Universiteit Leiden

HCI

World-Wide-Wii

Evaluation report (final)

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Summary

This document describes the results of two evaluation sessions which were used to evaluate the design and implementation of our prototype, as also the revisions that are needed.

For our user evaluations we focused on the 4 main aspects of usability according to Shackle's Usability Model.

1. Learnability (aka Memorability); the user was instructed to follow basic navigation exercises to evaluate the basic tasks of our system and to see if the basic navigation skills were acquired in a short amount of time.

2. Throughput (aka Efficiency); after doing some basic training exercises the user was instructed to complete 10 advanced objectives within a total of 10 minutes. We counted the user error rate (user got stuck on object / in room).

3. Flexibility; we recorded user comments both on paper and digital camera about the suitability of intended actions.

4. Attitude (aka Satisfaction); afterwards we provided the user a system usability scale questionnaire to assess the users global satisfaction with our system.

We used the following evaluation methods:

Cooperative evaluation (observational technique)
During the evaluation sessions users were asked in a form to think aloud, describing his actions, what he is trying to do. Using a simple paper and pencil we recorded user comments. During the evaluation process the user was asked questions about his behavior, as also the user could ask for clarification if a problem arose. Using this approach we could clarify some points of confusion which are dealt with in this evaluation report.

Protocol analysis
We used paper and pencil together with video for recording user actions; Using a digital camera we recorded user movements on tape for further analysis. This has the advantage that we can see what the participant is doing.

Questionnaire (query technique)
Next to the observational evaluation technique we also used a specific query technique called the "System Usability Scale questionnaire" to have a global understanding of the users satisfaction with our system. The results from the questionnaires can be found in the analysis section of each evaluation.

1. Evaluation 1

Instructions

Introduction
Most of today's applications use standard input devices like for example the mouse and keyboard to control interaction. With the use of alternative input devices we would like to give the user the ability to maneuver like they would in daily life. Besides the use of alternative input devices we would also like to transform the way of displaying 2 dimensional data and representing it in a 3 dimensional "more natural" environment.

Thus this HCI project consists of building an interactive 3D environment. The user walks through a 3 dimensional world by use of the balance board. Using the Wii-mote the user can control the view in all dimensions. The 3D environment can for example consist of hotels and buildings with electronic walls containing dynamic web page information. A gatekeeper can for example be used as authentication. An elevator for the sitemap. We basically like to transform the 'going online' experience to more day-to-day activities, like going to a mall or walking on the street. We will try to make the controls as natural as possible and use gestures to simulate natural actions, like sorting e-mail.

As it is yet impossible to fully convert all 2D applications to the virtual world, we will try to find a hybrid solution, by the means of projecting the screen on some object and allowing a person to interact with the object in a more 'traditional way'. As a practical example, an (office)desk might contain a typewriter with some documents lying on the table which could be inserted into the type writer instead of using windows to manage the documents.

The World-Wide-Wii HCI project will be build upon Project Wonderland. Project wonderland is a 100% Java and open source toolkit for creating collaborative 3D virtual worlds. Within those worlds, users can communicate with high-fidelity, immersive audio, share live desktop applications and documents and conduct real business. Wonderland is completely extensible; developers and graphic artists can extend its functionality to create entire new worlds and new features in existing worlds. Using this framework we will create a new world with new features. We will implement the Nintendo Wii-mote and balance board as input devices for navigating through the virtual world. The final prototype will be used for demonstration purposes.

World-Wide-Wii uses the following functional specifications:

- Viewport control using the Wii-mote
- Navigating the 3 dimensional world using the balance board
- Viewing dynamic web information on 3D models
- Controls for operating the 3D world

Instructions

Test case
The user evaluations are aimed at evaluating the current interface. We want to evaluate if the users understand the basics concerning 3 dimensional navigation with the mentioned input devices Wii-mote and balance board and investigate if the basic interface we provide is sufficient or needs further adjustments.

For the evaluation sessions we will use an existing virtual environment named MPK20 demo. This is a standard environment included in the Wonderland 0.4 package.

Objectives
The user has to complete the following objectives within the virtual environment using the mentioned input devices. Beginning with the basic navigation training, the user can score points for standard movements using the input devices. This can be considered basic training exercises before the user is allowed to complete the advanced objectives. The main goal of this basic navigation training for the user is to understand the product without manual or additional information. For each of the advanced navigation objectives completed successfully, they will get 1 point. Thus a maximum of 10 points can be achieved. The number of points scored will be used as KPI (Key Performance Indicator) for our system.

Basic navigation

1.	Turn left	(Move Wii-mote in left direction)
2.	Turn right	(Move Wii-mote in right direction)
3.	View up	(Move Wii-mote to top)
4.	View down	(Move Wii-mote to bottom)
5.	Walk forward	(Stand on balance board and make balanced steps)

Advanced navigation (10 objectives, Appendix A[1])

1.	Find location (objective 1)	(1 minute(s))
2.	Find location (objective 2)	(1 minute(s))
3.	Find location (objective 3)	(1 minute(s))
4.	Find location (objective 4)	(1 minute(s))
5.	Find location (objective 5)	(1 minute(s))
6.	Find location (objective 6)	(1 minute(s))
7.	Find location (objective 7)	(1 minute(s))
8.	Find location (objective 8)	(1 minute(s))
9.	Find location (objective 9)	(1 minute(s))
10.	Find location (objective 10)	(1 minute(s))

Usability specifications
Time
- User has to complete all advanced navigation objectives within 10 minutes.

Error
- User is allowed a maximum of 5 navigational error's, e.g., navigating to wrong places within the virtual environment.

[1] Advanced navigation objectives can be found in Appendix A

Results

Usability specifications
Time

- User 1 completed 5 out of 10 advanced navigation objectives within 15 minutes.
- User 2 completed 9 out of 10 advanced navigation objectives within 10 minutes.

Error

- User 1 experienced the maximum of 5 navigational error's, e.g., navigating to wrong places within the virtual environment.
- User 2 experienced 1 navigational error's, e.g., navigating to wrong places within the virtual environment.

*Navigational errors in this case mean getting stuck on objects in the environment or not being able to control the system any longer.

Comments

Observations

- Sometimes a user is stuck on a wall and because of the camera angle he can't really move anymore.
- Without instructions, basic navigation like walking forward is not clear.
- Without instructions, basic navigation like turning left or right is not clear.
- When user first stood on the balance board, he was going backwards.
- Users are applying more pressure in order to try to move faster.
- When asked to express emotions the user tend be more 'verbose' with the wii-mote and do not think about pressing the buttons.
- Emotion gesture 'wave' is executed by the user by waving it's hands.
- Emotion gesture 'approve' is executed by the user by moving the wii-mote up and down.
- Emotion gesture 'disapprove' is executed by the user by moving the wii-mote from left to right.
- User expect the avatar and camera position to return to it's original position, when placing the wii-mote back into 'neutral' position.
- User found advanced objectives are hard to find.

Comments by user
We received the following comments from users evaluating our prototype:

- Illustrations with basic navigation instructions could be helpful.
- Person expects movement going faster when leaning more forward.
- Advanced objective screenshots are a bit difficult to recognize when printed in grayscale.
- Pointer does not work, not allowing to interact with the objects.

Analysis

Further analysis of the previous comments can be found below.

Occasionally the user is stuck somewhere next to a wall and can't move around anymore. This happens because of the 3rd person view that is used when controlling the avatar. The home button can possibly resolve this problem when used for leveling the view to a default.

When the user first stood on the balanceboard, he was trying to walk forward by 'stepping' on the board like in daily life one would make balanced steps to walk around. The user expected to walk forward this way. Instructions at this point should be more clear in a way that users have to balance themselves more forward or more backward on the balanceboard. Using the more realistic manner of stepping on the balanceboard to perform natural movement is not an option, because the balanceboard sensors could be damaged when doing so.

Viewing in the virtual environment using the wii-mote could also be improved. Users were trying to move the wii-mote in either left or right direction. The system did not react like it should, because of wrong navigation instructions. The wii-mote should be rotated around the Z-axis instead of moving it around the X-axis.

When the user first stood on the balanceboard he was going backwards. This is because different users have different weight. When any spare time is available the system should somehow calculate a person's weight so that the balanceboard sensors can be accurately configured.

A few basic emotional exercises like 'waving', 'approving', 'disapproving' turned out to be quite valuable as well. When trying to express these emotions, the user was immediately convinced that waving should be done by waving the wii-mote, like in daily life. And approval should be expressed by moving the wii-mote up and down and so forth.

Other points of improvement concerning the balanceboard include faster movement through the virtual environment. The standard walking speed is sometimes insufficient. Sometimes the user likes to 'run' through it and therefore tries to lean more forward, but nothing happens.

Next to the navigational aspects, the system should somehow be able to interact with an object. This is taken into account when working on the next version of our prototype.

SUS
The System Usability Scale is used for global assessment of the systems usability.

User 1, overall system usability score: 53. (Appendix C)
User 2, overall system usability score: 70. "

Analysis of the usability scale shows that users find the system unnecessarily complex, although they find it easy to use the 2 main input devices. They find the basic system functionality yet not integrated very well and one of the users thinks he will need a technical person to give instructions. Another point of attention includes system consistency. One user stated there was too much inconsistency and the system was cumbersome to use. Overall the system should make the users feel more confident.

Revisions

We found the below revisions necessary to improve our product. The first revisions were made by adjusting the basic navigation instructions which were not clear at the first evaluation. At first we used the wii-mote to control the view of the 3 dimensional environment. We decided to use the “Nunchuk” an extension for the wii-mote to control the view, because it makes viewing while moving through the virtual environment more natural. We adjusted some basic instructions like ‘Rotate Nunchuk’ instead of ‘Move Nunchuk’. Also instructions for walking through the virtual environment were not clear and so we adjusted them as well. We also added some additional features such as ‘Interact’ to interact with an object, ‘Walk faster’ to walk somewhat faster and ‘Walk slower’ to easily navigate through the environment. Besides instructions we also added illustrations for clear examples how to navigate. Next to the basic navigation revisions we adjusted the time-scale to complete the advanced objectives, because experience from the evaluation session learned us the user was always over time.

Basic navigation (illustrations, Appendix B[2])

1.	Turn left	(Rotate Nunchuk in left direction)
2.	Turn right	(Rotate Nunchuk in right direction)
3.	View up	(Move Nunchuk to top)
4.	View down	(Move Nunchuk to bottom)
5.	Walk forward	(Stand on balance board and lean forward)
6.	Walk backward	(Stand on balance board and lean backward)
7.	Interact	(Press A on wii-mote, while holding B)
8.	Walk faster	(Press + (plus) on wii-mote)
9.	Walk slower	(Press – (minus) on wii-mote)

Advanced navigation (10 objectives, Appendix A)

1.	Find location (objective 1)	(2 minute(s))
2.	Find location (objective 2)	(2 minute(s))
3.	Find location (objective 3)	(2 minute(s))
4.	Find location (objective 4)	(2 minute(s))
5.	Find location (objective 5)	(2 minute(s))
6.	Find location (objective 6)	(2 minute(s))
7.	Find location (objective 7)	(2 minute(s))
8.	Find location (objective 8)	(2 minute(s))
9.	Find location (objective 9)	(2 minute(s))
10.	Find location (objective 10)	(2 minute(s))

Usability specifications

Time

- User has to complete all advanced navigation objectives within 20 minutes.

Error

- User is allowed a maximum of 5 navigational error’s, e.g., navigating to wrong places within the virtual environment.

[2] Illustrations can be found in Appendix B

2. Evaluation 2

Instructions

Test case
This 2nd user evaluation is aimed at evaluating the interface again, but with adjustments derived from the first evaluation. We want to evaluate if the users understand the basics concerning 3 dimensional navigation with the mentioned input devices Wii-mote and balance board and investigate if the basic interface we provide is sufficient or needs further adjustments. Next to the basics concerning navigation we also want to evaluate for example interaction within the environment.

For the evaluation sessions we will use an existing virtual environment named MPK20 demo. This is a standard environment included in the Wonderland 0.4 package.

Objectives
The user has to complete the following objectives within the virtual environment using the mentioned input devices. Beginning with the basic navigation training, the user can score points for standard movements using the input devices. This can be considered basic training exercises before the user is allowed to complete the advanced objectives. The main goal of this basic navigation training for the user is to understand the product without manual or additional information. For each of the advanced navigation objectives completed successfully, they will get 1 point. Thus a maximum of 10 points can be achieved. The number of points scored will be used as KPI (Key Performance Indicator) for our system.

Basic navigation (illustrations, Appendix B[3])

1.	Turn left	(Rotate Nunchuk in left direction)
2.	Turn right	(Rotate Nunchuk in right direction)
3.	View up	(Move Nunchuk to top)
4.	View down	(Move Nunchuk to bottom)
5.	Walk forward	(Stand on balance board and lean forward)
6.	Walk backward	(Stand on balance board and lean backward)
7.	Interact	(Press A on wii-mote, while holding B)
8.	Walk faster	(Press + (plus) on wii-mote)
9.	Walk slower	(Press – (minus) on wii-mote)

[3] Illustrations can be found in Appendix B

Instructions

Advanced navigation (10 objectives, Appendix A)

1. Find location (objective 1) (2 minute(s))
2. Find location (objective 2) (2 minute(s))
3. Find location (objective 3) (2 minute(s))
4. Find location (objective 4) (2 minute(s))
5. Find location (objective 5) (2 minute(s))
6. Find location (objective 6) (2 minute(s))
7. Find location (objective 7) (2 minute(s))
8. Find location (objective 8) (2 minute(s))
9. Find location (objective 9) (2 minute(s))
10. Find location (objective 10) (2 minute(s))

Usability specifications

Time

- User has to complete all advanced navigation objectives within 20 minutes.

Error

- User is allowed a maximum of 5 navigational error's, e.g., navigating to wrong places within the virtual environment.

Results

For the 2nd user evaluation we did not specifically test against any usability specifications. We evaluated the revisions and current state of the system. In general giving more focus on the aspects of alternative navigation in a 3 dimensional environment. Comments and analysis can be found in the next paragraphs.

Comments

Observations

- User is not able to pin back to last known working location.
- User does not get feedback of navigation. Instead of keeping the Nunchuk at a certain position, user is ‘pushing’.
- User does not feel himself in control.
- Make sure all objects are present. Test with same environment and re-check changes upfront.
- Controls are too sensitive.
- User feedback sometimes missing. Not all movement is picked up.
- Mouse navigation stutters while interacting.
- User easily learned mapping button ‘1’ to enable and disable mouse control via the Wii-mote. Although the feature is not very convenient, it takes the user little time to handle.
- Participant has a specific mental model of how the system should work.
- Position of the input devices in hand not clear.
- User tries full axis rotation.
- Movement is mirrored while interacting with an object. Although movement is mirrored, mental mapping is made quite fast.
- Interaction like drawing on a virtual whiteboard is difficult.

Comments by user
We received the following comments from users evaluating our prototype:

- Use lot of input at the same time.
- Wii balanceboard is too sensitive. Small difference between walking forward and backward.
- Sideways walking (strafing) is not considered natural movement. User knows about this feature from his gaming experience.

Analysis

Analysis of the above comments can be found below.

Occasionally the user is not able to pin back to the last known working location. The system should somehow be able to give onscreen instructions / waypoints.

At some points the user does not get any navigational feedback of the system. This could be linked to the user not feeling himself in control. The screen feedback problem is due to a lack of interface response, which is sluggish due to low frame-rate. Wonderland beta 0.5 could possibly resolve this problem.

During the evaluation session some objects were missing within the environment. This is because of a slightly different world used for this evaluation. Before each evaluation a test run should be made to verify each object is present.

When looking at the input devices users state that controls are too sensitive. Every movement is picked up, even the small ones, and sometimes not even all movement is processed. Sensitivity can be easily adjusted and Wonderland beta 0.5 could possibly fix interface responsiveness.

Users found interaction with an object easy to accomplish with instructions given, although creating interaction in the environment is still a bit of a challenge with the whole set-up. SUN Wonderland is still under development and not fully functional. Some particular problems while interacting with an object consist of a stuttering mouse pointer in vertical position. This could be due to the small distance between the infrared sensors that is currently set up, or maybe more sensors should be used.

Furthermore participants have a specific mental model of how the system should work. Users expect putting more pressure on the balanceboard means faster movement, which of course is logical in a sense. The current interface restricts in a way easy implementation of this functionality.

We also noticed some problems using the Nunchuk input device. Users try to rotate the Nunchuk in the right direction, but only using a few fingers to accomplish this. The best way to use the Nunchuk for example is to grab it with the whole hand. Maybe we should include some additional illustrations in the instructions section.

As mentioned before interacting with an object is yet a bit difficult because of a stuttering mouse pointer etcetera. Some additional problems consist of mirrored movement and pointer sensitivity. A larger distance between the infrared sensors and better interface responsiveness in Wonderland beta 0.5 can possibly improve this.

Users also mentioned they had to use a lot of input at the same time. E.g., if users want to run through the virtual environment they have to use the Nunchuk to control the view, lean on the balanceboard ‘and’ press the + (plus) key on the wii-mote. This is quite a lot at the same time.

Some last comments concerning the balanceboard include sensitivity and sideways walking. Like other comments about the input devices the balanceboard is also too sensitive and doesn’t have for example a dead-zone where the user can just stand still. Also sideways walking (strafing) is not considered natural movement.

SUS
The System Usability Scale is used for global assessment of the systems usability.

User 1, overall system usability score: 43. (Appendix C)
User 2, overall system usability score: 70. “

Analysis of the usability scale shows that users find the system still a bit to complex to use. Using the Nunchuk for exploring the virtual environment is more natural than using the wii-mote, however a lack of responsiveness causes the system to be a bit difficult to use. As also the large variety of input the user needs in order to navigate can cause unease about the system. Like the first evaluation users also find the system a bit cumbersome and don’t feel very confident. This could be then again because of the large variety of input and possibly the lack of responsiveness from the Wonderland 0.4 framework.

Revisions

We found the below revisions necessary to improve our product.

Some first revisions are made by adjusting the instructions necessary to use the system. Viewing in the virtual environment has to be clear and so more and precise instructions are given. Following the instructions we decided to use the 'Z' button at the back of the Nunchuk to easily speed-up and walk faster. This is more convenient for the user than using some button on another device like the wii-mote which we used before. Continuing the revisions on the input devices, some changes are made to the sensitivity of the devices in a way that users can better control the system.

Another important revision will be the use of the Wonderland 0.5 framework, which causes the interface to respond better to user actions. Possible frame-rate issues should be resolved. This will result in better feel and control of the system.

Basic navigation (illustrations, Appendix B[4])

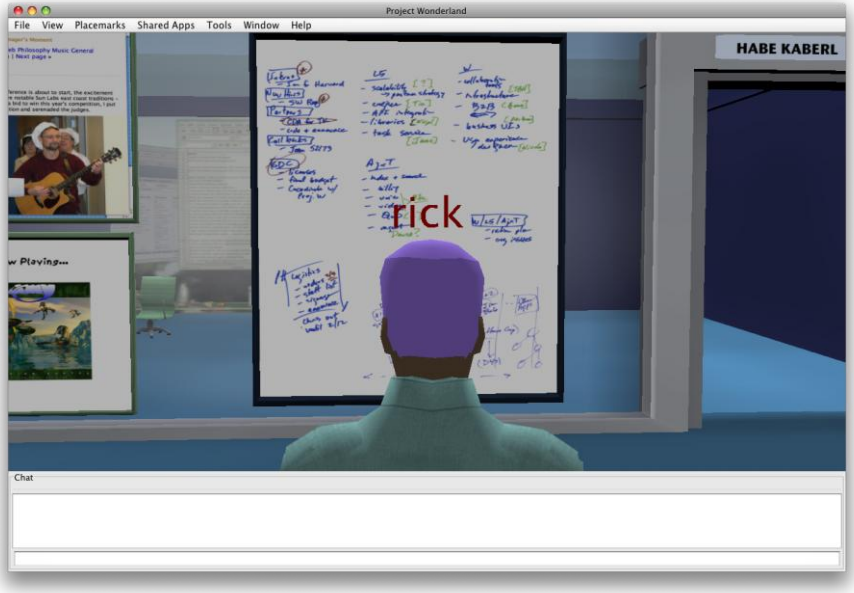
1. Turn left (Rotate Nunchuk in left direction)
2. Turn right (Rotate Nunchuk in right direction)
3. View up (Rotate Nunchuk in upper direction)
4. View down (Rotate Nunchuk in lower direction)
5. Walk forward (Stand on balance board and lean forward)
6. Walk backward (Stand on balance board and lean backward)
7. Interact (Press A on wii-mote, while holding B)
8. Walk faster (Hold 'Z' at back of Nunchuk)

[4] Illustrations can be found in Appendix B

Appendix A – Advanced navigation objectives

(objective 1)

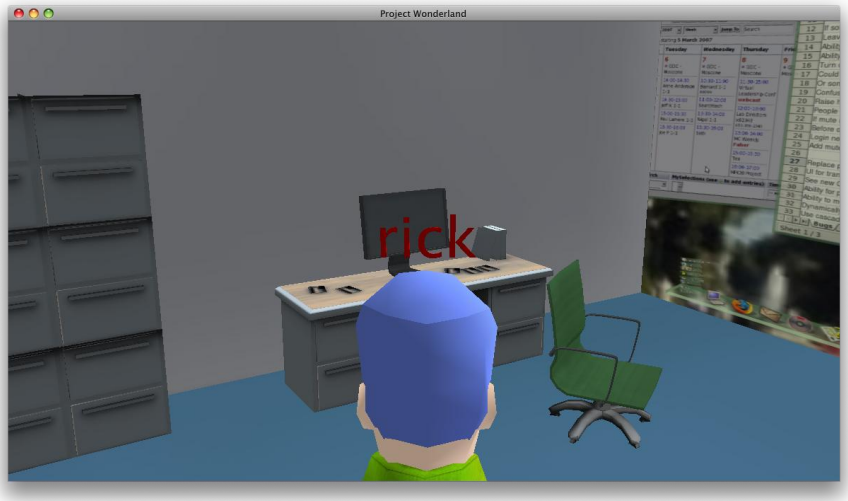
(objective 2)



(objective 3)

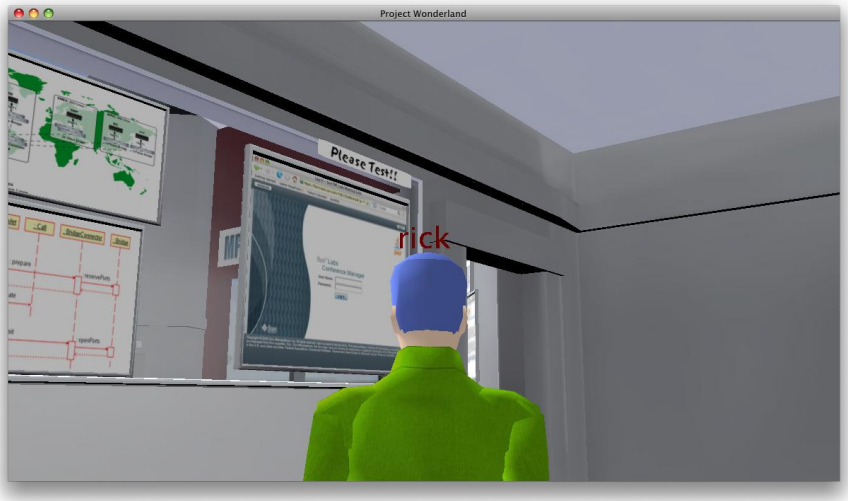
(objective 4)

(objective 5)



(objective 6)

(objective 7)



(objective 8)

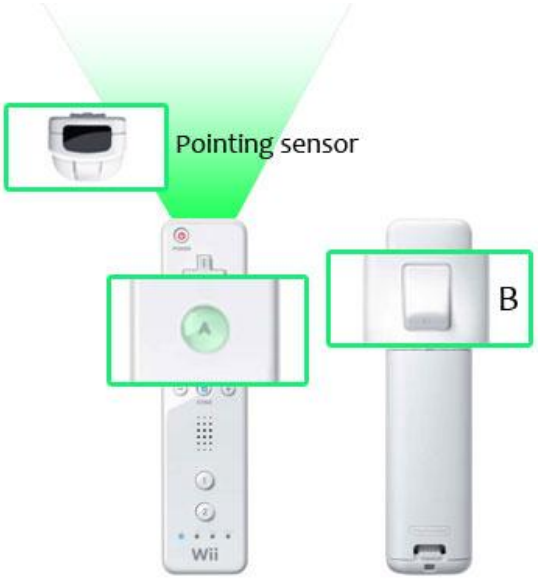
(objective 9)

(objective 10)

Appendix B – Basic navigation revisions (1st evaluation)

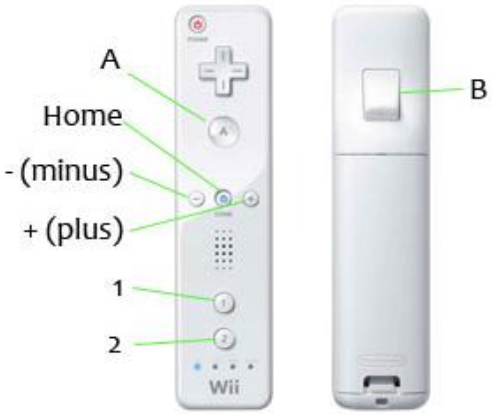
1. Turn left (Rotate Nunchuk in left direction)
2. Turn right (Rotate Nunchuk in right direction)
3. View up (Move Nunchuk to top)
4. View down (Move Nunchuk to bottom)

5. Walk forward (Stand on balance board and lean forward)
6. Walk backward (Stand on balance board and lean backward)



You can interact with an object by pointing on the object.

You also need to press the A-button while holding the B-button at the back of the Wiimote.



A	→	Interaction (Hold B)
+ (plus)	→	Walk faster
- (minus)	→	Walk slower
Home	→	Reset view

Appendix C – System Usability Scale

User: Matthew Jarvis, Mediatechnology

	Strongly disagree				Strongly agree
1. I think that I would like to use this system frequently		X			
	1	2	3	4	5
2. I found the system unnecessarily complex					X
	1	2	3	4	5
3. I thought the system was easy to use					X
	1	2	3	4	5
4. I think that I would need the support of a technical person to be able to use this system			X		
	1	2	3	4	5
5. I found the various functions in this system were well integrated			X		
	1	2	3	4	5
6. I thought there was too much inconsistency in this system					X
	1	2	3	4	5
7. I would imagine that most people would learn to use this system very quickly					X
	1	2	3	4	5
8. I found the system very cumbersome to use					X
	1	2	3	4	5
9. I felt very confident using the system					X
	1	2	3	4	5
10. I needed to learn a lot of things before I could get going with this system	X				
	1	2	3	4	5

System Usability Scale

User: Job de Reus, Mediatechnology

	Strongly disagree				Strongly agree
1. I think that I would like to use this system frequently				X	
	1	2	3	4	5
2. I found the system unnecessarily complex		X			
	1	2	3	4	5
3. I thought the system was easy to use				X	
	1	2	3	4	5
4. I think that I would need the support of a technical person to be able to use this system	X				
	1	2	3	4	5
5. I found the various functions in this system were well integrated					X
	1	2	3	4	5
6. I thought there was too much inconsistency in this system	X				
	1	2	3	4	5
7. I would imagine that most people would learn to use this system very quickly					X
	1	2	3	4	5
8. I found the system very cumbersome to use				X	
	1	2	3	4	5
9. I felt very confident using the system		X			
	1	2	3	4	5
10. I needed to learn a lot of things before I could get going with this system				X	
	1	2	3	4	5

System Usability Scale

User: Jelle Bril, De Leidsche Flesch

	Strongly disagree				Strongly agree
1. I think that I would like to use this system frequently	X				
	1	2	3	4	5
2. I found the system unnecessarily complex				X	
	1	2	3	4	5
3. I thought the system was easy to use		X			
	1	2	3	4	5
4. I think that I would need the support of a technical person to be able to use this system	X				
	1	2	3	4	5
5. I found the various functions in this system were well integrated				X	
	1	2	3	4	5
6. I thought there was too much inconsistency in this system		X			
	1	2	3	4	5
7. I would imagine that most people would learn to use this system very quickly		X			
	1	2	3	4	5
8. I found the system very cumbersome to use				X	
	1	2	3	4	5
9. I felt very confident using the system		X			
	1	2	3	4	5
10. I needed to learn a lot of things before I could get going with this system			X		
	1	2	3	4	5

System Usability Scale

User: Paul Langelaan, De Leidsche Flesch

	Strongly disagree				Strongly agree
1. I think that I would like to use this system frequently		X			
	1	2	3	4	5
2. I found the system unnecessarily complex		X			
	1	2	3	4	5
3. I thought the system was easy to use				X	
	1	2	3	4	5
4. I think that I would need the support of a technical person to be able to use this system	X				
	1	2	3	4	5
5. I found the various functions in this system were well integrated				X	
	1	2	3	4	5
6. I thought there was too much inconsistency in this system		X			
	1	2	3	4	5
7. I would imagine that most people would learn to use this system very quickly				X	
	1	2	3	4	5
8. I found the system very cumbersome to use			X		
	1	2	3	4	5
9. I felt very confident using the system				X	
	1	2	3	4	5
10. I needed to learn a lot of things before I could get going with this system		X			
	1	2	3	4	5

Appendix D – Detailed user analysis

Here we identify the user group that we are addressing with our product.

The following analysis is done based on the tasks we are going to implement in the Wonderland framework, by taking a more closes look at our (intended) users and by talking to them.

• User characteristics

1. Semi-experienced users, most users know how to move around in a 3D environment in a sense they are able to understand the concept of virtual worlds, meaning input for example does not always has a 'real' life feedback.
2. Familiar with Wii-mote and balance board input devices, in a way that they know where to turn it on, find the buttons on the device and how to use them safely. No knowledge of specific gestures.
3. Information is mainly consumed in a (mainly) passive way and at fixed locations, but it takes quite some time by visiting all the information locations and check for updates.
4. Social activities on the internet are mainly used to keep in touch with friends and relatives, almost none had any previously experience with remote collaboration.
5. When working on assignments, for example documents a lot of text needs to be inserted.

• Skills

1. High general skill level, university degree of thinking, able to understand abstract concepts.
2. General level of computer skills or higher. Feeling comfortable over working with input devices like mouse, keyboard on a daily basis.

• Conclusions

1. Basic navigation instructions will not be needed, the gestures however require some initial documentation, which could be given upfront or by means of inline documentation.
2. Enable some form of hybrid functionality, to ensure the user is able to work on his documents on the same time as navigating for information the other time.
3. Minimize typing and/or finding alternatives for keyboard based navigation input, like forms and urls.

Appendix E – Hierarchical Task Diagram

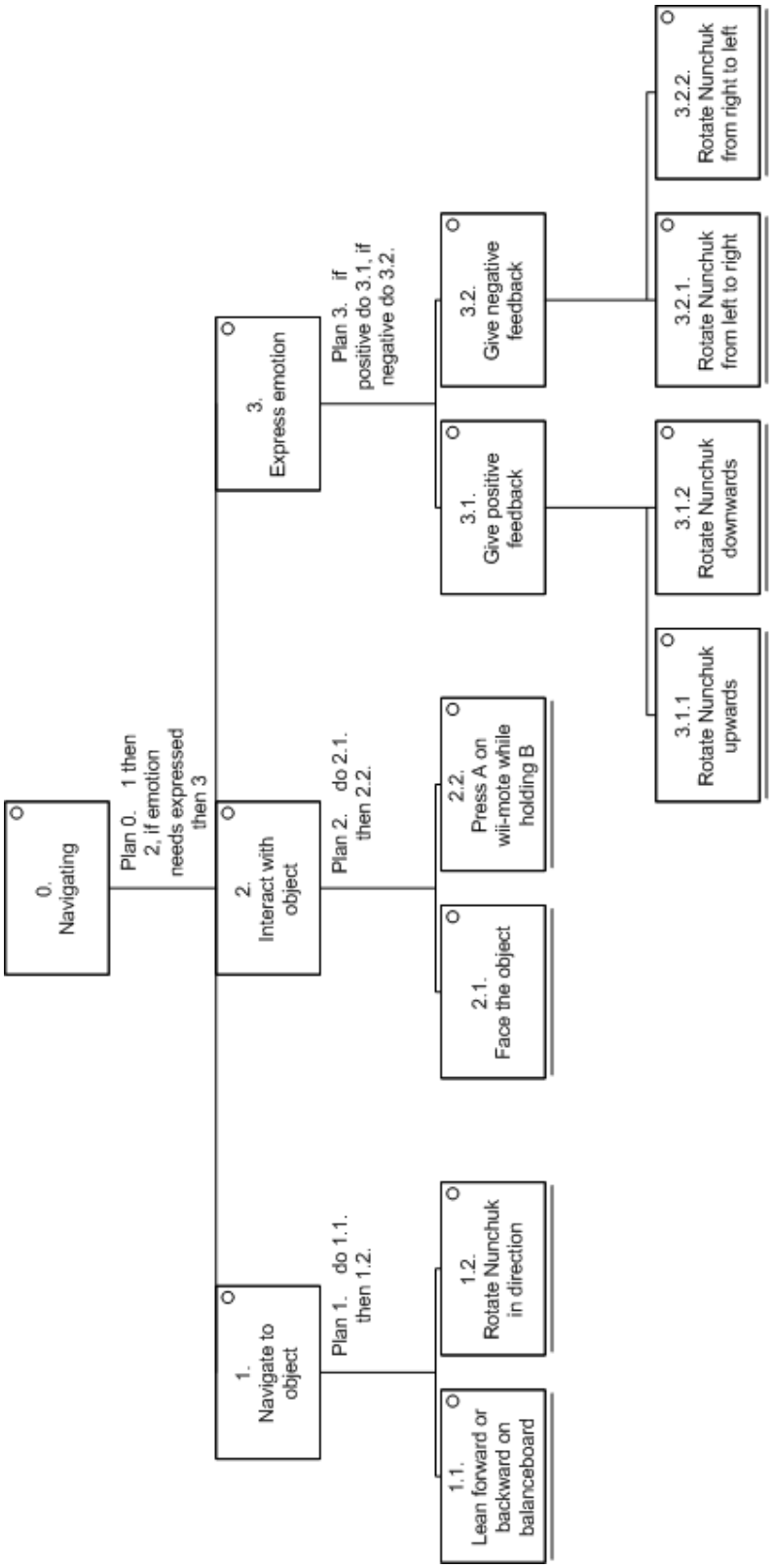


Figure 1: Detailed task analysis: Navigation

3. Document management

Version history

Version	Date	Author	Comments
1.0	18 December 2008	Rick van der Zwet, Frank de Boer	

Document distribution

Name / Lecturer / Assistant	Datum	Versie
Dr. Ir. Fons J. Verbeek Job de Reus	18 December 2008	1.0

Name / Members		
Rick van der Zwet Frank de Boer	18 December 2008	1.0