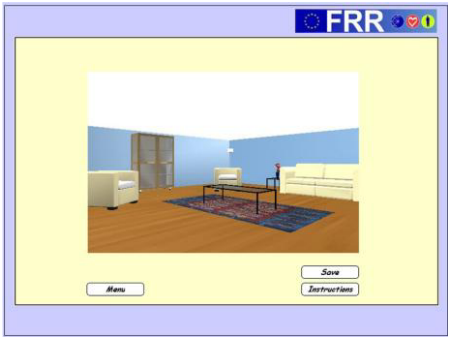

Figure 6. The 3D 'living room' scene

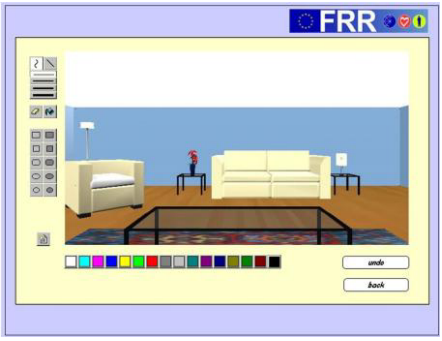

Figure 7. The paint/drawing screen

Figure 8. The paint/drawing screen

Figure 9. The 3D scene after writing

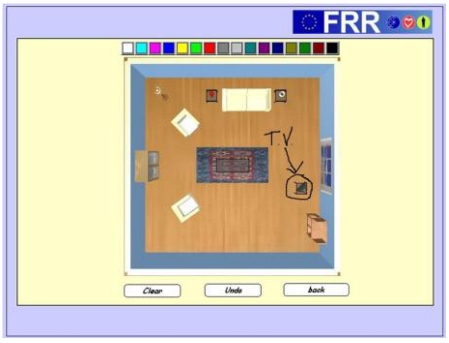

Figure 10. The top-down view

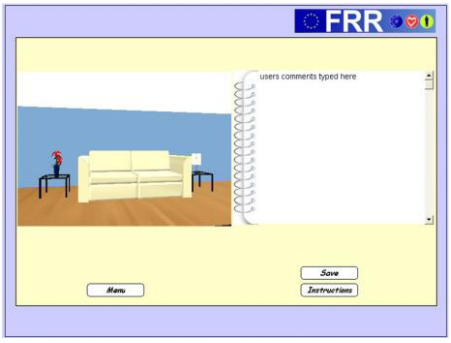

Figure 11. Onscreen notepad

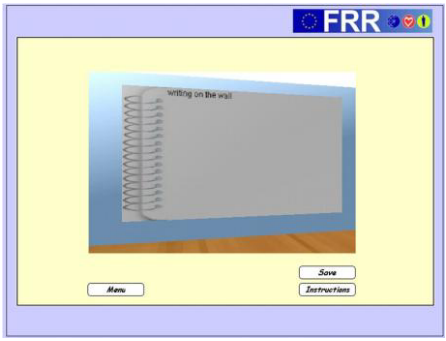

Figure 12. Notepad on the wall

6. Summary

In its work with older people the FRR project found that participants were generally unconcerned about talking about toilets and toilet-habits. In this respect, the CBI's that were designed did not prove as necessary as first expected. However, it was shown that the CBI was still beneficial for gathering and storing data electronically, especially when dealing with large user-groups and sizable amounts of data.

In group discussions and focus groups it was discovered that the elderly user group proved to be equally open and frank. The use of drawings within the CBI's was discussed with such user groups and the addition of drawings was found to be an effective addition to the interviews. However, it was suggested that general acceptability could be increased by making the characters more humorous cartoon-type figures. This would have the effect of making the material less personal and the use of humor was recommended as a way to make possibly embarrassing material more comfortable to discuss.

The feasibility of using web-based virtual reality tools to support information and requirements gathering was also explored throughout the project. This included 360 degree panoramic representations of rest room environments, produced by stitching together sequences of digital photographs. The users clicked on 'hotspots' within the scene to get a close-up of an object or to move to another room within the virtual tour.

Virtual environments incorporating 3D models were also investigated where the user may feel more immersed within these scenes as they are able to move more freely within the scene. A novel idea was introduced where the user could make comments and notes about the scene within the actual environment itself by writing/drawing on the walls or floor. A pilot study was performed where the use of a more traditional paper-based interview is compared with the interactive environment as well as scenarios using a virtual onscreen notepad. From this pilot study it was determined that the onscreen notepad was the preferred choice of the participants as a tool for information gathering, however the participants highlighted the enjoyment aspect of being able to draw and write within a 3D environment.

References

[1] Dove GAW, Wigg P, Clarke JHC, Constantinidou M, Royappa BA, Evans CR, Milne J, Goss C, Gordon M, de Wardener HE. The therapeutic effect of taking a patient's history by computer. Journal of the Royal College of General Practitioners. 1977; 27:477- 481.

[2] Duffy JC, Waterton JJ. Under-reporting of alcohol consumption in sample surveys: The effect of computer interviewing in fieldwork. British Journal of Addiction. 1984;79:303-308.

[3] Holt S, Guram M, Smith M, Skinner HA. Computer assessment of life-style in a gastroenterology clinic. Digestive Diseases and Sciences. 1992;37:993-996.

[4] Locke SE, Kowaloff HB, Hoff RG, Safran C, Popovsky MA, Cotton DJ, Kinkelstein DM, Page PL, Slack WP. Computer based interview for screening blood donors for risk of HIV transmission. Journal of the American Medical Association. 1992;268:1301-1305.

[5] Skinner HA, Allen BA. Does the computer make a difference? Computerized versus face-to-face versus self-report assessment of alcohol, drug and tobacco use. Journal of Consulting and Clinical Psychology. 1983;51:267-275.

[6] Morton HG, Alm N. Computer-aided interviewing of parents in a child psychiatric clinic. Journal of Microcomputer Applications. 1990;13:273-280.

[7] Peiris D, Alm N, Gregor P. Computer interviews -- an initial investigation using free text responses in People and Computers. In: Kirby MAR, Dix AJ, Finlay JE, editors. Proceedings of HCI'95 : People and Computers. Cambridge: Cambridge University Press; 1995, 281-288.

[8] Alm N, Arnott, JL, Murray IR, Buchanan I. Virtual reality for putting people with disabilities in control. In: Proceedings of IEEE Systems Man and Cybernetics Conference. San Diego; 1998, 1174-1179.

[9] Peiris R, Gregor P, Alm N. The effects of simulating human conversational style in a computer-based interview. Interacting with Computers. 2000;12(6):635-650.

[10] Williams B, Peiris DR, Gregor P, Alm N, Cumming S, Flockhart G, Groundwater M. Computer-based interventions for assisting people who have suffered disabling trauma.. New Technology in the Human Services. 1999;12:69-75.