Qualitative Research On Understanding The Usability Of The Alecto DVM-70 Baby Monitor

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Abstract

The purpose of this research was to understand the use of Alecto DVM-70 baby monitor. The baby monitor consists out of two devices; a baby unit and parent unit that both have their own interface. An observational experiment was conducted focusing on the usability of the baby monitor. The test was done with two groups of people: students aged 19 to 25 (five males, five females) with little or no experience with baby monitors and parents aged 32 to 48 (three males, five females) with baby monitor experience. Participants performed one of three scenarios and research conductor asked clarifying questions afterwards. First, all participants had to perform task 0, were they had to explain all icons and indicators on the baby monitor. Three other scenarios were equally divided among the participants so each scenario was at least executed 6 times. When task 0 was completed the research conductor proceeded to one of the scenarios. The researchers identified and registered all the problems and strengths of the baby monitor that surfaced during the user test on multiple levels: the time mark of the problem/strength, the task that was performed at that time, what exactly happened, a quote from the participant, the cause of the problem or strength (researcher's interpretation), the actual cause (what feature of the product led to this problem or strength) and the severity of the problem, rated according to Nielsen's (1995) severity rating for usability problems. All the problems and strengths that surfaced were summarized in a matrix showing the quantity and severity of occurred problems and strengths across all the participants. Visual representations were made to quickly see where problems and strengths occurred during task 0 and when using the device. It was concluded that the icons, navigation of the menu, and the audio feedback are problematic usability areas.

Keywords

Interface, usability, baby monitor, Alecto DVM-70

Introduction

In this research a usability study of the Alecto DVM-70 baby monitor (see figure 1) was conducted.

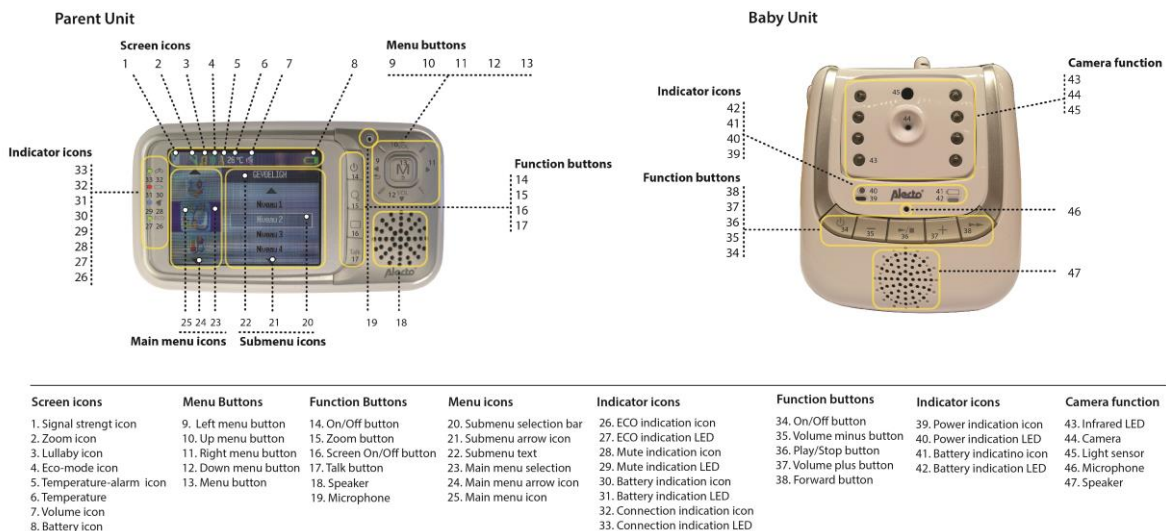| Screen icons	Menu Buttons	Function Buttons	Menu icons	Indicator icons	Function buttons	Indicator icons	Camera function
1. Signal strengt icon	9. Left menu button	14. On/Off button	20. Submenu selection bar	26. ECO indication icon	34. On/Off button	39. Power indication icon	43. Infrared LED
2. Zoom icon	10. Up menu button	15. Zoom button	21. Submenu arrow icon	27. ECO indication LED	35. Volume minus button	40. Power indication LED	44. Camera
3. Lullaby icon	11. Right menu button	16. Screen On/Off button	22. Submenu text	28. Mute indication icon	36. Play/Stop button	41. Battery indicatino icon	45. Light sensor
4. Eco-mode icon	12. Down menu button	17. Talk button	23. Main menu selection	29. Mute indication LED	37. Volume plus button	42. Battery indication LED	46. Microphone
5. Temperature-alarm icon	13. Menu button	18. Speaker	24. Main menu arrow icon	30. Battery indication icon	38. Forward button		47. Speaker
6. Temperature		19. Microphone	25. Main menu icon	31. Battery indication LED			
7. Volume icon				32. Connection indication icon			
8. Battery icon				33. Connection indication LED			

Figure 1. Definition of symbols and units

"Kieskeurig.nl" (2014) showed that the Alecto DVM-70 is an extensive model, placed in the highest price category. The baby monitor consists of two parts: the baby unit (with the camera directed to the baby) and the parent unit (which stays in the same room as the parent). The baby unit has a built in camera with eight infrared LEDs making it possible to show the baby on the screen of the parent unit during day and night. The camera has a zoom function that can be controlled with the menu arrows from the parent unit. In addition to the camera, the baby monitor features a talk back function which allows the parent to talk to their infant, a temperature sensor that allows the parent to check the room temperature and five lullabies that can be played from both the baby and parent unit. The baby monitor also has an ECO mode for energy efficiency. The ECO mode is activated when both devices are in sleep mode. When the set sensitivity level is exceeded the device will then again provide both image and sound. After a few minutes the device will go back in sleep mode. A feedback sound tells the user when using a button is not possible. Various forums showed that the usability of all the above functions strongly depends on the user and the context ("Babyenkind" 2011, "Kindjeopkomstforum.nl" 2008, "Forum.viva.nl" 2011). For example people that live in a house with five floors the device will be used differently than in a one-floor apartment, as the inhabitants of a five floor house will for instance use the camera function more than a one-floor apartment user. Therefore, the primary goal of this study was to investigate the usability of the Alecto baby monitor with all its current functions.

An important element of the usability is the user interface. A user interface (UI) design should make the interaction between the user and the system easy and understandable. As "Usability.gov" (2014) stated there are no real design guidelines for UI design, but there are some general things to consider. Users (with UI experience using comparable devices) expect elements to act in a certain way. Patterns in the design enable fast learning. Also W.O. Galitz (2007) described that screen menus utilized the recognition memory of the user, therefore menu choice labels must be meaningful and understandable to be truly effective.

This study focused on several usability aspects of the baby monitor:

Icons and indicators (both on and off screen) research question:
   What usability problems do users face in understanding the meaning of the icons and indicators on both the parent and baby unit, on and off screen?

Menu structure research question:
   What usability problems do users face when navigating through the menu and selecting different options?

Feedback research question:
   What aspects of the auditory and visual feedback does the user notice, understand, and/or value when using the baby monitor?

With use of the framework designed by A.J. Onwuegbuzie and N.L. Leech (2006) the qualitative natured research questions were linked to qualitative research methods. Observational research was conducted focusing on the usability of the baby monitor. Additional questions were asked to the participants in order to get a better understanding of what the users think about the usability of the product.

Method

Only a selection of the many functions of the baby monitor was tested. The tasks that were included in the test were found by the researchers to have a high probability of uncovering usability problems. Task 0 concerns all icons and LEDs on the baby and parent unit to see what usability problems users face in understanding the meaning of the icons and indicators. Three different scenarios were created, each scenario including several tasks (see table 1). Scenario 1 concerns the usability problems of the parent unit's menu structure where the user looks for a solution to set the temperature from Fahrenheit to Celsius. Here, the focus is on usability problems that the participant faces when navigating through the menu. Scenario 2 concerns the parent unit buttons where the participant zooms in on the baby and talks to the baby with use of the parent unit. Scenario 3 concerns both the baby and parent unit where the participant looks for a solution to play lullabies on the baby unit with use of first the baby unit itself and then via the parent unit.

Task 0	Explain buttons and icons, turn on device and explain icons on screen
Scenario 1	Change the temperature format
Scenario 2	Zoom in, navigate, talk to baby and turn off screen
Scenario 3	Turn on lullaby 3, turn volume up or down and turn on song on parent unit
Scenario 4	Turn off device

Table 1. Overview of tasks

Participants

Beside parents being the main user group of the baby monitor, other users include neighbours, grandparents and babysitters. The test was conducted with two groups of people: students aged 19 to 25 (five males, five females) with little or no experience with baby monitors, who were recruited from Industrial Design Engineering at the Delft University of Technology, and parents aged 32 to 48 (three males, five females) with baby monitor experience, who were recruited at the DOK library in Delft. All participants were native Dutch speakers. The test was conducted at two places: the faculty of Industrial Design Engineering at the Delft University of Technology and the DOK library in Delft.

Stimuli

The parent unit of the baby monitor was placed on a table in front of the user. The baby unit was hidden in the same room. If the participants were to play in a scenario where the user was in another room than the baby, a picture of a baby was placed in front of the camera of the baby unit to represent a real baby. With use of the *'Guidelines for conducting user studies'* study provided by A. Vermeeren (2011) a set up was created for the test. To capture the user's behaviour and actions, the sessions were recorded with a video camera and notes were taken with pen and paper. Furthermore, a written script was used by the research conductor.

Procedure

According to J. Nielsen (2000), testing with five users will already reveal 85% of the problems in usability testing. Participants in the DOK were recruited on the spot, so the aim was to make the duration of the test short so that the participants would be more willing to cooperate. Therefore, each participant only needed to do task 0 and one of the scenarios. In total six participants per scenario were used, meaning a total of 18 participants. When task 0 was completed the research conductor proceeded to one of the scenarios that were equally divided among the participants so each scenario was at least executed 6 times. Clarifying questions were asked after the participant completed a task in order to understand why they did a particular action and/or how they felt about the outcome of it.

Roles were allocated to three researchers: the research conductor took the role of active listener, another researcher recorded the test session on camera and the last one observed the test session and took notes of both participant's performance and comments. Before each test, the settings of the baby monitor were changed corresponding to one of the three scenarios. First, the research conductor informed the participant about the procedures of the test and asked permission to record the test. Based on the study of T.M. Boren and J. Ramey (2000) the participants were asked to comprehensively explain and describe any actions, decisions and feelings during the test. During the test the participant was not interrupted, except to remind them to talk out loud when they did not.

Data analysis

The data from the user test was analysed in two steps. First, the data (video recording and notes) of each participant were analysed by an individual researcher. In total, six researchers analysed three participants each. The researchers documented their findings in two excel spreadsheets. On the first sheet, the researchers identified and registered all the problems and strengths of the baby monitor that surfaced during the user test on multiple levels: the time mark of the problem/strength, the task that was performed at that time, what exactly happened, a quote from the participant, the cause of the problem or strength (researcher's interpretation), the actual cause (what feature of the product led to this problem or strength) and the severity of the problem, rated according to J. Nielsen's (1995) severity rating for usability problems. On the second sheet of the excel file, the meaning of all the buttons and icons was registered as explained by the participant, with a supporting quote from the participant. Again, the severity of any occurring problem was registered.

In the second part of the analysis, the surfaced problems and strengths from the analysis of the individual participants were all combined and put together by two researchers into one table (see table 2). In order to increase the accuracy of the findings, the same two researchers went through all the individual analyses adding any findings that might have been missed. All the problems and strengths that surfaced were summarized in a matrix (see table 3) showing the quantity and severity of occurred problems and strengths across all the participants. The results from task 0 (see table 1), were combined by another researcher (see figure 2). From the individual analyses, statement cards were made containing participants' quotes and the researchers' interpretation of what caused the problems/strengths. These statements cards were then divided into different categories and subcategories to present problematic areas. An overview was created of the structure that emerged during the analysis, together with quotes from participants (see figure 3). These quotes gave a better understanding of what kind of usability problems participants encountered (Vermeeren, A. 2011).

Results

Initial understanding of icons and buttons by participants

Results of task 0, 'Explain buttons and icons', can be seen in figure 2. The bar charts indicate the amount of problems the participants had with understanding the elements.
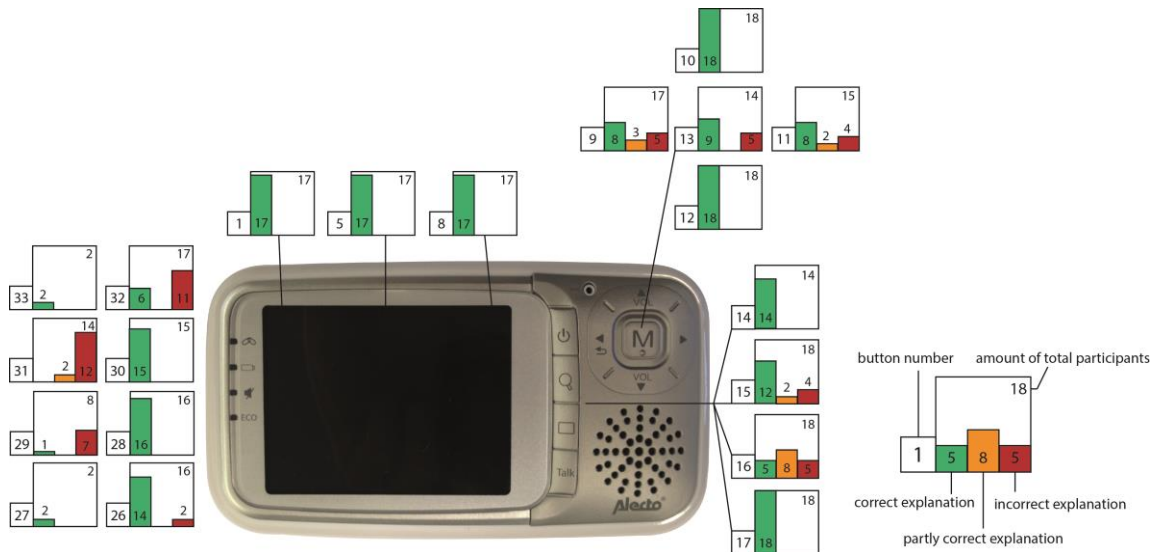

Figure 2. overview of initial understanding of icons and buttons by participants

Statement card clusters

Figure 3 shows the different clusters that followed out of the statement card analysis. The number of positive and negative comments are presented. Most frequent problems/strengths are supported with a quote.
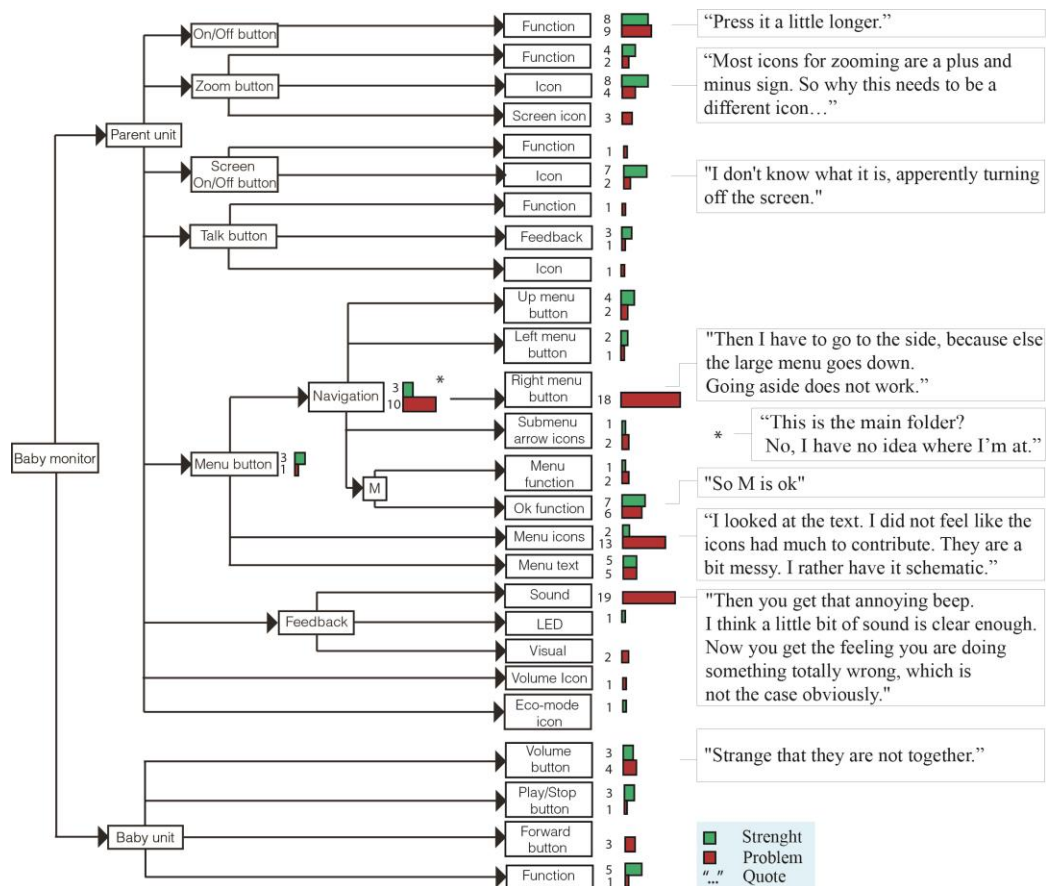

Figure 3. Statement card clusters

Frequency and severity of strengths and problems

Table 2 shows how the most important and common strengths and problems of participants were categorized. A total of 34 problems and 11 strengths were found among participants.

Strenghts (0)	Cosmetic Problem (1)	Minor Usability Problem (2)	Major Usability Problem (3)	Usability Catastrophe (4)
s.1 - Keep holding the talk button when talking is clear	c.1 - Order of buttons on baby unit unlogical	mi.1 - The word 'Formaat' is unclear	ma.1 - That the talk button needs to be hold is not clear	u.1 - Screen On/Off icon is not clear
s.2 - Adjusting the screen with left right menu buttons when zoomed in is clear	c.2 - Talk button is text instead of icon	mi.2 - Volume minus looks like a previous button	ma.2 - Icons belonging to tekst is unclear	u.2 - No consistancy between the two menu structures
s.3 - Going to another song is clear	c.3 - Not clear when the boundaries of the zoomed image are reached	mi.3 - Volume plus button looks like a next song button	ma.3 - Menu disappears after 8 seconds	u.3 - Getting out of the menu is not clear
s.4 - Using plus or minus to control the sound on the baby unit is clear	c.4 - Not clear when the boundaries of the zoomed image are reached	mi.4 - It doesn't comunicate that the left/right menu button can change the view when zoomed in	ma.4 - The feedback sound is annoying	u.4 - The Menu button does not look like an OK button
s.5 - Pressing play/stop button to play a lullaby is clear	c.5 - There is no display on the baby unit	mi.5 - Could not keep scrolling in the sub menu		u.5 - The Menu button does not look like a menu button
s.6 - The main menu selection communicates a clear way of where you are in the menu	c.6 - No feedback if something is selected or not	mi.6 - The menu does not have a start or an end		u.6 - The icons in the menu are not clear
s.7 - Main and submenu arrows to scroll through menu were noticed and liked	c.7 - Confusion over infrared LEDs	mi.7 - Main and submenu arrows indicate that there are more options		u.7 - Going from the left to the right menu is not clear
s.8 - Using text to explain the categories in the menu is clear	c.8 - The baby unit does not communicate it can play different songs	mi.8 - Translation from English to Dutch is unclear		u.8 - The right menu button communicates you can go to the right in the menu
s.9 - Going through the menu with the up and down menu button is clear	c.9 - Volume of lullaby does not change significantly	mi.9 - The feedback sound is not clear		u.9 -Zoom button looks like a search button
s.10 - Going back with the left menu button in the menu is clear	c.10 - Zoom icon on screen deviates from zoom icon on button	mi.10 - The On/Off button needs to be pushed too long		
s.11 -Holding the On/Off button by turning the device off	c.11 - Not clear that up and down menu buttons can be for scrolling			

Table 2. Categorization of strengths and problems

Table 3 shows the frequency of strengths and problems per participant. In the table the participants and the scenarios they did are shown vertically and the strengths and problems with its frequency and severity are shown horizontally. The bottom row shows the frequency of the problems and strengths with the number of participants that could encounter the problem, as not all participants could encounter the same problems and strengths due to the different scenarios. Dark grey represents student participants, light grey represents parent participants.

Participant	Scenario	Strength (0)											Cosmetic Problem (1)											Minor Usability Problem (2)										Major Usability Problem (3)				Usability Catastrophe (4)									Total
		1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5	6	7	8	9	10	1	2	3	4	1	2	3	4	5	6	7	8	9	Total
P1.1	1						x			x	x																					x									x	x		x	x	x	6
P1.2	2										x															x																		x	x	x	4
P1.3	3				x	x				x	x	x							x																								x	x	x	x	4
P1.4	1																																							x		x	x	x	x		4
P1.5	2														x				x		x															x											4
P1.6	3				x	x				x	x	x		x																	x											x	x	x	x	x	5
P1.7	1 + 2														x						x	x								x		x			x							x	x	x	x		9
P1.8	1 + 3						x						x						x	x						x						x		x	x	x	x					x	x	x	x		13
P1.9	2 + 3					x					x							x		x										x	x						x		x				x		x	x	7
P1.10	2 + 3	x			x	x					x									x		x								x						x	x		x			x	x	x	x		10
P2.1	1					x		x	x												x										x			x	x		x	x	x	x	x	x	x	x	x		10
p2.2	2																																	x	x			x							x		3
P2.3	3			x	x	x				x	x	x						x	x		x			x	x						x				x					x	x	x			x		11
P2.4	1										x																				x				x			x	x	x	x	x		x		5
P2.5	2		x																x																x							x			x		3
P2.6	3			x	x	x					x														x						x				x			x				x	x	x	x		6
p2.8	2				x						x																							x				x	x			x			x	x	2
p2.9	3										x				x			x	x	x																						x			x	x	6
Total		1/8	1/8	2/8	5/8	7/8	1/14	1/14	2/14	5/14	11/15	3/18	1/8	1/8	1/8	1/8	2/8	2/8	2/8	6/8	2/14	2/6	1/8	2/8	1/14	1/14	1/14	2/18	8/18	3/8		1/14	1/14	6/18	7/8	1/14	1/14	4/14	5/14	11/14	12/14	13/1	13/18				

Table 3. Frequency of strengths and problems

Discussion

Icons and indicators

Poor icon design left participants guessing what some of the buttons' functions were. The screen on/off button proved difficult to grasp with five participants not being able to define the function of the button because the square icon was found to be meaningless. An additional eight participants thought the button had probably something to do with the screen, but could not describe the specific function. Another icon that eleven out of eighteen participants struggled to understand was the connection indication icon. Some of them indicated they had never seen the icon before and various labels were given to the icon including paper clip, safety pin, and pills.

In general, the function buttons were interpreted correctly. Only the magnifying glass icon on the zoom button did confuse six participants. They thought the zoom button was either to search in the menu or to enlarge the menu screen. All participants understood the talk button and the on/off button. However, still eight participants encountered problems when switching off the device. They thought holding the On/Off button for three seconds to turn off the device is too long. Whilst the other participants executed this task correctly, because of previous experiences with comparable products, still feedback when pushing the On/Off button could be useful.

The LEDs' colours of the battery and mute indicator were seen as unclear. The battery indicator LED was lit red, which the participants interpreted as a low battery level, while the battery icon on the screen communicated an almost full battery level. This left participants worried as they did not know whether the battery was full or not. The blue colour of the mute indicator LED was described as meaningless by participants as they are more accustomed to green and red light indicators.

The icons in the top of the screen were clear to the participants but not always noticed, for instance the zoom icon. Also, six participants felt the icon showed little resemblance to the icon used on the zoom button, leaving them confused about the meaning of the icon in the screen.

Menu structure

The most significant usability problems were encountered in the menu of the baby monitor (see figure 3). Both the menu button and the right menu button caused problems navigating through the menu. Five out of nineteen participants did not recognize the menu button as a menu button (see figure 2), which meant they had problems getting into the menu. Also, for six participants it was not clear that the menu button also served as an 'OK' - or selection - button. This and the right menu button led to twelve participants having difficulties getting into submenus. They believed they would get into the submenu by pressing the right menu button. Furthermore, eleven participants stated that the menu icons were not clear to them (see table 3). Most of them did not even notice the icons and were mainly focused on the submenu texts, which informed them on what option they were.

Feedback

In the main menu it is possible to endlessly scroll up and down the options in the menu. However, when in the submenu the end of the list of options is reached, it is not possible to scroll further down like in the main menu. This inconsistency is confusing to the user. This is further strengthened by the confusing use of the main- and submenu arrow icons. The function of these arrows is to show the user which way he is scrolling to. Users think it communicates that there are more options to scroll through, but then the sound goes off which means this is not possible.

The sound feedback was not received well by participants at all, with thirteen out of 18 participants expressing negative feelings about the feedback. The sound was experienced as being too loud and aggressive, making the participants feel punished. Also, it was not clear to participants what the sound feedback was for. Some participants did like the baby monitor to give sound feedback when they did something that was not possible, but in a more subtle way than is currently the case.

When using the zoom function, two participants noted that no feedback was given that it is possible to change the view on the screen by using the menu arrow buttons.

Baby unit

The placement of the buttons on the baby unit caused confusion among participants. Two participants thought they could skip to the next song by pressing the volume plus button, because they interpreted the plus icon as 'next' and it was not specified that the plus and minus buttons were for volume control. However, the icons for playing a song and controlling the volume are the same as on most other products and therefore easily

recognizable. One of the participants gave an explanation to why he thought the placement of the buttons was illogical to him, saying that volume buttons are usually placed together, like on a remote control for example.

Two groups
Interesting to see that there are little differences between the student participants and the parent participants. The two participant groups encountered the same most frequent problems. The problems that only few participants experienced were equally divided over the two groups.

Strengths
Table 3 also communicates the strengths of the product. The most interesting strengths are the icons on the baby unit and the up and down menu buttons. The icons on the baby unit for playing a song and turning up or down the volume are the same as most other products, therefore easily recognized and used by almost all the participants (see table 3). Scrolling through the main menu with the up and down arrows was done correctly by thirteen participants. Also all the participants recognized the up and down menu buttons without using them (see figure 2). These buttons and icons are beneficial to the usability of the baby monitor.

Conclusion

Users with UI experience from comparable devices expect elements to act in a certain way (Galitz 2007). Looking at the usability problems participants had with understanding the meaning of the icons and indicators on the baby monitor it is clear that users better understand icons and indicators that they are familiar with from previous UI experience. Comparing icons and indicators on other devices and looking into commonly used icons is needed to make the device better understandable.

Navigating through the menu interface was not clear on many levels. Inconsistency throughout the menu and use of the main- and submenu arrow icons led to bad usability. The menu icons were found to be unclear or were not even noticed because the participants were mainly focused on the submenu texts that informed them on what option the cursor was set. Participants did not recognize the menu button as a menu button and did not acknowledge it also served as a selection button. Instead, participants believed they would get into the submenu by pressing the right menu button.

Audio feedback itself was valued by the users, but not in the loud and aggressive manner leaving participants feel punished instead of informed. The visual feedback for navigation was sometimes misunderstood. This was the case for navigating through the main menu and the submenu and changing the camera view when zoomed in. Often the visual feedback of the indication LEDs was not comprehended as well. Green and red colours are preferred, since they are generally understood as right and wrong.

Recommendations

Among the users of baby monitors are also grandparents. This is a user group that was not included into this study due to limited available time, thence some problems could have stayed unnoticed. In future research it is useful to also take this group of users into account.

Due to time limitations it was not possible to have the data of each participant be analysed by two different researchers and have those analyses combined. Instead, only two researchers went through all the individual analyse to add any findings that might have been missed. A better triangulation of researchers would have made the outcome of the research more reliable and accurate. For a next study, the number of participants might be reduced in order to make the data more manageable and individual analyse less time consuming.

A last recommendation is made based on the tasks that were divided among the participants. Only one task involved the use of the baby unit. Therefore, only six of the 18 participants used the baby unit. In order to obtain more findings on the baby unit, it could be included into all the tasks or an extra general task could be introduced to the script involving the baby unit.

Acknowledgements

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