blurring the boundaries

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Final Master Project Report
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To the reader

This report is the result of my Final Master Project in the course of Industrial Design at the Eindhoven University of Technology. It is intended for two purposes. First it is intended to document the project both in terms of process and content, in order for follow up projects by myself or others to benefit from the work that has been done. Secondly, it is intended for the assessment of my project. It should allow the assessor to get an insight in the way of working and thinking, and explain thoroughly the work that has been done.

Also I would also like to spend some words on the focus of the report. In the exploratory stages of the project, there is a strong focus on the virtual. Nevertheless, the physical aspect is at least as important for the project. The focus was chosen because the qualities of the physical world are more evident. Furthermore, the initial intention was to allow the benefit of the virtual in the physical.

Within the focus on virtual worlds, there is a strong focus on Second Life. It is however important to note that there are many other digital virtual worlds. Second Life was chosen as a case, but other worlds such as social networks and message boards often show the same qualities and have been explored during this project.

Besides the digital virtual worlds, also non-digital virtual worlds such as role-play, reading, dreaming etc. were looked into. This project is in no way intended to make these worlds loose their value. Rather it should support the source of these worlds: imagination.

I hope you will enjoy reading the report and if any questions occur, please feel free to contact me.

Serge Offermans

Abstract

Digital virtual worlds are important to the people living in them. They allow people to use other means to exploit their capabilities. Who they are, what they can do and what they experience in these worlds however, is hardly ever valuable outside the virtual. This project aimed to create an integration of the qualities of the virtual and the physical world, and in doing so allow benefit from one world in the other.

The result is a virtual world, designed specifically with integration of the worlds in mind. It literally draws the virtual world into the physical by bounding it to our physical reality and effectively placing virtual, invisible characters and objects in our physical world.

Interaction with the world is made possible by a device that channels audio from one world to the other and allows you to 'feel' and manipulate the world through movement and touch.

The specific world that has been worked out is designed for the use by children and their parents who can now benefit from the dynamicness of the virtual world without the closed medium of the PC.

Children and parents can now together experience the virtual world and spend time together while they are engaged in activities that also benefit the childs educational development. Because the world can only be perceived through touch and audio, the world stimulates the child's imagination.

1. introduction

ships approaching a harbor near the 'Lost Gardens of Apollo'; Second Life

1.1 The Isolated Beauty of Virtual Reality

Besides the reality that we commonly agree to live in, there are other realities in which people live a part of their life. These realities are online virtual environments where people flock together. These realities emerged together with the rise of the Internet [Meadows, 2008], and have been growing ever since. Though the appearance of the environment has changed from text-based message boards to advanced 3D worlds, the general concept is still the same.

Especially in these modern worlds, the same phenomena appear to emerge as we can see in our common reality: social structures, economies, relations, etc. [Rosedale, 2008]. Like in our physical reality, people live a life according to certain rules and roles they collectively adopt. The agreement upon the existence and importance of these worlds by their inhabitants make it into a reality. One of the most talked-about examples of these realities is Second Life.

These virtual worlds appear to be important to people. When really engaged in such a world, the time and money spent in it is considerable and the world quickly loses its game-like appearance. The world becomes a reality where the consequences of your actions are no longer insignificant. The world allows you to make what you want to make and go where you want to go. You can have a real job, earn real money, make real friends and have real experiences. Therefore people value these worlds tremendously, or in other words; these worlds create tremendous value for the people living in them.

Currently, there are only a few concepts that can transfer the values between these realities. One of them is money. People can exchange virtual money (e.g. L$ - Linden Dollars; Second Life) for other currencies, and that way spend their day-job money in Second Life, or even earn money in second life and spend that

in the physical world. This is a concept that creates added value for both the virtual and physical reality. Besides money, knowledge is also transferred between the realities. This is because in the end it is the same human in the virtual and physical world.

Because there are so few concepts that allow the virtual experiences to be valuable in the physical world, the virtual world remains isolated form our 'normal' society and it becomes increasingly interesting to exploit and build on these values only in the virtual world. This can create problems for the people involved, as they naturally have a physical body and a social environment in which they live. Moreover it presents a large opportunity for the use of virtual worlds to benefit our everyday life.

1.2 Goal

The main goal of the project is to develop a system which is able to transfer value from the virtual to the physical world to contribute to either one of the worlds, and in doing so create added value. Concretely, the system should allow the qualities of the virtual world to be valuable in the physical world and with that contribute something to the life of the person involved.

1.3 Approach

1.3.1 Transfer through integration

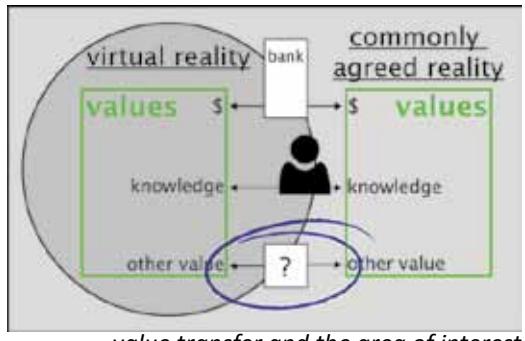
An important starting point for this project has been the idea that the virtual world is part of the real world [de Mul, 2008]. This means that the system to be designed should not treat these worlds as parallel universes, but rather see the virtual world as a place within the real world, very much as other 'worlds' are places in our reality. The project therfore aims to enable the integration of the virtual into the physical. To achieve this integration, transfer of value is a means. A medium (like money) can be used for the value transfer from one reality to the other. This medium is the area of interest.

1.3.2 Why would we transfer values and integrate these worlds?

Value can be seen as, rather then a property of an object, a concept created between object and subject [Pirsig, 1999]. Each action or event that we experience thus creates value. The accumulation of these values determines who we are; our identity. Our ability to accumulate these values thus makes us 'richer' people with each experience.

When we live part of our lives in a different reality, let's say the virtual reality, the values that are created by our behaviour are not naturally a part of our physical reality. Not all rules that apply in the virtual reality (both physical and social), also apply in the physical reality. The objects in this virtual world are different in matter and meaning and the same goes for the subject. It may thus be that value created in the virtual world, can not be transferred to the physical world, and thus does not contribute to our identity in the physical world.

the virtual world as part of the real world



value transfer and the area of interest

This means that we shape two separate identities. Partially this is the whole aim of the virtual world. However, in my view, transferring the values between these realities could be an enrichment for both the identities. Not only the addition of new value to an identity causes this enrichment; but the combination of values, created in two different realities may result in a synergy which allows for greater enrichment of the identities. After all, synergy can be the result of the combination of values from different perspectives, whether his be ideas, objects, capabilities, experiences, qualities, etc. I am very interested to see if in this case this synergy could be achieved and whether this would be desirable.

Some people who have a 'second life' in a virtual world consider this life to be a more desirable reality then the physical one. As there are different rules in virtual worlds, people's capabilities to create value change. For some people, these new rules may be much more convenient, and allow them to express their capabilities much more. For instance people with serious physical disabilities or people with social limitations may find that their identity in the virtual world is much more interesting. The reason for this is that they are better able to create value in this world. This also becomes apparent in the book 'Alter Ego: Avatars and their Creators' [Cooper and Dibbel, 2007].

Because they are more capable in the virtual world, for these people it is highly attractive to spent time in the virtual world, and less attractive to spent time in the physical world. In essence there is not much wrong with this. However, all identities in virtual worlds have a physical person behind them. This means that this person inevitably also lives in the physical reality. As they spent less time in the physical world, that identity creates less value, which makes the identity less 'rich' and less interesting to spend time on; resulting in a negative vicious circle.

I think it would be a great contribution to these peoples' physical identities if they could use the value they created in the virtual world, also in the physical world. This would cause an enrichment of the physical identity, which in turn allows for more valuable experiences in the physical world. Vice-versa, the virtual identity may benefit from values which came form the physical world. This could cause a positive vicious circle which in the end may lead to a greater balance between the amounts of time spent in each reality.

2. background

To understand what makes the virtual world so valuable to the people living in it, an understanding of the concept of value and the values in virtual worlds is important.

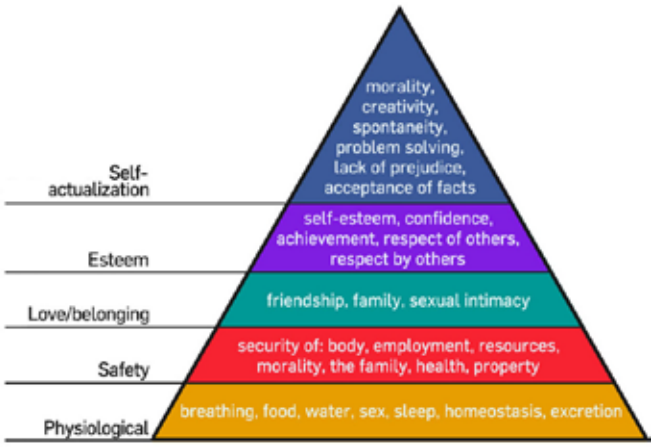
2.1 An Inquiry into Values

There are various approaches to the concept of value and values. People may assign value to objects, we have moral values and we have our fundamental human values. When talking about 'values' people often refer to our moral values, while the value of an object is sometimes even expressed in terms of money.
I would like to state that in my view all these approaches are not separate approaches to the concept of value. Rather I believe they are all elements of the concept of value as a motivational construct.

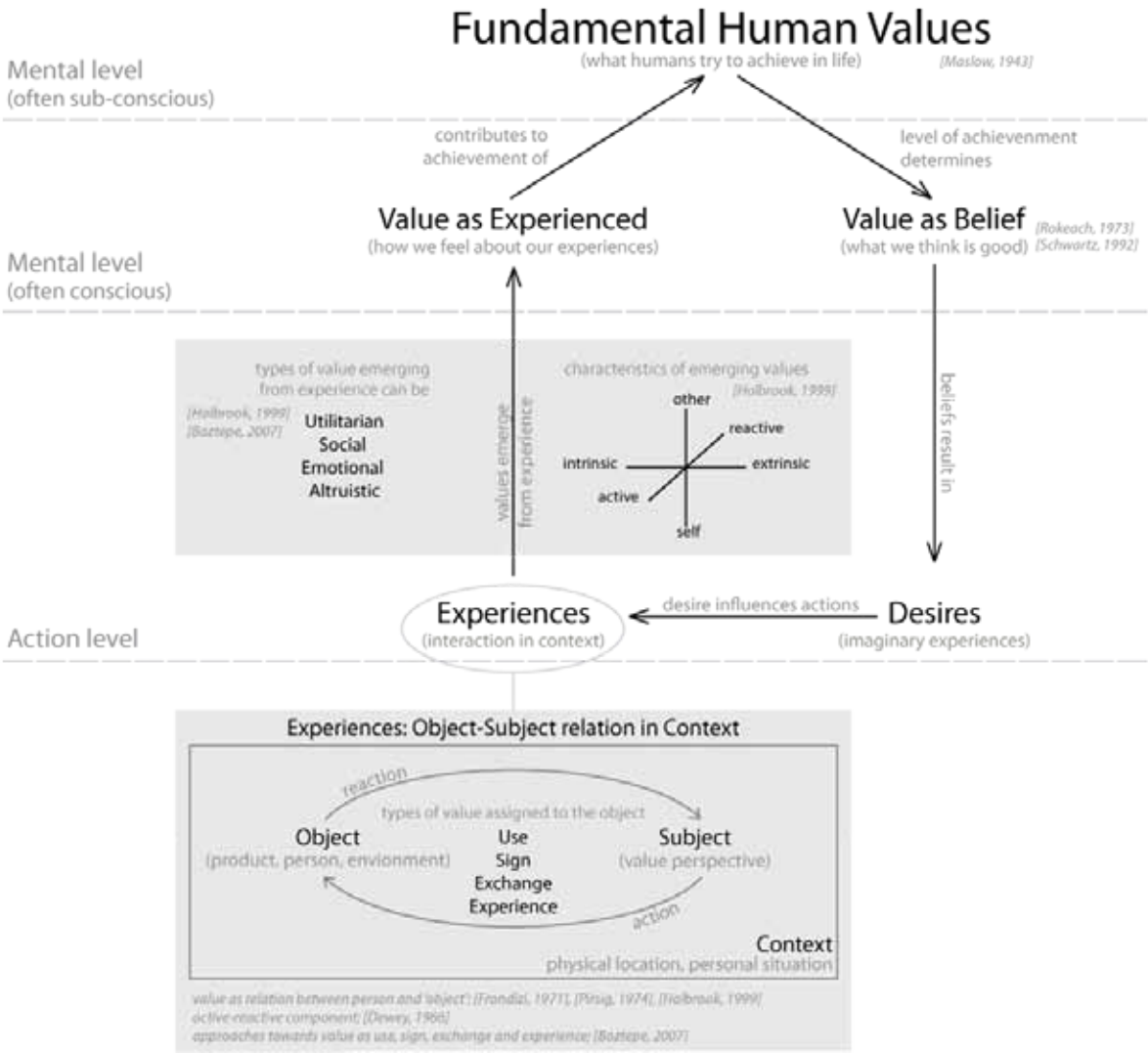
In the diagram on the next page, the relation between all these elements can be seen. In the end, everything contributes to the achievement of our 'Fundamental Human Values' [Maslow, 1943]. The extent to which we have achieved these values determines what we think is important; our 'Values as Beliefs'. What we consider to be important then determines what we 'Desire' which directly influences our (inter-) actions; our 'Experiences'. The result of that is the 'Value as Experienced'; how much we valued a certain experience. To complete the circle, this reflection determines the extent to which we have achieved our Fundamental Human Values.

The Experiences are not really an approach to value; the experience is the 'value instance' itself. It is the moment at which all value is created; the 'now'. This part also explains why we attach value to certain objects or people.

Besides the circular influence of all the elements, there are actually also cross-influences. For instance our experiences directly influence our desires, and our desires directly influence the value we attach to our experiences.



Abraham Maslow's Hierarchy of Needs; image source: wikipedia.org



an overview of different approaches to value

A more elaborate description of this study can be found in the appendix 1.

Within this value framework, the project focuses on the experience value on an action level. It is concerned with the relation between people and objects in a certain context. Actually it will try to take the value emerging from this relation from one context to another. Therefore, when reading about 'value' in this report, it can be considered 'what we value'. It is a relation in context, an experience or a 'quality'.

2.2 Virtual Worlds and Reality

Virtual worlds are no less real then our 'real' world. Our lives are actually filled with other virtual concepts we have adopted and that we accept to influence what we do and who we are. Our image of reality is constructed around what we perceive, as is made clear by Plato's Cave Metaphor. This chapter explains why the virtual worlds can be so real to the people living in them.

2.2.1 'Each world when attended to is real in its own fashion'

This is a famous quote by the British philosopher Wiliam James. Essentially, it means that when we are reading a novel or watching a movie, we enter a world which becomes our temporary reality. We imagine that things are actually happening and emotionally feel what the character in the story is feeling.

This is no different when one is engaged in the virtual world. You are looking at a character with which you can empathize which has an emotional effect on your body. This ability is generated by the mirror neurons in our brains, which make that what we perceive is also felt.

Furthermore, fiction registers as fact [Reeves and Nass, 2003]. This means that when we perceive something; the brain first registers this as an event that has actually happened. A next cognitive step allows us to decide whether this is truly the case or not. If this last step is not taken, the virtual world is as real as the real world. Dreams are a good example of that.

2.2.2 Perception and agreement

Another important point is that our reality is constructed by the agreement upon its existence. Take the value of money as an example. It only has value because we agree upon it; other then that it's a worthless plastic card or small metal disc. Another example may be your country. The borders are a virtual concept; they don't exist. Nevertheless, they are real enough to fight wars over. Religion is the same story. As we agree upon the existence of a God, it is real. We thus have the collective power to generate realities.

Also the ability to perceive a certain reality makes something real. Humans have the tendency to look for a confirmation or a proof of reality. This may sometimes be found in peer affirmation as is described above, but can also be found in the own perception of it.

virtual borders made real by perception and agreement

In the case of virtual worlds, the inhabitants agree upon its existence which makes it real, and this is confirmed by their perception of it. However, outsiders can not perceive it and do also not necessarily agree upon its reality.

2.2.3 Rules and Roles

Our lives in general revolve around rules and roles. They give us purpose in life while there may be none. These rules and roles actually determine the way we act and live our lives. When I am being served in a restaurant; there is no real difference between me and the waiter, but the rules and roles make us act and relate in a certain way. Similarly, without rules and roles, it would be ridiculous for someone to grab someone and take away his freedom, however, if one is a police officer arresting a criminal it makes sense.

These rules and roles determine our reality. We can't go without them. Even in a culture that has no rules and roles in principle such as Second Life, they quickly emerged to create this reality. Without these rules and roles there is nothing to do; no purpose.

2.2.4 Our virtual worlds and identities

It is not only in the digital virtual worlds that we temporarily switch to another identity. Actually, I would like to argue our complete existence consists of the sum of various worlds and identities.

When going on holidays, I am a different person then when I am at home because I am in a different world. I act differently, I feel differently, I do different activities and value other things. Then again, when at home, I am a different person in a different world compared to when I am at work. I approach people differently and may expect different things from them.

The rules and roles are different, as are the agreed values. There is nothing wrong with a ball rolling on the floor in between two poles. However, if these poles are part of the goal that

rules and roles determine our behaviour
Photograph by Alan Jones Nov 12th, 2008

I am defending during a soccer match, it may truly feel terrible. That is the reality I attend to at that moment, and that determines my feelings and actions.

The digital virtual world is no different from these physical worlds and therefore as real and potentially valuable. The difference is that most of these other worlds are agreed upon, not only by the inhabitants of that world, but by more people. The visibility of 'perceivability' of the

world is an important factor in this agreement. Imaginary friends have the same problem. Also mirror neurons can only work if we understand the concept we are confronted with, another problem for digital virtual worlds.

2.2.5. Summary

In essence all that makes our realities, worlds and identities is present in the digital virtual world as much as it is in any part of our world. However, principles that make us perceive something as real are often blocked by the medium of the digital virtual world. As the digital virtual world is so confined to its 'online' environment and the boundaries are so strong, these worlds are often perceived as separated from reality.

2.3 Values in Virtual Worlds

The previous chapter explains why things in virtual worlds are so real to the people living in them. It is then important to see what the concepts are that have or create the value in these worlds, so that it becomes evident what can be transferred.

To find what the values of- and in virtual worlds are, Second Life was taken as a typical case and various books, documentaries and papers were consulted to get grips on the matter. Furthermore two interviews were conducted with inhabitants in Second Life, discussing the meaning of their life there (results in appendix 2). Also I tried to engage in the world to find out for myself.

A summary of the most important values is given below.

2.3.1 Creativity

Creativity in creation

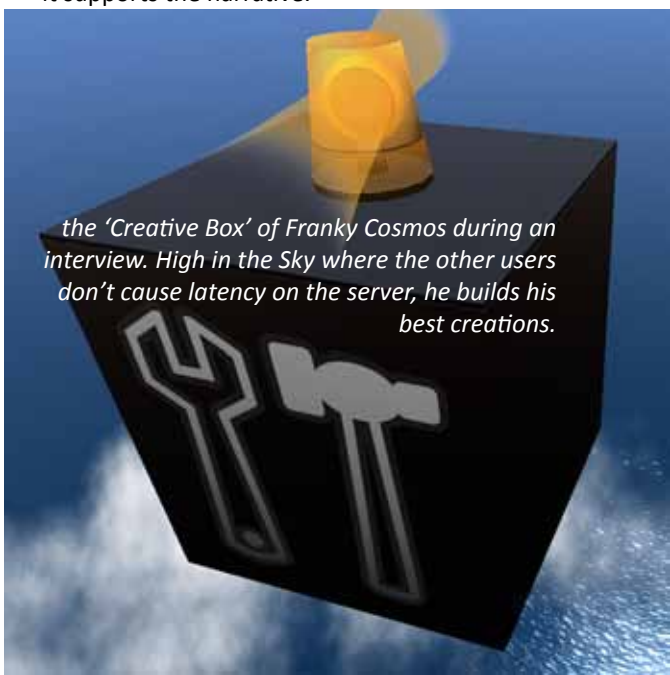
The ability to create your own world is not unique for Second Life. The entire non-natural world around us has been created by ourselves. There are however two major differences.
First of all, everything in Second Life has to be created. If something is not created it does not exist. This means that also nature has to be created. The landscape, animals, people and their movements have to be created. In order not to end up in a boringly perfect world, we also have to create garbage, broken things, inpracticalities, handicaps, etc. In other words, an interesting landscape requires creativity.

Secondly creativity is the prime limitation. If you imagine something, it is very likely that with some time spent on it; you will be able to realize this imagination in Second Life. You don't need a large corporation nor a production plant to create things. The interface for building is fairly easy for someone who knows how to use a computer. Money is also not a real issue and physical limitations are unknown to the virtual world.

Collaborative fiction

Something else that is lacking in the virtual world are the rules and roles that were discussed earlier. The world is in fact an empty book which requires creativity in the creation of a narrative. Together with the other inhabitants, you collaborate on this fictional story.

This means that people have to come up with activities, professions, hobbies, and everything that comes with that. Ilja Leonard Pfeiffer states: "The last thing you need in Second Life is a house" [Pfeiffer, 2007]. You don't need a house because you don't need to sleep or a shelter or anything inside a house. However; sooner or later, everyone wants a house; simply because it supports the narrative.



the 'Creative Box' of Franky Cosmos during an interview. High in the Sky where the other users don't cause latency on the server, he builds his best creations.

Clever entrepreneurship is another result from this. People re-identify the gaps in the market and try to fill them. This creativity is of the more profitable type as money can easily be earned with this.

2.3.2 Freedom

Little physical limitations

The world knows little physical limitations. People can fly and gravity is 'available' if you like it. Moreover, you can teleport from one place to another, meaning that you can be 'with' someone on the other side of the world (both the physical as well as the virtual world). During one of the interviews, a participant explained that Second Life allowed her to share a 'home' with the person she loved, although he lived over a thousand kilometres away.

Be who you want to be

Anyone can choose the role he or she wants to perform. This starts with your appearance and will go to the behaviour that is performed and the activities that are done. Often the role that is chosen, allows for an extension of the normal personality. The person can exhibit personal traits that he/she is unable to portray in daily life. Men may show their feminine side, people in a wheelchair may walk. Also more extreme forms of role-play are performed.

2.3.3 Social

Love and belonging

A crucial part of life; one of the basic human needs identified by Maslow, is 'Love and Belonging'. This is a value strongly present in Second life. One of the reasons is that for people who don't have a strong sense of belonging with a certain community, the virtual world easily provides these communities. There are numerous 'groups' one can be a member of, and because the world can be considered a sub-culture; being a resident in itself creates a sense of belonging.

Social vs. Objective driven

Second Life is a social world. In contrast to games that are objective driven, Social Worlds are socially driven. Peoples' goals concern a social status [Meadows, 2008]. It is the difference between Rules or Roles that are the dominant means to frame the interaction within the world.

An extension of the social network

Virtual worlds are a means to extend the social network as appeared from literally all sources of information. True friendships can develop among the residents, up to the point where people meet or even get married in First Life. The possibility to be 'together' with people you can't be together with normally creates the

Medesca Markova with her boyfriend during the interview

bathing in the 'Lost Gardens of Apollo'; Second Life

social value in virtual worlds. It allows you to live together with people in one world that live in many different cultures and have many different ideas of values. This was brought forward in one of the interviews.

Illusion of the mask

The illusion of the mask [Meadows, 2008] means that we think we are unknown to the person we are talking to. This is actually an illusion because as we feel safer behind the mask that we believe the avatar (virtual representation of a person) to be, we speak more freely and open up our deepest secretes.

This makes the virtual social contacts extremely real, arguably more real then physical social contact.

2.3.4 Achieving and satisfactory experiences

Virtual Worlds create a very achieving environment. This allows for the contribution to the fundamental human values related to (self-)esteem. Furthermore, extraordinary experiences can take place with relative ease.

First of all, everyone is beautiful, and you can fly. You can dive with dolphins, fly Da Vinci's helicopter, visit the Eiffel Tower or talk to a dragon. It satisfies your desires in an extraordinary manner [Pfeiffer, 2007]. In other words, what you can imagine is possible.

It is also relatively easy to become successful in Second Life, as long as you spend some time on it. Everyone can start a company, build things for yourself, or sell them. You can find friends, date people, find a partner and another one if you please.

In Second Life, it is possible to have what you could not have in First Life. One of the interviewees showed me around her beautiful mansion, that she got as a thank-you gift for working as a night-club manager (in Second Life). She explained how she could sit at her private beach with her boyfriend watching the sunset. To her, it really made dreams come true.

Of course, the sunset is a computer generated image, as is the home and the representation of her boyfriend. Nevertheless, the human imagination is able to augment the flat virtual world to a full experience by means of what is explained in the previous chapter ('mirror neurons', 'fiction registers as fact', etc.)

2.3.5 Identity development

The avatar (virtual representation of the user) is the means by which the user develops his or her identity in the virtual world. Moreover it is used to develop the own identity.

Like mentioned, the avatar is often an extension of the physical person. It is carefully developed and a constant reflection on the result is made. The avatar can thus be seen as a part of the 'Self'. People indicate to actually act differently depending on the active 'Self' without consciously thinking about this difference. As

Ilja Leonard Pfeifer put it during a symposium on 'Identity in Virtual Worlds'; "I acted and thought differently in certain situations than I would have reacted in the physical world in a similar situation." He referred to a situation where he was a woman in Second Life, and ugly men walked in and expected her (him) to engage in interaction of some kind. Reflecting back on these types of experiences allows development of the identity both in Second- and First life.

Isablella [Isabella, 2007] makes the analogy with transitional objects. She states that the creation of the Self in a virtual world is very similar that of a young child. A transitional object is often used to guide the transition towards the understanding of 'Self' in contrast to outer world. This transitional object is something over which the child has control, which opens the realm of play: a combination of real world objects and imagination. The avatar can be seen as an equivalent of this transitional object.

The virtual world thus allows one to develop its identity in a playful manner (combination of fiction and reality) and benefit from this development in daily life. This was also proven in a study [Yee and Bailenson, 2007].

2.3.6 Values in other virtual worlds

Besides Second Life and other online virtual worlds, there are a lot of other worlds that can be considered virtual worlds. When you are dreaming, reading a book, watching a movie or telling an anecdote you are imagining yourself to be in a different place and time. Also having imaginary friends and fantasizing about yourself in a different role are ways of stepping into a virtual world.

The qualities (values) in these virtual worlds are not much different from those in second life. In the end they all contribute to the achievement of fundamental human values. They may let you explore parts of you own mind and yourself that you were unable to see from your daily perspective and add to your identity.

2.3.7 Summary

In essence it can be said that the values in Second Life are no different from the values in 'First Life'. The emphasis however is different as more focus is on higher layers of Maslow's pyramid. The lower layers are irrelevant (physical and safety). Love and belonging is important, as is the esteem, and then there is all the time in the world for self-actualization.

3. exploiting the opportunities

3.1 The search for Value Transfer

As shown in the previous chapters, the values created in virtual worlds offer tremendous opportunities if they could be transferred to the physical world. Exploiting these opportunity was now the task at hand. Transfers were investigated, both from the virtual to the physical world, as well as from one physical world to another.

3.1.1 Transferring in the physical world

In our lives, we transfer and transform values on a daily basis. We create the values in the different 'worlds' or 'realities' that we live in. When we leave work, our salary provides us with food at home and the ability to go on holidays. On these holidays, we have our special experiences of which we make photographs that we share with our family at home.

To find how value can be transferred from the virtual world to the physical, it was important to find out how values are transferred between other worlds. In other words, when do we benefit from values in our daily life that originated in another part of our life? And what does this change about the original value?

Analytical session

An analytical session with fellow students was performed to see how these values were transferred, and also how they were transformed during transfer. The characteristics of values as described in the previous chapter were used to analyze this transformation. The results of this session can be found in the appendix 3.

What we transfer and transform

It appears that what we take with us from one world to another is often taken within ourselves. Experiences add to our identity, they shape our behaviour and the way we feel about ourselves. This became especially evident in the analytical session, and was also found in a study on the effect of virtual world experiences on physical

world self-perception [Yee and Bailenson, 2007].

Besides what we take with us within ourselves, we often take value representations to another world. Things that physically represent a certain value and that can be transported from one world to another. More about this can be read in chapter 3.1.3. These representations often also transform the original value, for instance from an intrinsic value (experience) to an extrinsic one (esteem).

3.1.2 Transfers and transformations between Second Life and 'First Life'

Money

Value transfer through money is one of the first things that comes to mind when thinking about the transfer between Second Life and First Life. Money transforms the value of the effort put into creation into something ambiguous; money. This is no different from the way we earn money in our everyday reality. Because the money has no predefined meaning it is superbly suitable for the transfer between worlds. From your work to bungee-jumping or from a gamble to a place to live in; as soon as something is transformed into money, the original context is no longer relevant.

Another reason why it is such a suitable transporter for value is that it is something virtual already. The money itself does not have any value; it is the prospect of what you could do with it.

Frendships/relationships

Sometimes, virtual friends become friends outside the virtual world as well. Often this happens gradually, going from Second Life, through other web-based medium to sometimes a physical meeting. However, also without a physical meeting, true friendships or love can occur. The moment you tell someone your real name and start to discuss things about your other life, the physical and virtual blend, even though no physical meeting has happened. And even without telling someone about your 'First Life' identity, affections may arrise.

Inspiration

The different worlds are a source of inspiration for one another. In one of the interviews it appeared that the interviewee often created things based on what he knew from his First Life. Vice versa he indicated looking on the web for clothing that was similar to things he had seen in Second Life.

Also when people are in Second life, a lot of them tend to visit things they have seen in real life as well (the Eiffel Tower, Amsterdam, etc). The other way round, one of the interviewees indicated that he went diving in the physical world after he had done this in the virtual.

Another inspiration from the physical world are the limitations to it. In Second Life, people often make or do things that are impossible in first Life like flying, owning a castle, or realizing other dreams.

World perspective

Looking at the physical world with the eyes of a Second Life resident makes you appreciate the physical world. This was stated in one of the interviews, and also confirmed by both Meadows and Pfeiffer in their books.

All of them mention looking at the physical world differently after an intense period of Second Life activity. They start counting 'prims' (virtual building blocks) in physical buildings and observe deviant behavior in the physical world residents. In general, they mention being more aware of the fact that it has all been created.

The way you treat people and expect to be treated in return is part of your identity. Second Life may change your ideas of right and wrong, and with that shape your identity, as was indicated by one of the interviewees. Also Pfeiffer mentioned that looking through the eyes of his avatar, he observed annoying behaviour that he had to admit he performed himself in the physical world.

Anshe Chung on the cover of 'Business Week' in 2006

Iconic People

Sometimes iconic people from the virtual world are special, though recognizable enough to make their way into the physical world. A second life model was 95th in Maxim magazine's 'Hot 100' list, in July 2007. Also the first virtual person to become a US$ millionaire in Second Life was widely seen in the physical world in 2006 when she appeared on the cover of Business Week.

Energy Use

There is also a strong negative influence on the physical world. Energy use in terms of servers and PCs for one avatar per year is on average approximately 1.752 KWh. [Meadows, 2008] This is quite a large amount, when comparing it to the consumption of a physical which is only about four times as much in the Netherlands; 6.850 KWh [www.nationmaster.com].

3.1.3 What we physically take with us

We can not physically transfer value; but rather transfer the representations of values; reminders and hints towards potential values. A representation of value is per definition not the real value. This is the case for instance for money as well. Three types of value representations were identified. These types are based on their temporal relation to the actual value instance, past, present and future as was described in the 'Inquiry into Values' (appendix 1).

Past – Reminders

Reminders allow us to think back or relive certain experiences. Furthermore, they allow us to share aspects of a world with others who have not had the same experiences.
Examples can be a photograph, objects (souvenirs) or relics.

Present - Updaters

Updaters create value because they transfer value from a world we are currently not attending, to the world that we are attending. To be more accurate, they provide us with a temporary window to that other reality.
Examples can be (news-)websites, stock indices, weather reports or magazines.

Future - Prospectors

Prospectors create value by imagination. They are things that allow a value instance in the future. Money can do this because having it allows you to do all different things in the future. Thinking about what that could be requires imagination. The prospector may also create a strong anticipation, as is the case with concert tickets. A representation of a fairly practical nature may also create value. It is nice to know that you have a pen so you can write something down if you want to.

3.2 Ideas

The ideas described here are largely based on the results of the search for value transfer described above. These ideas all focussed on the context of Second Life, as this was set as the application domain. Ideas aimed to support the transfer of values from one world to the other.

Some of the ideas have been worked out in detail while others are broader concept directions. Together they describe the most important ideas that have lead to the final concept, and also indicate the boundaries of the design space in which has been sought for the 'solution'.

To start the idea generation phase, a brainstorm session was held with fellow students. The setup and the results can be found in the appendix 4.

3.2.1 Capture and represent valuable experiences in both worlds

This is one of the first ideas that arose when setting up the project. It is about the mixed representations of valuable experiences in both worlds through a mutual object. The representations are present in both worlds, both physical as well as virtual.

An example of this idea is a photo camera that functions in both worlds. It is a physical object that can be used to take photos in you physical environment. The same device can be used to take photographs in Second Life. When in the virtual world, one could get the camera and use it as always, except that it will now look inside the virtual world. The photographs taken in one world could be shown on representational objects in the other.

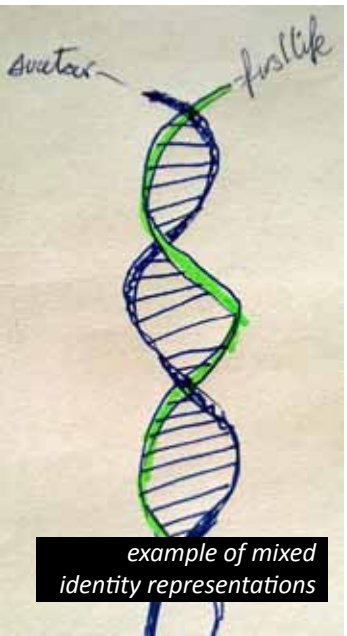
It is based on the idea that it allows memory cues for achievements / experiences to be viewed beyond one world and to experience the value of these achievements in the other world. Furthermore it allows experiences from one world to be shared in the other world which in itself can create new values.

It may also trigger people to consciously capture experiences and re-value them; things you take for granted in one world may seem much more extraordinary in the other. The different perspective on the content of the input allows for new insights and understanding.

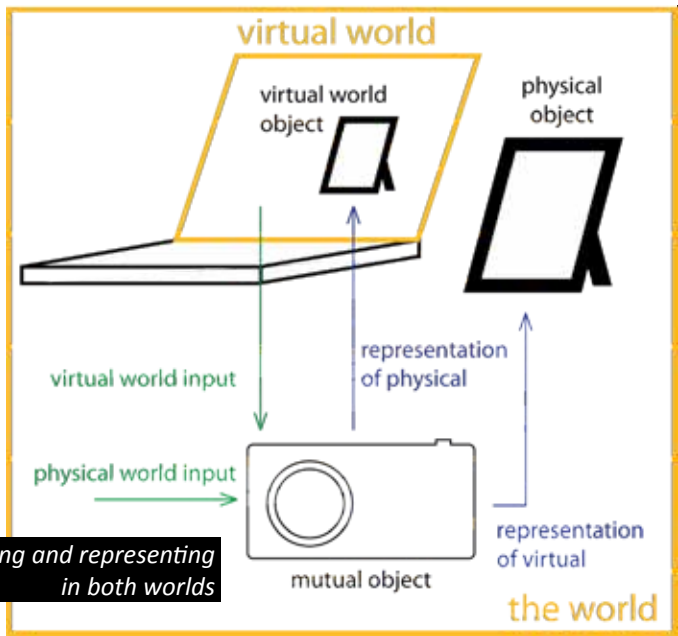
This mutual object may function as a transitional object between the two worlds [Isabella, 2007], similar as described in chapter 2.

3.2.2 Identity representation

Identity development is an important aspect of the virtual and physical world. The development however is usually separated while they in fact are part of the same person. A representation of the virtual avatar in the physical world, combined with representation of the physical person creates a holistic view on the entire life of the person. Having this object present in -and affected by- both worlds would create a tool for self reflection and identity development. The input for such a representation could be both consciously added as well as gathered automatically. One could think of activity monitoring; the amount that is 'spoken' in either world or the time spent in each world could be visualized. On the other hand, also poetic sentences could intentionally be added to the object.



example of mixed identity representations



capturing and representing in both worlds

3.2.3 Purposely mixed

Things that are happening in both worlds are often interesting events or movements in themselves. However, looking at them in combination with similar on contrasting things in the other world may raise interesting questions and thoughts.
This idea supports the creation of projects where the contrasts or similarities in both worlds are highlighted by mixing them with the intention to make you think.

3.2.4 Experience maps

In our physical reality, everything is connected through our physical world. We can go somewhere to see it because it is on the same earth surface. This geographical connection makes things part of our reality.
There are however other ways to connect things, often much more meaningful then geographical position. Creating a world map based on the nature of experiences could integrate experiences from both worlds and make them into one reality.

Two elements would be required for this concept. First, a tool capable of capturing something both worlds when you tell it to capture. This capture could be in all different sorts of forms and modalities; photographs, colours, sounds, written or spoken text, videos, paintings, etc. This input would have to be linked to and placed in the existing map. People themselves may create this link based on their own interpretation of their experiences as well as the maps.

Secondly, a tool to view these maps would be required. The map may be 'overflown', like Google Maps while the content is represented in small thumbnails.

Of course, the basis should not be a geographical background, but could be composed of the elements that make it up. A system that uses a similar approach to mapping is the World Mind Map. This system generates a map of word-associations based on peoples input [www.womima.com].

Besides creating a map of the combined reality of virtual and physical experiences, such a system would also create an overview of where you 'have been' in terms of experiences, and what 'places' are new for you to explore.

two examples purposely mixed

Eva Longoria (l) and caLLie cLine(r) in Maxim's Hot 100

treehuts in the physical and virtual world

a screenshot of 'Google Maps' with thumbnails

a screenshot of the 'World Mind Map'

a pethouse for an entity that lives in both worlds

3.2.5 Direct transfer

Another way of taking values from one world to the other is by directly taking objects from one world to the other.
This is sometimes already happens in some. One of the interviewees indicated making t-shirts in Second Life that he owned in his physical life. There are also companies that offer a 3D physical object to be created from your virtual object, like your avatar. One of these services is Fabjectory [www.fabjectory.com].

These objects can serve as memory cues for the other world. A service could be created that does this transfer in both ways.

3.2.6 New entity that lives beyond each world

Creating an entity that lives in both worlds like the user itself, would be able to create a stronger connection between the two worlds. This is similar to what money does. The actions in one world have consequences in the other, and there is an affirmation of the virtual reality.

This entity could be a kind of pet-robot, a Tamagotchi if you like, that lives both in the virtual world and the physical. It decides on its own to move from one world to the other. It can also only be in one world at a time meaning that, you sometimes may have to look for it in another world.

Its physical form could be a semi-mobile robot that moves around your house and that you may take along on a holiday. The virtual could be something similar, only virtual.
The things you do with the robot in both worlds determine its behaviour in both worlds. Feeding it or spending time with it could be required for the entity's survival. Also some activities require one world or the other. 'Walking the dog' or some other physical activity can only be done in the physical world, whereas meeting other pet-bots may only be possible in the other world. This would allow for a balanced amount of time spent in the two worlds by the robot, which may again stimulate the user to do the same.

3.2.7 Creative activities beyond one world

The virtual world may be used as a platform for creative activities. The fact that it allows people from different sides of the world to be connected makes it possible for people with similar interests to cooperate in creative activities.
The virtual world could serve as a workspace for musicians or architects to create things that may be valuable in either world. A virtual building created in Second Life could serve as a blueprint for a physical building. A specialized interaction platform for such a target group may exploit the value of skill in both worlds.

A band could use real instruments to make music together, that can be heard in the virtual world. This is something that already happens, and a concept that could further be extended. Another beautiful example of an event that took place beyond worlds was given by Ilja Leonard Pfeiffer [Pfeiffer, 2007] who describes a memorial party for a DJ who passed away. This party took place in a club in Utrecht (the Netherlands) as well as in Second Life. The DJs in Utrecht played the music that was streamed to a virtual club in Second Life. Streaming video of the party people in Second Life was displayed in the club in Utrecht.

3.2.8 Support transfer of values that are naturally transferred

Values are often naturally transferred within the people that move in and out of the virtual world. Knowledge and social skills are examples of such values. Further supporting this transfer could also be an interesting direction. The aim for such a system would be to make the transfer easier or more effective.

A way to access knowledge gained in the virtual world; or to be reminded of events could achieve this. Something that would enable someone

to use the social skills gained in Second Life in physical life could also achieve this.

3.3 A new Virtual World

Developing the ideas for the virtual worlds raised the awareness that the virtual world has a paradoxical desire to separate itself from reality while integration is required for people to benefit from it in their physical life. The project has tried to achieve the integration to alow this benefit, but the desired separation at this point created a problem that could not yet be solved. The desired separation originates from two sources [Neustaeder and Fedorovskaya, 2009]. One is that introducing the 'real world' in the fantasy world degrades the fantasy. Another is the secrecy that is desired around the life in the virtual world. You don't necessarily want everyone in your environment to know what you do in the virtual world. Also the illusion of the mask could for instance be broken down, which is an important aspect in the social qualities of virtual worlds.

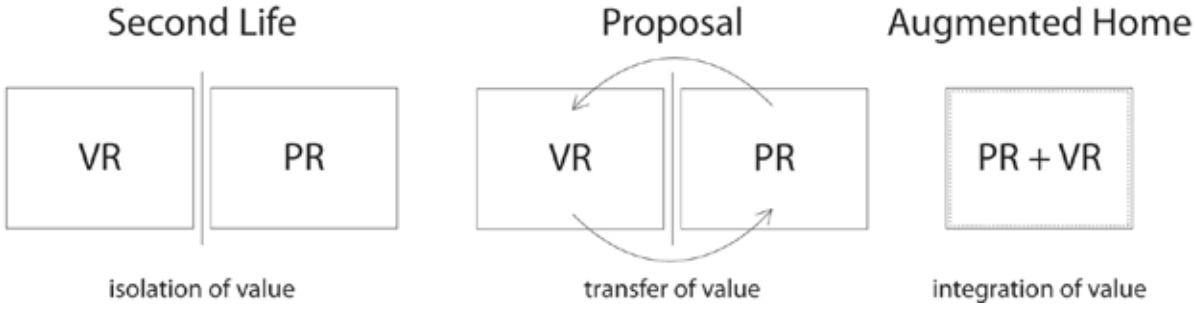
To find whether value transfer through integration could be a valuable approach and to bring the design project to a good end; the choice was made to develop a new virtual world, where the desire for separation was less strong. While Second Life has been the great inspiration for this project, from this point on, a new virtual world would be the starting point for the design.

The choice was made to focus on the context of children and the virtual worlds they live in. These virtual worlds can also be digital virtual environments like 'Habbo Hotel' or 'the Sims', but also imaginary worlds created by the child itself.

The main values there are, just as in Second Life, the experiences they have. These experiences may contribute to the child's development on a social level through the interaction with the characters in the virtual world. They also provide value on an educational level through the challenges and games that can be done.

These values are often naturally transferred because the child takes the experience with it. However, like with Second Life; sharing these experiences further affirms the reality of the world and creates more value for the experiences. Also the sharing itself can contribute to the relation between the parent and child and thus create new value. Again, this transfer and creation of value is often limited as the world is isolated from our daily life.

Looking at this shift in the project in terms of value transfer level; it could be visualized as below.



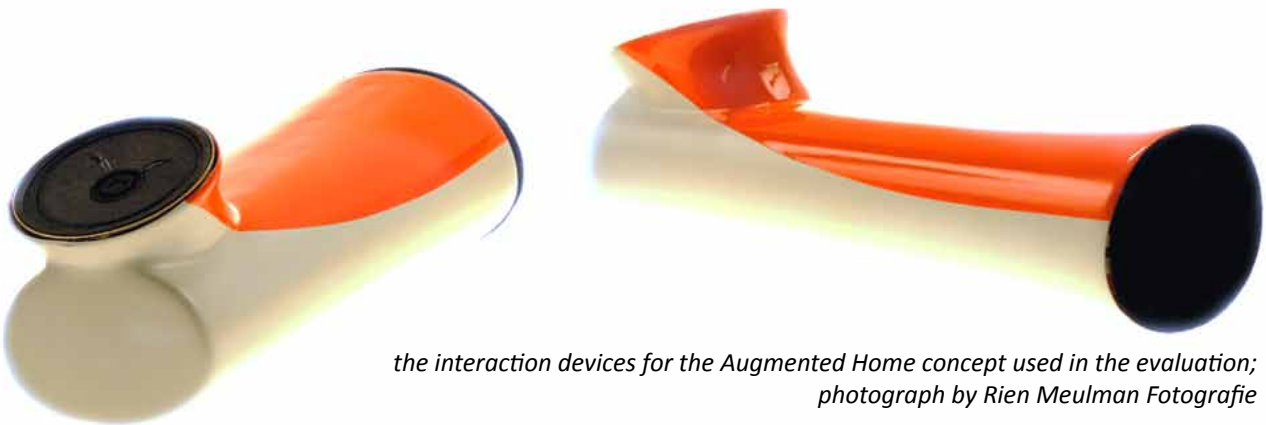
4. the augmented home

4.1 Concept Basis

The augmented home is a system that creates a virtual world in the home environment. This virtual world is an invisible layer of reality containing characters and things that exist in, and around your house.
In other words, there can be a virtual creature living behind your couch and a virtual object lying on your table.

The Augmented Home is available to all inhabitants of the house. This means that the virtual layer functions as a shared and affirmed fantasy world, which in turn makes it into a kind of reality. If one member of the household does something in the world, this changes the world for all who are involved.

The native inhabitants of the world are the virtual characters (Non-Player Characters or NPCs). These NPCs make for the basis of the virtual world as most of the events in the world revolve around them. The users can communicate with the NPCs, do activities together and create bonds. This is the basis for progression in the world.
There are two types of activities in the world. On one hand there are the casual activities like conversations or a simple game. On the other hand, activities can be real challenges that the user accepts and tries to complete. Activities can be done alone, but more often activities will be done together with an NPC. Furthermore, the users can, and often have to, cooperate on challenges.



the interaction devices for the Augmented Home concept used in the evaluation; photograph by Rien Meulman Fotografie

Together these activities determine the progress in the world. The progress is translated in an experience-points architecture. This means that the user has a large set of parameters that will change depending on the activities done in the world, and which in turn will influence the behaviour of the world towards the user.
The virtual world also contains objects. These objects vary in value to the user. Some can be used to better perform at the challenges; others are objects that are just present, but that may be involved in some of the challenges. Objects can be gathered by the user and also influence the behaviour of the world.

The virtual layer is invisible, but can be sensed and interacted with through a specific device. This device is essentially a tool that allows you to perceive and influence the virtual world. It uses sound and tactile feedback to let you experience the world, and in turn, you can influence the world via the same modalities. You can talk to the characters in the world, and your movements with the device will influence the world depending on the situation. Are you carrying a virtual bell? Shaking the device will make the bell ring in the virtual world. Moving from one room to another will allow you to interact with virtual elements that are present in that particular room.

Because both worlds and the interaction with them are bound to the same physical home, the two worlds are essentially not separated, but the virtual world is part of the physical.

4.2 Target Group

The augmented home concept is a specific application of the broader idea that physical and virtual world are integrated. In the context as described, the Augmented Home specifically aims to contribute to the development of children on both educational and social aspects.

The system is focused on a home environment where parents live together with young children. The age of the children may vary roughly between 4 and 12 years old. The system is adopted around the age of 4, and the world will grow with the child over the years. The language used by the characters will become more complex, the challenges more difficult, and the themes will be tailored towards the age and preferences of the child. The target group can therefore be defined as young children and their parents.

4.3 Rationale

4.3.1 Integration to take the best of both worlds

Integration

This concept integrates the virtual world with the physical so a new augmented and enhanced reality is created. This integration takes place in two manners. Primarily, the integration is achieved through the topography of the virtual world. Things in the virtual world happen in the same locations as the physical activities do.
Secondly, the integration is achieved by making a single world available to all members of the household. This means that everyone is aware of the world and can perceive it as part of their daily life.

Best of both worlds

The virtual world can have unique qualities, especially from an educational standpoint. It can provide a means for shared fantasy, a safe environment to experiment and in general a dynamic platform that can benefit the development of the user. The physical world however, has its own unique qualities such as the possibility to move around and explore, as well as being part of the social environment you are in at that moment.

Currently, the qualities of virtual worlds are only available to children through various computer platforms. Consequently they are temporarily separated from the ‘real world’, and are on their

own in a fantasy world that requires them to sit behind a screen of some sort.

In the Augmented Home, the physicality of the virtual world allows one to benefit from this virtual world combined with the benefits of the physical (or the other way round if you wish).

For children, the qualities of the virtual world such as the tailored complexity and dynamicness, no longer have to be compromised by the lack of physical qualities such as physical activity and the ability to involve others in their activities.

4.3.2 Achievement of fundamental human values

As is described in chapter two; people strive to achieve the Fundamental Human Values as described by Maslow. The virtual world uses the capabilities of the virtual world to contribute to the achievements of fundamental human values. It mainly focuses on achievements which contribute to the value 'esteem', and on the social aspect which contributes to the value of 'love and belonging'.

Completing the challenges, reaching new levels and getting to know more about the world and its inhabitants all contributes to the achievement of esteem, both for the self and others.
Love and belonging is achieved because the system requires teamplay with other players for some challenges. This has the ability to bring child and parent together and together let them experience achievements. This is very much like reading a book to a child.

Furthermore the bottom and top of Maslows Pyramid are accessible at all times. Not having to extract oneself from the physical world while in the virtual, allows for the physical needs at the bottom to be fulfilled. The Self-Actualization (top-layer) is made available through the situations that are presented in the virtual world. These are now also available when the family is present, rather then only in the pc.

4.3.3 The advantage of a physically shared world

Because our reality only exists as we agree upon it, shared experiences can help to strengthen the reality of the virtual which allows for a stronger effect and a higher value of the achievements made in this world. This is in contrast with for instance Second Life, where shared experiences only occur within the virtual world.

The physical extension of the virtual world allows for more shared experiences than screen representations of the virtual world. While the screen is a very closed medium that is in principle to be used (or at least controlled) by one person, the Augmented Home is affected by all inhabitants of the house.
A world where multiple users can interact with the system at the same time logically allows for more shared experiences.
Furthermore, having a virtual world that is topographically similar to -and primarily interacted with via- the physical world, makes it much more accessible to people that would normally not pick up a game console controller (e.g. parents).

4.3.4 Imagine the world

The world is only apparent through sound and touch. This means that the entire visual appearance of the world is left up to the imagination of users and especially the children. As imagination is an important part of a child's development in terms of its creativity, the lack of the visual aspect stimulates the child's development on this point.
The approach taken here is very similar to reading a book or telling stories; the appearance of the virtual world is constructed by the person listening to it or reading it. This is a human capability that is also very present in other virtual worlds. People are able to augment the basic representation of the virtual world and make it into a reality.

4.3.5 Educational development

On an educational level, the child develops knowledge, skill and insight by doing various challenges. Challenges are categorized in different development areas (spatial insight, math, language, logic, etc.). Also physical development such as eye-hand coordination, balance and physical exercise are part of the challenges. Communication with the characters also teaches a child skill in language.

The use of computer games for children's development is nothing new, and quite a proven principle. The fantasy themes, dynamic-ness, tailored assignments and the playful nature make it a highly effective and efficient contribution to the child's education [McFarlane, 1997], [Parker and Lepper, 1992].

4.3.6 Social development

The social development works on several layers. The way in which the relations with the Non Player Characters are influenced by the actions of the user is very similar to the way this happens in the normal life. This teaches the child about social relations. Because conversing with the virtual world is an important element, speech is chosen as an important part of the interaction.

Moreover, a number of challenges require other players to cooperate or compete in the game. This increases inter-person interaction, mostly between parent and child, but also for instance between the child and friends. They can together achieve things in challenges which will contribute to their relations.

4.3.7 Value transfer and creation

The concept uses qualities of both the virtual and physical world to enhance one another. It transfers values created in one world to the other and with that blurs the boundaries between these worlds. Also new value is created; both by the transfer (sharing) as well as by the experiences in the virtual world.

The transfer is mostly achieved by allowing everyone to understand and experience the world. This means that it is easy to talk about things that are valuable to you in the virtual world (events, objects, experiences) to others. These values are thus not only valuable in the virtual world but also outside it.

Value creation is mostly achieved by the activities in the world itself. Besides that, the communication with the parent creates value. Sharing the experiences and doing things together strengthens the bond between parent and child.

4.4 Complete Concept

This chapter describes the complete concept as it is developed. It gives a global indication of how the system would function.

4.4.1 The story and the environment

The virtual world is a themed fantasy environment. It has a loosely set story context; where the player is free to choose activities he/she wants to do. The story is about a group of characters that live inside your house. They are called the 'Allegories'. Initially, you are introduced to one of the characters in the world, who will help you to get going. In principle the story is endless as there is no particular goal to be achieved, other then being a part of the world. This is similar to other virtual worlds such as Second Life.

4.4.2 The user profile

Each user of the system has a profile stored in the virtual world. This profile contains the identity of the user and it is used to record the progress in the virtual world. This is done through a set of parameters that is influenced by all activities that are done in the virtual world. Variables for instance store the level of development on an educational level, but also the strength and nature of the relation between the user and a particular character. If a math game is played with a certain character, both the variables

for math and the friendship variable for that character will increase.

In turn, these variables determine the behaviour by the world. As the system is intended to support the development of the child both on an educational and a social level, the system will aim to create a balance between the developments. By monitoring the activities that are done and offering challenges that contribute to the less developed variables, the system guides the development.
Also the behaviour of the NPCs is dependant on these variables. If the friendship parameter of a certain character is somehow negative; this particular NPC is unlikely to help you if you request his help.

4.3.3 Non Player Characters – The 'Allegories'

The NPCs in the virtual world are called 'Allegories'. They are autonomous agents that live their life in the virtual world. They make progress themselves and have friends and family. They move through the house on their own, experience things and have a personality.

Meeting them and doing things together will let the users get acquainted with the Allegories and become a part of their life and vice versa. The bond between the players and the NPCs can grow stronger or feign over time, depending on the activities that are done together, very much as in real life. The NPCs function as the guides, but also as companions and opponents in the various challenges.

One NPC is introduced as the user starts to use the system, but more NPCs are introduced throughout the game, depending on the extent to which the user engages with them.

Their behaviour in general is based on certain variables that are partially influenced by your interactions with them. For instance friendship with the child is a variable. Other variables describe their personality traits such as extrovert-ness, playfulness, smartness etc. These variables determine the reactions on players' requests as well as the behaviour that they initiate themselves.

The behaviour of the system consists of the decentralized behaviour of the inhabitants. It is a learning system that gets to recognize patterns in behaviour and bases its actions on that.
A friendly agent may go to the child's bedroom every night at 8 because that's where the child is usually seen around that time.

The agents also have a memory. This means they know things they have done before. They know which challenges they participated in and with whom. They are also aware of the whereabouts of other NPCs and objects. However, their awareness is determined by a variable. This makes some NPCs seem more wise then others. A more ignorant NPC may thus also refer you to a wise NPC. The definitive knowing (yes/no) is however determined by chance. Then again, chances of knowing something for a highly aware NPC are larger.

4.3.4 The Activities

The main activities that players can do in the virtual world are challenges and games. There are basically two types of activities; Games and Challenges. Games are fairly short lasting activities that can be played. challenges are assignments that consist of a series of smaller activities that lead to a desired end result. They are a type of quests.

The games and challenges in the Virtual World are handed to you by the NPCs. Challenges can be done only once as they influence the state of the world. Games can be played multiple times. Once a game has been played, you can return to its physical position inside the house to play it again. If you can't find it; you may ask an NPC or other player if he/she has seen it or can help you find it.

The difficulty level of games is also variable. The system bases the difficulty on the parameters in the players profile. The parameters are in turn influenced by the actions in the game.

Some activities have to be done with others. The other player can sometimes be a NPC and sometimes a person. These multiplayer activities can be cooperative or competitive. The multiplayer activities can also be off-time or real-time; meaning that sometimes you can cooperate while you are not attending at the same time.

The multiplayer activities may sometimes also provide different roles. If an activity is completed in one role, the system will suggest the other role the next time round. If applicable, the roles are characterized. They can be for instance be leading or following. If a certain polarity is observed in a player's behaviour, the system will suggest opposite roles for new activities.

Activities often try to make use of the non-existence of the boundaries between the two worlds. In other words; they use the qualities of the virtual world as well as the qualities of the physical world.

4.5 Interaction and the interaction-device

The world is made available to the users via a specific device. This device is effectively the channel between the virtual and physical world. To perform this function it uses speech and movement both for in- and output.

4.5.1 Exploring the Environment

To explore the environment, the channelling analogy is translated to a pointing interaction. The device channels the virtual world from the place you are pointing at, to the user. To explore the environment, you point your device around the room, until you point at a character. At that moment, you will feel and hear the character.

Feeling it

Depending on the distance to the virtual character, a vibration will be felt in the device. The strength and frequency of the vibration are determined by the distance. If the user moves closer towards the character, the vibration strength and frequency will increase.

In early experiments with the vibrations for exploring, several mappings were tried that related the direction and distance of the virtual character to the two variables of strength and frequency. It appeared that the relation direction-frequency and distance-strength was easily understood and people were quickly able to find the character (appendix 6). Problem was that the difference in frequency was much easier felt then the difference in strength. In the final prototype the direction and distance are not available as separate parameters, but integrated in one. Therefore the choice was made to link both strength and frequency to this parameter.

Identifier sound

Along with the vibration, an identifier sound can be heard. This way it is easily known to the user which character has been found. The volume of the identifier sound is another feedback mechanism indicating the distance to the character. The identifier sound is a sound spoken by the character that is typical for this specific character.

4.5.2 Communication

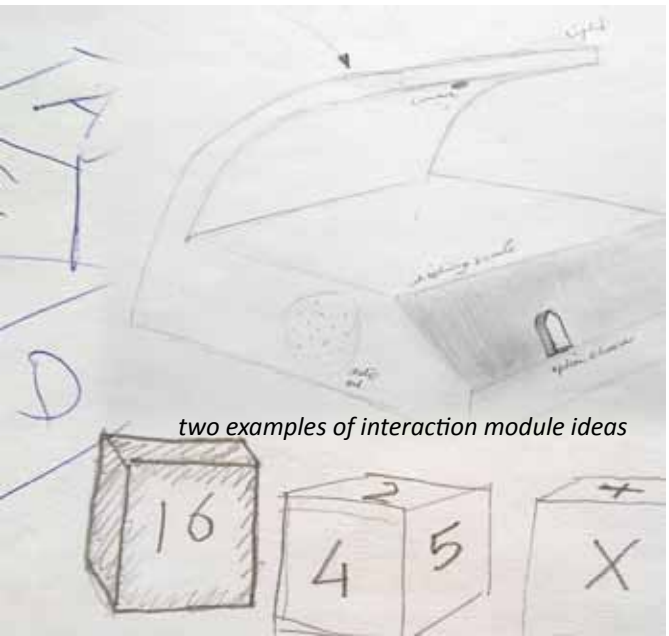
One of the most important aspects of the interaction with the virtual world is communication with the characters in the virtual world. This communication is done through speech. The choice for speech was made for several reasons. Primarily the choice was made because, as audio is the main modality for the system and conversations are important, speaking characters were a logical result. If the characters can talk to you; the most logical reaction would be to talk back.

the channel between the virtual and physical world

Metaphorically, the virtual sound comes in on one end of the channel, and is 'physically' outputted through the speaker on the other end. Speech from the user to the virtual world goes exactly the other way round.

4.5.3 Virtual Objects

In the virtual world, objects can be given to the user. When one receives a virtual object, this can be felt because the device appears to become heavier. The object can now be used by moving the device; it now functions as if it were the object. Depending on the object, having or using the object also generates a sound. When one would carry a bell, shaking the device will generate a bell sound.



two examples of interaction module ideas

4.5.4 Form and Appearance

The appearance of the device is mainly the result of the interaction as well as the channelling analogy. The main shape can be described as a tube where the front is the virtual end, and the rear the physical. As the speaker/microphone in the rear should face the face of the user, this speaker is placed at an angle of 70 degrees. To accentuate the flow from virtual to physical, the split between the two tones of the device follows the curve from front to rear.

The colour orange was chosen for two reasons. It is a vivid and friendly colour, making for an attractive device for children to use. Secondly it is a genderless colour. Blue or pink may have been preferred by respectively boys or girls. As the evaluation was done with both boys and girls, a neutral colour like orange was preferred.

The black front cover is chosen to have similarities to the black speaker side. Therefore the two 'audio ends'; virtual and physical, have a similarity in appearance, this further accentuates the flow between the worlds.

4.6 Development of the Augmented Home

The augmented home concept originated from the idea that a virtual world itself does not have to be bound to the computer. This is still the essence of the concept. The interaction with this virtual world however evolved heavily over time. This chapter gives some insight in its development. In this part of the design process a creative session with fellow students was also performed to further develop the concept. More about this session can be found in the appendix 5.

4.6.1 Interaction modules

The original idea consisted of various modules with different possibilities. Different games and story elements would use different modules, and communication would go via a different module then for instance moving through the house. Some modules were very generic such

as a photo camera module or inter-connectable cubes with a small display. Others modules were fairly specific such as a weighing scale.

All the modules together would make for the interaction possibilities with the virtual world. For example, a virtual compass could be used to find certain virtual objects and the regular television could be connected to play certain games with virtual characters and your family.

Communication with the virtual world would be done via a messaging system that used textual in and output via a kind of 'buzzer'.

A web based module could be used to track progress in the world and to manage your challenges, items, buddies and communication. This could also be used to look back in the past and even see where virtual elements were to be found in the house.

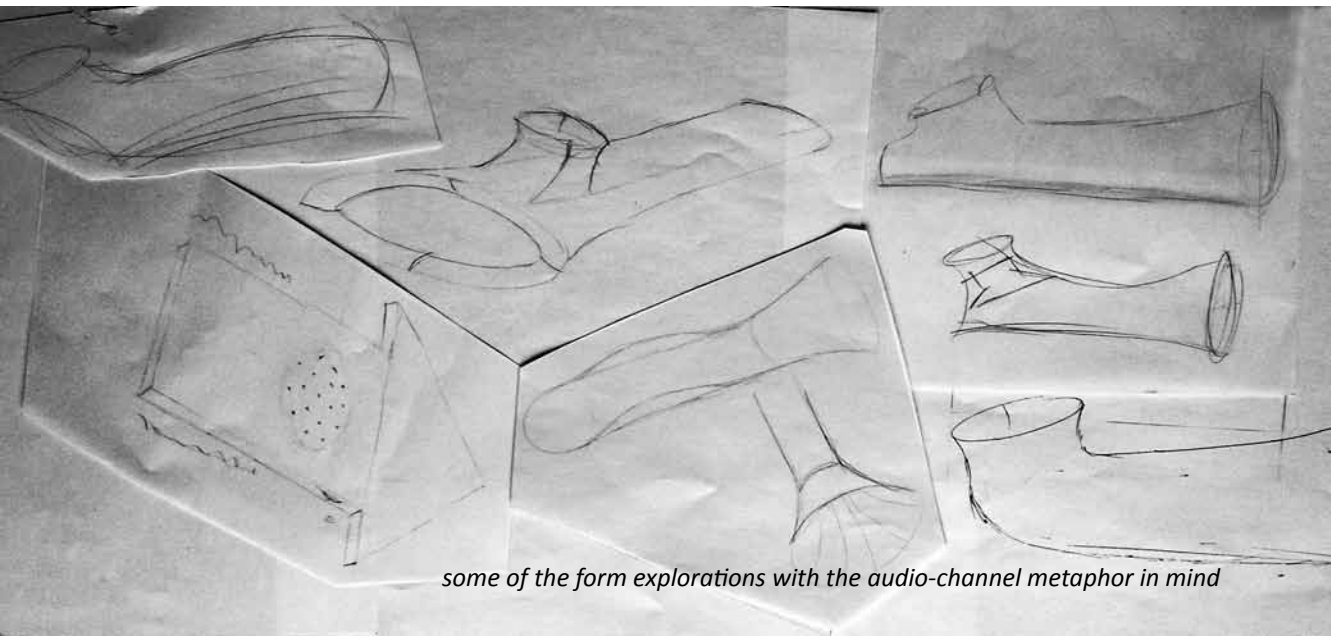
These modules evolved over time and the focus of the concept shifted towards the 'avatar module' that was used for movement through the world, communication and as the basis for some challenges.

Later on, the choice was made to use just this single interaction device. This choice was made mainly because of the chosen modalities and a lot of the other modules became obsolete. Also a system with so many modules would be very expensive. It was considered positive if all possibilities of the system would be available without the need to buy extra modules.

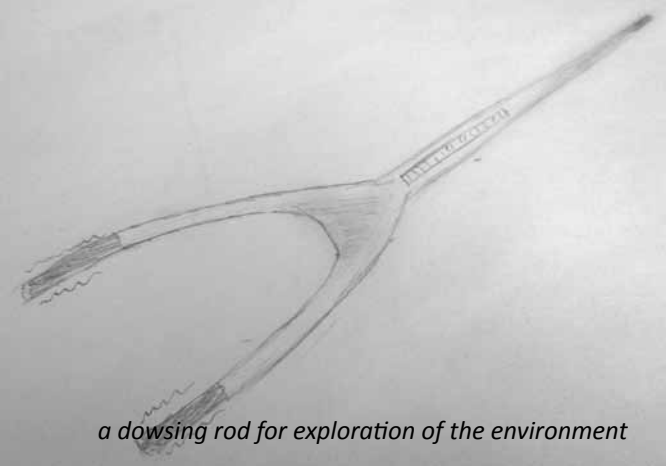
4.6.2 Modalities

While imagination was an important asset from the beginning, the choice for audio and haptics was not so evident from the beginning. Although it had never been the intention to create a visual representation of the virtual characters, other elements such as games and the communication did sometimes use visual aspects.

Because the imaginative qualities of spoken stories and audio in general were considered very strong, the choice was made to make sound the main modality for interaction. This was immediately combined with haptics for physicalization of the virtual world. The haptics would allow the user to physically interact with virtual objects, further integrating the two worlds.



some of the form explorations with the audio-channel metaphor in mind



a dowsing rod for exploration of the environment

With this decision in mind, the sound channel-analogy was quickly born which strongly guided the final design towards the tube.

4.6.3 Form and interaction

Various options were explored for the form and interaction of the device. Several metaphors served as an inspiration such as a metal detector, a flashlight or a dowsing rod.

Because browsing the environment was an important feature, pointing devices were also considered. A returning problem was how to deal with the matter of communicating with the virtual world. Several methods were considered such as plain buttons, jog dials and moving pins.

In the end the choice was made that answering back in the same modality as the system would approach you, would be most desireable. The existing problems with speech recognition were considered less important and something that can over time be solved.

When the decision was made to use audio as an important interaction aspect, this strongly guided the form and interaction with the device. The use of headphones was logically considered, as was a stethoscope metaphor.

In the end the choice was made for a handheld device with a speaker for two main reasons. The handheld-factor would stimulate active searching behaviour. Having the speaker in the device meant that the device was a fairly open medium, allowing the child to converse with its parents while exploring the virtual world. This was after all one of the advantages over the closed medium of a PC.

4.7 Prototype and Scenario

For the evaluation of the concept, one scenario of the virtual world is worked out in a working prototype.
The prototype functioned and looked very much as is described in the previous chapters, a brief description of its workings and the differences with the complete concept are desribed in this chapter.

4.7.1 Scenario

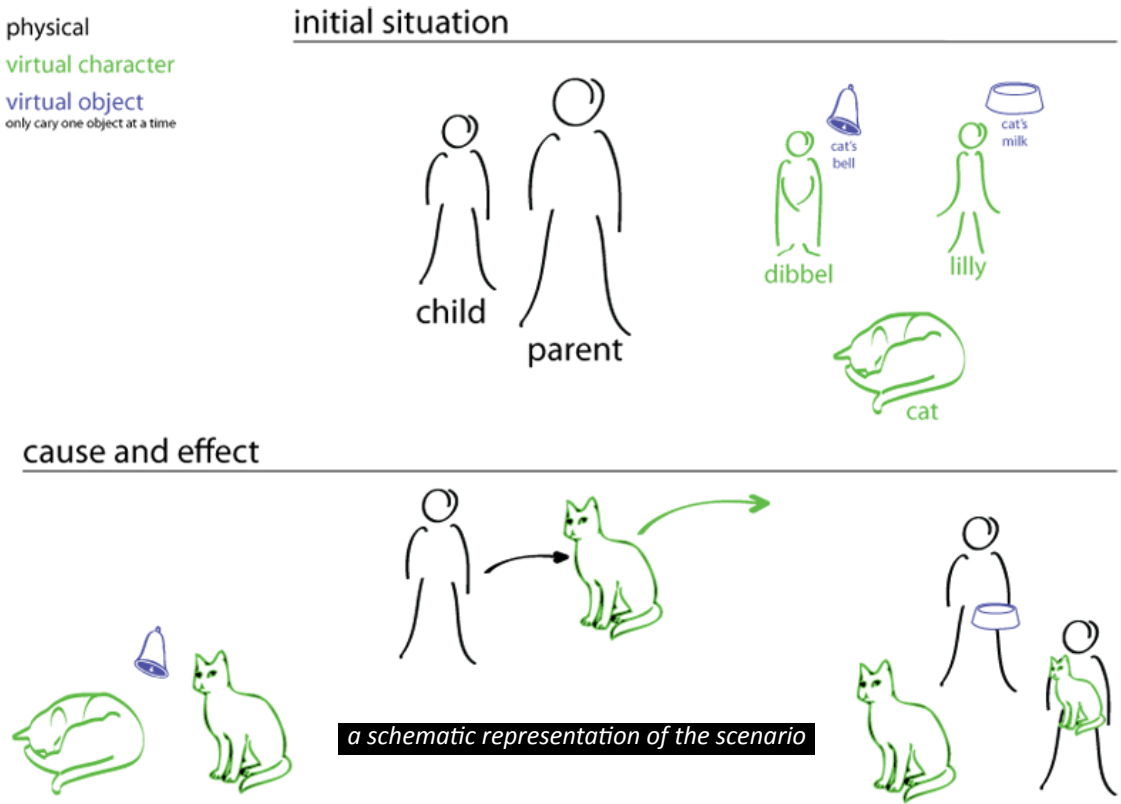
The story is about the Allegorie called Dibbel who has lost his cat. Dibbel asks for cooperation from the user to help him find his cat and return the cat to him. There are however some difficulties. The cat is asleep and can't be found unless you ring its bell in the same room. You will receive this bell from Dibbel. Furthermore, the cat is quite shyer, and therefore tends to run away if you approach him. If you keep him at ease with a cup of milk however, someone else can pick up the cat and return it to Dibbel. You can get a cup of milk from Lilly. She is somewhere in the house and you will have to find her. If you have the milk, walk carefully in order not to spill the milk from the cup.

4.7.2 Conversations

In the prototype, all possible courses of the scenario are covered by a predefined set of sentences that were spoken by two people. The server calls sentences depending on the situation and progress in the story. As the prototype system initiated the conversation, the user's speech was in principle limited to several possible responses. Recognizing, interpreting and entering the user's response was up to the evaluator, after which the system again determines the influence of the response on the story's progress.

4.7.3 Virtual objects

The virtual objects that can be carried in the prototype are the bell, the milk and the cat. When carrying a virtual object, the device appears to become heavier. When carrying the bell, shaking (ringing) it will create a ringing sound.



a schematic representation of the scenario

When carrying a cup of milk, tilting the device will spill a bit of milk. When it is tilted too far, it will spill all the milk, and the device will appear to become lighter again. You will have to return to Lilly to get new milk. When the cat is picked up, a purring sound comes from the device.

4.7.4 Electronics and functional hardware

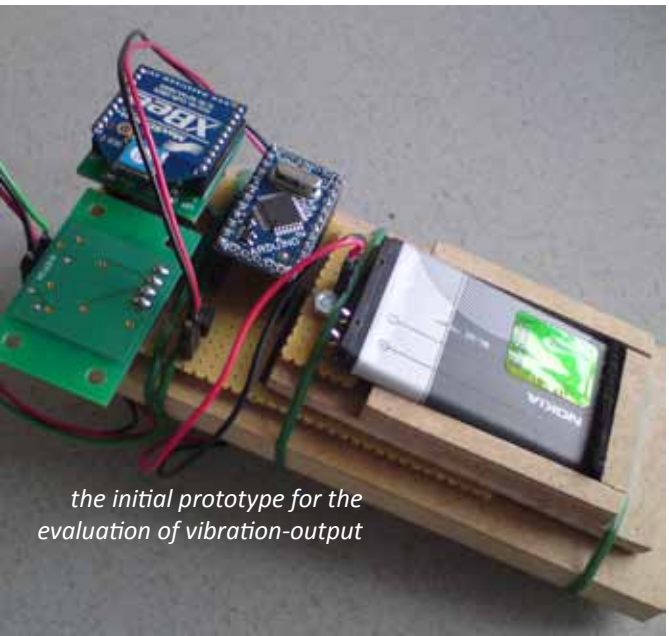
The prototype's electronics consist of the elements shown in the image of the final prototype's hardware on page 36/37.

The whole system is controlled using an Arduino microprocessor that communicates with a world-server via an xBee radio. The whole system is powered via a 3,7v 1100 mAh Lithium-Ion battery. The power is regulated to both 5v and 3,3 v for the various components on board.

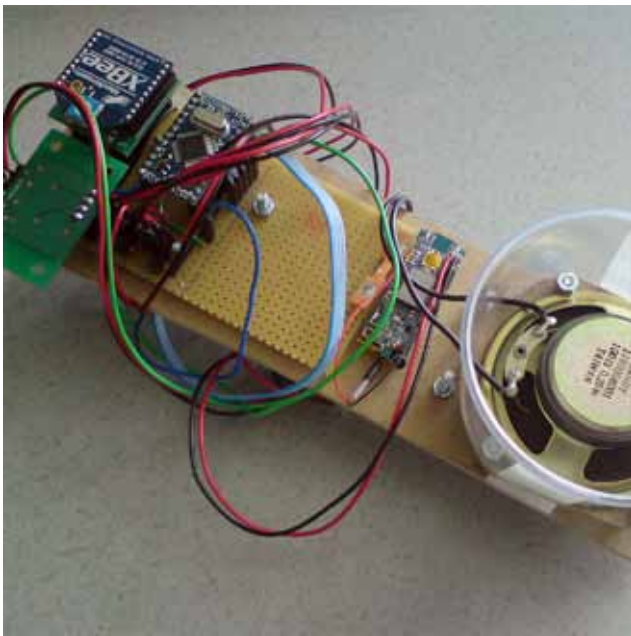
The electronics for the final prototype came about in various stages. The initial prototype was concerned only with 'browsing the environment' and was used to explore several options for vibration feedback varying in frequency and strength. The results of this can be found in the appendix 6. This prototype only contained a battery and a power conversion system, an Arduino microprocessor, an xBee radio for data transfer and a vibration motor. After the first evaluation, audio was added via a wireless headphone which was also evaluated.

After this, the prototype was extended bit by bit adding infra-red detection and signal strength measurements, Bluetooth audio, an audio amplifier and a speaker.

A weight distribution system was used to make the device appear to become heavier and this



the initial prototype for the evaluation of vibration-output

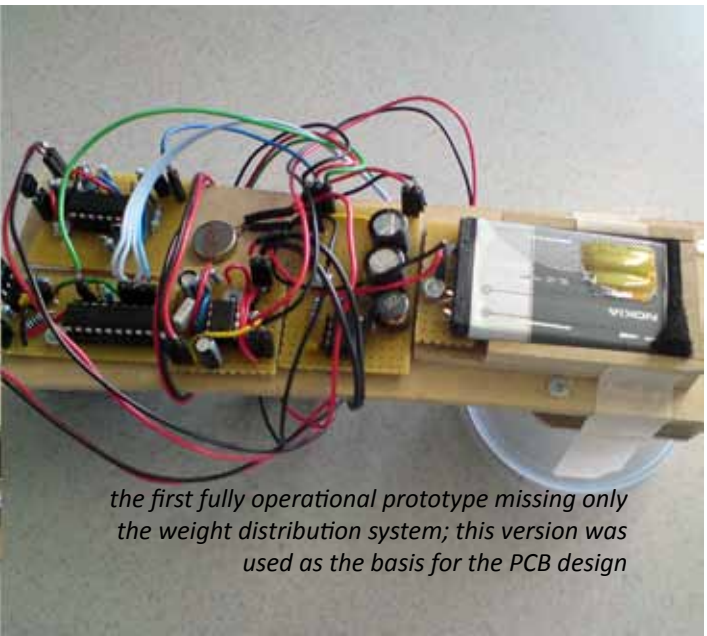


was integrated in the final prototype. Various options for such a system were explored.

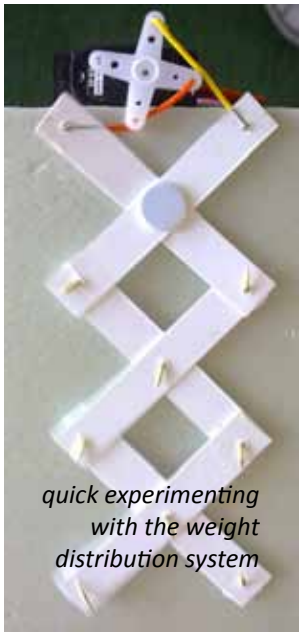
For the final prototype, the electronics had to become much smaller. I therefore designed and made a custom Printed Circuit Board. This was done using a technique that involves spray-painting a blank PCB after which a laser-cutter is used to create the patterns. The etching itself is then done using Ammonium persulfate $(NH_4)_2S_2O_8$. The PCB was designed in the Eagle software [www.cadsoft.de].

The prototype determines its location based on infra-red signals that it receives from beacons hidden in the environment. These beacons constantly emit an address that is read by the devices. The beacons were also custom made similar to the device's PCB.

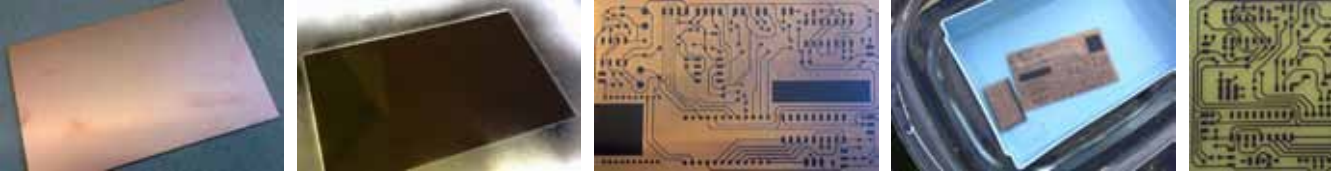
The schematics and board designs for both PCBs can be found in the appendix 8.

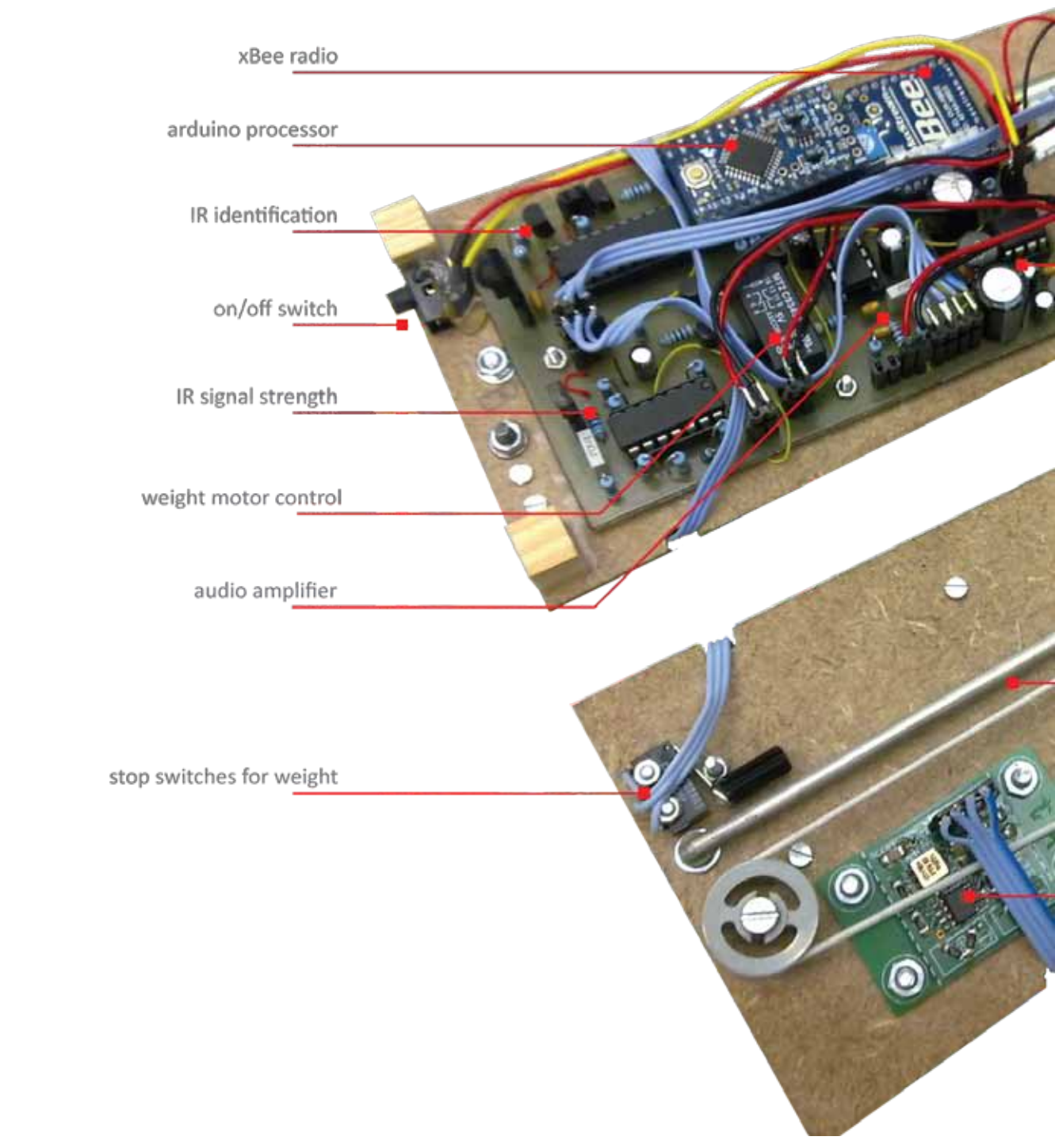


the first fully operational prototype missing only the weight distribution system; this version was used as the basis for the PCB design

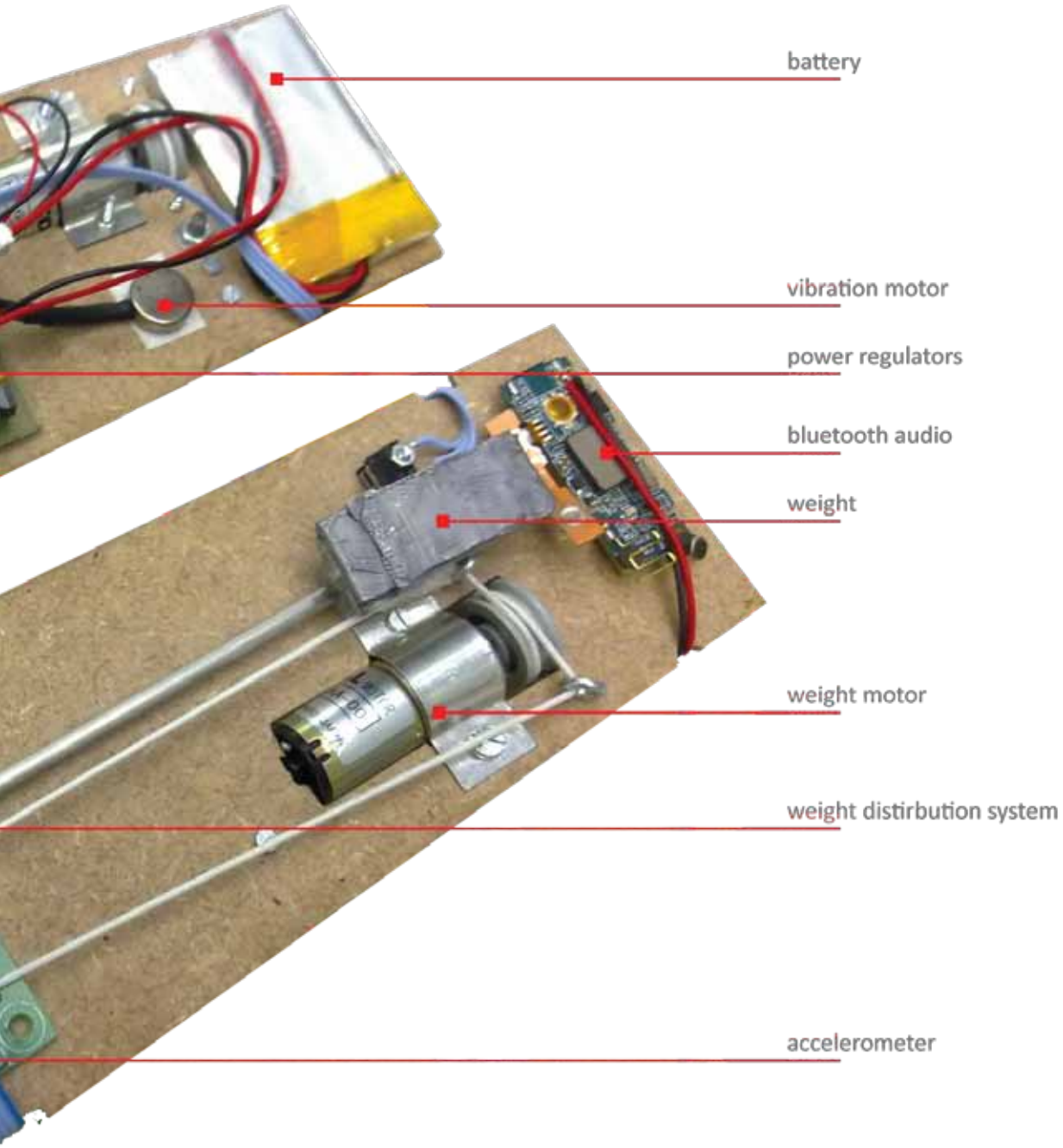


quick experimenting with the weight distribution system

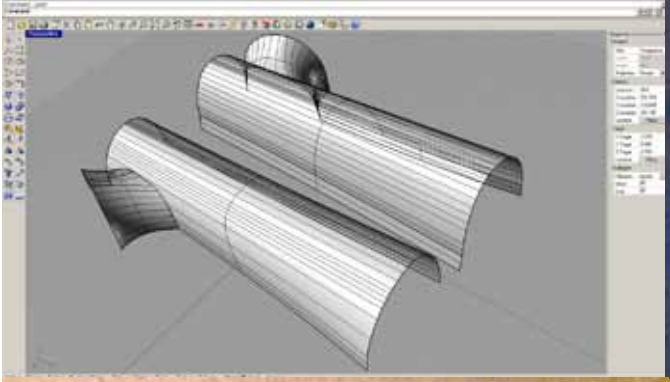



xBee radio
arduino processor
IR identification
on/off switch
IR signal strength
weight motor control
audio amplifier
stop switches for weight

the Princted Circuit Board creation process



final electronics and functional hardware










4.7.5 Model

The model containing the inner workings of the prototype was created using a CNC milled mould to create the two halves of the model by vacuum forming. The two halves were glued together after which spraypaint was used to finish the devices. The functional hardware can be inserted via sliding rails through the front of the cover, while the speaker is attached to the cover.

The design of the cover was based on the design as described in the previous chapter.

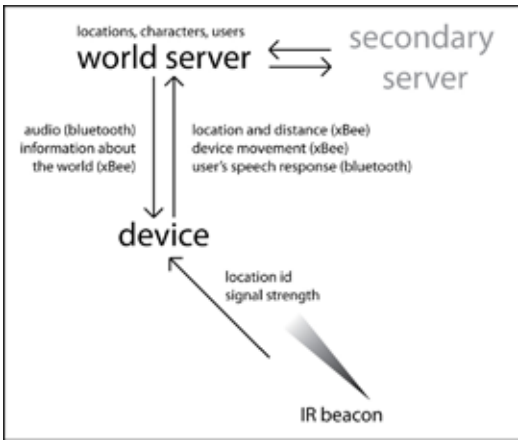
4.7.6 Software

Server Software

The software in the prototype consists of a main server which controls the world and the child's device, and a secondary server to control the parent's device. The two servers are connected via an Ethernet connection and exchange information via a custom messaging system.

The server's main purpose is to connect the physical behaviour of the user to the virtual world. The server contains a basic model of the house (a set of locations) and positions the devices in this model based on the information it gets from the devices.
The server also assigns all virtual characters to a physical location (an IR beacon). It also assigns all virtual objects to a character. These assignments are dynamic and will change depending on the users' actions. For instance if the child approaches the cat's location without the milk, the cat will run away. The server then moves the cat to another location. If the user is carrying the milk but the milk is spilled (device tilted too far), the server will take away the milk from the device and give it back to Lilly.

The server also keeps track of the progress in the challenges. It does so from the players perspective. Different variables are updated depending on the actions in the world.



the system architecture

The server is also responsible for the conversation management and playing the audio files. Depending on the progress on various parameters and the responses by the user, different audio files are played back to the device via Bluetooth audio. The identifier sounds of the characters are played when a device registers a location with a character present. The conversation sentences are played back depending on the response by the user. In the prototype, this response is translated from speech to a predefined user-response by the evaluator. Audio for the virtual objects is played depending on the movements with the device. If the user is carrying the bell, it will send accelerometer data that results in the playback of random bell sounds at the volume depending on the accelerometer deflection.

All software is written in the Processing programming lanuage [www.processing.org].

Device Software

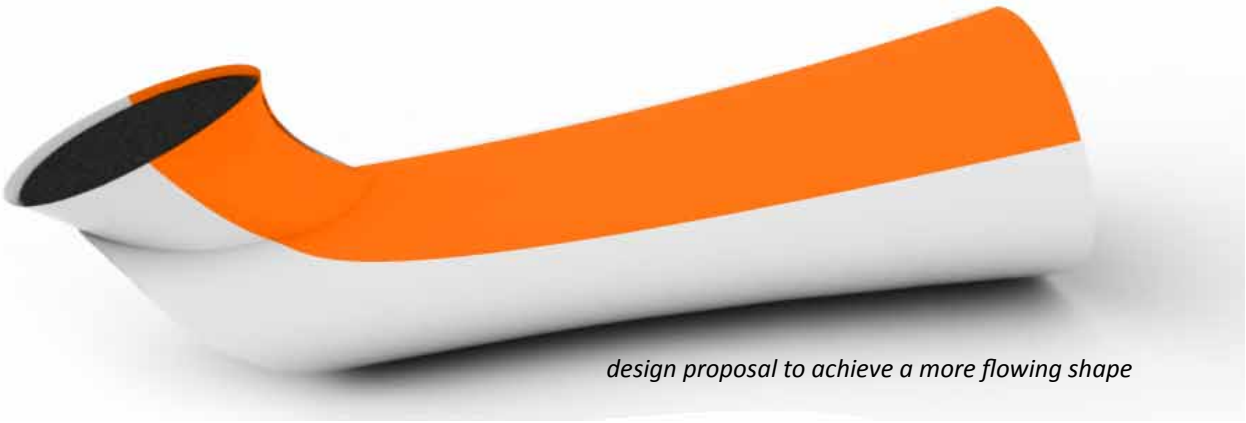
The software on both devices is identical. The functions of the device are kept locally as much as possible. This means that the server updates the device on the status of the world and events, but the device itself determines how to act on that. It performs the following functions:

- Read server input
- Read Infra Red Signals
- Read Infra Red Signal Strength

If required due to a certain situation, it also performs the following functions:

- Read accelerometer data
- Move weight
- Vibrate

The devices are programmed in the Arduino programming language [www.arduino.cc].



design proposal to achieve a more flowing shape

4.8 Final Design

4.8.1 Form and ergonomics

Flow

The shape of the prototype was intended to accentuate the flow of virtual to physical and vice versa. Due to the technology that had to fit inside the prototype, the rear end of the device was now extended beyond this flow line. In the final design this line should be maintained over the entire device.

Size

The model used in the user evaluation was slightly larger then was initially intended. This was due to the technology that had to fit inside the system in order to create an experiencable prototype for the evaluation. The prototype's size was comfortable to use for an adult, but slightly too large for a child which made it not completely suited for a part of the intended users. In order to determine the dimensions suitable for the final design, the prototype should be scaled down with a factor 0,66. This is calculated using the ratio between an adults hand-size and that of a child [Dined IO Delft, 2004 and 1993].

Mean hand hand-width (without thumb)

Adults (20-60)	85 mm
Children (5-6)	59 mm
Ratio	1 : 0,7

Mean grip circumference

Adults (20-60)	128,5 mm
Children (5-6)	82 mm
Ratio	1 : 0,65

To determine the definitive size of the device, the average ratio was used. The dimensions of the final device are therefore 1/3 smaller then the prototype, 1 : 0,67. The length of the device is therefore determined at 135 mm. The width at the handgrip 40 mm and at the virtual end 57,5 mm.

Achieving this smaller size would be possible when using SMD (Surface Mounted Device) components and a double layered Printed Circuit Board. Also a large part of the prototype's PCB consists of elements that would not be necessary in the final product such as infra red components and the need to be able to disassemble the separate elements.

Weight

The weight of the prototype is 358 gram. This is slightly heavier then would be desirable for small children as appeared during evaluations. The desired weight would be a little lighter then a game controller because the device is often held high up at chest-height. The Nintendo WiiMote for instance is about 270 grams. In order for the weight to be comfortable for the child, the weight of the actual design should be reduced to about 250 grams.

Reducing the weight can again be achieved by using SMD components on the PCB. Furthermore it can be achieved by removing the added weight that is used to shift the centre of gravity in the device. Shifting the centre of gravity could also be done by moving heavy components such as the battery and the weight-shifting-motor itself.

4.8.2 Technology

For the prototype to become a product, a lot of changes need to be made in the technology. This chapter gives an indication of the major

changes. What is not specifically mentioned in this character will be similar to the prototype.

World Server

The virtual world will be hosted on the 'world server'. This is a screen-less mini computer that is connected to the internet and that can communicate with the devices in the house. The system is configured via the home PC of the user that communicates to the server via an Ethernet connection.

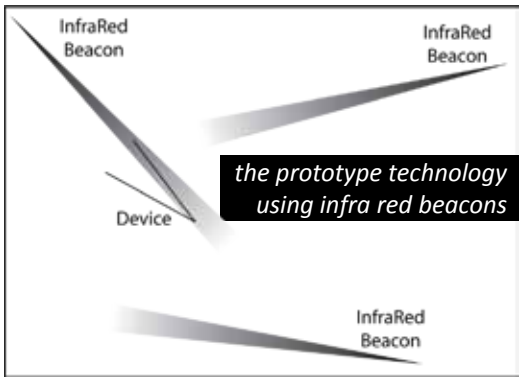
Location technology

In the prototype, infra red beacons were used to determine the location and orientation of the user.

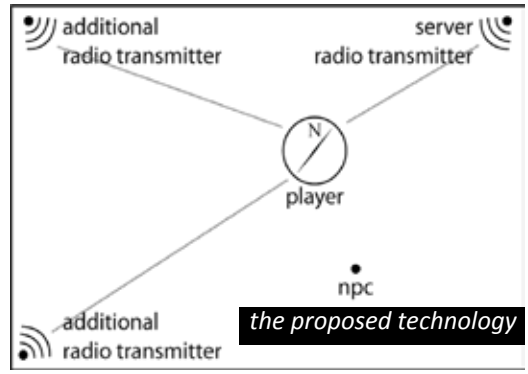
In an actual product, rigging the house with transmitters is an undesirable feature. Not so much because of the required effort, but because it reduces the magic of the system if the characters are bound to the beacons that users themselves have placed in the environment. Furthermore it requires power supply for all beacons and therefore also uses energy.

An alternative system is based on a combination of triangulation for location and a digital compass for orientation.

This system uses the radio transceiver in the device that is also used for data communication. This transceiver uses the signal strength from three transmitters that are strategically placed in the house. One of these transmitters is the world server itself. The other two are additional radio transmitters. The three transmitters have to be placed in three corners of the house on the ground floor. This allows the system to determine the position of the device in three dimensions based on triangulation using the signal strength of the three transmitters.



the prototype technology using infra red beacons



the proposed technology

In order for this system to work, the house needs to be calibrated once. Calibrating the house requires one person to walk through all the rooms and corners of the house once, notifying the system when entering a new room and at each corner of a room. During the calibration, the system generates a digital representation of the house. The system is then able to place the virtual characters in different locations in the house and is able to tell when a user is at that location.

Haptic Feedack

The haptic feedback in the prototype consisted of two elements; the vibrations used when exploring the environment, and the weight distribution system to indicate whether a virtual object was carried in the device.

The weight shifting system in the prototype used extra weight. In the product, the centre of gravity should be changed by moving components within the device.

In the product additional feedback could be provided by other actuators such as gyroscopes that give the feeling the device is harder to tilt or rotate.

Audio and conversations

In the prototype, the characters could respond with a predefined set of sentences spoken by

actors. The final system would need a more dynamic way of generating speech for the characters.

The sentences should be separated from the voice that pronounces the message; the character. This allows for new challenges and conversations to be developed without having to change the characters themselves. Each character would have a voice and a speech engine, able to pronounce the content of any message.

The sentences could also be generated separate from the challenges. The challenges could contain the essentials of the message content. Building a sentence from these essentials could be done using the characters 'personalities'. A sentence that relates to a challenge could for instance be 'Could you help me find my cat?' This could be generated from the message essentials 'help' and 'find cat'. Depending on the character generating the sentence, this could also result in 'I need help to find my cat!' The exact composition of the message could again also be influenced by the other variables of the character such as the relation with the user and the current activities and emotions of the character.

A speech recognition system would be required to interpret the speech by the user. In the prototype the user's speech was interpreted by the evaluator. Although this technology has been under development for a long time, new learning algorithms bring improvements to this area of work.

System backups

All progress of the characters and the results of their activities are automatically stored online. This means that a local system failure will not result in data loss. By collecting the reactions to system behaviour, the behaviour by the system can also be adapted towards more natural behaviour using various learning principles.

4.8.3 Business proposal

No extensive research was done on possible business strategies as this was not within the scope of the project. Nevertheless, a brief proposal for a potential business strategy is made.

Mission

The mission for an enterprise based around this concept would be to 'allow as many families as possible to benefit from the qualities of virtual worlds in their physical home environment'.

The virtual world is intended to benefit as many people as possible. The business is therefore set up without a profit motive. This means that prices can be kept low and people working for the company should work from a social rather then fiscal motivation.

Value Proposition

What the system has to offer is support for the development of a child and the relation with its parents.
It does so by offering the platform for experiences that combine the dynamic, educational and imaginative qualities of a virtual world with the cooperative and physical nature of other parent-child activities in the everyday home-environment.

Pricing and competition

The virtual world is not intended to replace existing products. However, because the system is likely to be perceived as a modern type of game console in the beginning, the he system should be able to compete with other game consoles that are focussed on family use like the Nintendo Wii.

A 'starter kit' containing the required hardware for two people in one house, should be available for about 130 euros. This places the system in the bottom price range of game consoles, making it more easily available for more people.

Business strategy

A big difference with the game console industry is that there are no games for sale, meaning that the only thing the customer pays for is the hardware. All software is freely available from the website. The price of the hardware is therefore not only determined by the production costs, but also by the software development costs.
The reason to do this is that free software updates and upgrades makes buying the system much more valuable as you purchase all possibilities at once.

Where to buy a system

Although the system is not a game console, the system will be sold in similar ways as game consoles. Computer stores, toy-stores and also online stores like Amazon will sell the system. Apart from these channels, the system can also be bought through the corporation's website.

System Package

When buying the system, one acquires the essential elements of the system, required to make it work for two people in one house. This 'starter kit' includes:

- The World Server
- The initial virtual world
- 2 Devices (+ chargers)
- 2 Radio transmitters (for triangulation)

What is required for the system to work is that people already have an Ethernet network with a connection to the internet and a PC that is connected to this network.

Extensions and replacement parts

All elements of the system can also be bought separately through the website. Besides that, several accessories can be bought such as chargers, batteries, replacement covers, cables, etc.

Services

After the system has been bought, various services are available through the website.

Updates are available from the website. These updates contain system updates, new challenges, characters and new knowledge. Especially because the system is intended to grow with the children, and their development, tailored updates can be downloaded that are suitable for the development stage of the child. Rapid updates could be made available with regard to current affaires. This way the characters could also converse about new developments in the world. Users can also deliberately look for certain updates containing for instance new games in an area of interest.

User Generated Content is also available through the website. Besides new software developed by the corporation, users themselves can create new characters, challenges, games and knowledge. This allows the worlds to grow rapidly and become more intelligent through its use.

User generated content is rated by peers on quality, aspects of complexity and the various variables that determine the progress in the game. Based on these ratings, the UGC is offered to other users and positioned in their world. Like with the corporation generated content, users can also look for items of their interest.

The virtual world community that also creates the UGC, allows users (in principle the parents) to contact and benefit from one another via the website. Cooperating on the development of UGC and discussing elements of it will allow parents to benefit from each others' work and knowledge in further shaping the world. This community in a sense creates another virtual world from which value is transferred to the virtual world as intended by this project.

Backups of the system are automatically made and uploaded to an online server.

one of the participants listening to Dibbel during the evaluation

5. evaluation

5.1 Aim and Approach

The evaluation aims for results on two aspects. First of all, the idea of integrating physical and virtual worlds and the extend to which that allows for value creation and transfer. Secondly, evaluation of the final concept and the implementation as demonstrated in the prototype.

In the end, conclusions should to contribute to future work regarding the integration of virtual and physical worlds, both in terms of how useful this integration is, as well as in terms of the design of a system to support this integration.

5.1.1 Integrating physical and virtual

The concept as described is an instance of the broader idea that the integration of virtual and physical worlds can create value for people and transfer existing value from one world to another. The extent to which this is made possible should thus be evaluated.

Value creation

The value creation will be evaluated on two aspects; the cooperation and communication between parent and child on one hand, and the value of the experiences in the virtual world on the other. This will also be compared to current activities that the parent and child do together.

Value transfer

The transfer of values will be evaluated by finding out if experiences would be used at other moments. This may mean that an experience is discussed during dinner, or that the child's development benefits from the experiences.

Integration

In general the integration of the two worlds will be evaluated. This allows conclusions to be drawn about the extend to which the world is experienced as part of their reality. This integration will be evaluated by finding out whether the participants feel the virtual world is around them in their physical environment or whether it is perceived to be in the device.

5.1.2 The concept

Besides the bigger picture, the concept of the Augmented Home will also be evaluated. This will show the qualities and downsides of the chosen application of the broader concept of integration.

Understandability of the world

Do the participants understand the world as such that there are characters and objects invisible in the environment, and that they can be found and communicated with through the device?

Device and Interaction

What is the effect of the chosen modalities for the interaction? Are people able to communicate with the virtual world and how is the haptic feedback experienced? Does the device support the intended interaction and experiences?

Scenario and challenge

Is the theme of the scenario a suitable theme for the targeted age group of the evaluation (5-9), and how do they feel about the complexity of the challenge?

General desire to have such a system

Since the project is in the end a design project; it is important to know whether a system like this would be desired by the participants. To find out about this, parents will be asked to think abut the system in its larger context and the use of it over a longer period of time.

5.2 Participants

The evaluation is performed with three couples of a child and one of its parents. The children were all between the age of 5 and 9. These age limits were chosen because of the theme and complexity of the challenge that was worked out in the prototype. The choice for the age group was made together with a primary school teacher.

5.3 Setup and Procedure

The planning for each session is as follows:

0:00 - Explanation of concept and scenario
0:10 - Execution of task
0:25 - Interviews
0:40 - Thank participants

The evaluation takes place in the TU/e ID Context Lab. This is a home like setting consisting of a living room, a parents' bedroom and a child's bedroom.

Both parent and child will be given a device. The experimenter will explain the following:
- There are invisible characters in this house
- With this device you can feel and hear them when you point at them
- If you are close enough, they will talk to you
- You can talk back to them
- One of the characters is looking for you; he is in that corner (point at Dibbel's position)
- Dibbel lost its cat that is asleep in the house and needs to be woken up with a bell
- Once awake you can grab the cat by walking towards him; however, he is a bit scared, so you need a cup of milk to keep him at ease so the other person can catch him
- You can carry 1 object in the device

The experimenter will now give the opportunity to ask questions, and explain that questions may be asked during the assignment. The experimenter will then help the child until he/she is talking to Dibbel.

The quest described in the scenario is performed; this will take an estimated 10 minutes.

5.4 Limitations

The virtual world is typically something that gets its value over time as the user gets to know the various characters and creates a history. Using the system for the short period of time will probably not result in the engagement with the world that could potentially occur when the system could be used in a real household context for a longer period of time. As this value and the value transfer are the key elements of the concept, this can not be evaluated directly.

The evaluation will therefore not draw hard conclusions on the effectiveness of the concept in terms of value, but try to get a feel for the qualities in such way that it is usable for further development. Whether value creation and transfer could occur will be deducted from the users' experiences.

5.5 Results and Conclusions

This chapter describes the results of the evaluation and some conclusions that can be drawn from these results. The interview notes and observations can be found in the appendix 7.

5.5.1 Engagement with the virtual world and the scenario

Engagement and reality of the world

All children indicated that after the evaluation, they thought that Dibbel and the cat were still around- or in the house. One child (6) even asked about the cat after he was explained the workings of the system.

This indicates that the children were able to imagine the virtual world to be in their physical world, and actually believed this imagination. This was also stated by one of the parents who said that she thought this was all very real to the children.

Combined reality

Two of three children tried to find the cat, based on the behaviour of cats they were familiar with. They started by looking for the cat on respectively the couch and the bed, as that was the place where cats they were familiar with would usually reside. One child also kept on reasoning after the test, about how they could have done better by trying to understand the behaviour of the cat. All children also immediately knew how to ring the bell when they were asked to do so by one of the characters.

This indicates that the children saw the virtual world as part of their real world, and that they did not see them as two completely separate worlds.

Scenario and Challenge

The challenge was considered to be rather easy, even for the youngest children. The cause and effect relations appeared clear to them, at least after they had been explained by the evaluator and Dibbel. Using a cat in the scenario also made it very interesting for the children. This appeared from their behaviour when looking for the cat and it was confirmed by one of the parents.

The scenario's theme can therefore be considered suitable for the target group, while the complexity of the challenge may be suitable for a first try, but should become more advanced over time.

All three couples followed a similar path. The child received the bell from Dibbel (this may have been caused by the question 'shall I give you the bell?' that was posed to the child) and all parents received the milk from Lilly after the child was asked to whom to give the milk. One of the parents indicated that the children and parents were likely to choose this option as the parents would not want to take the pleasure of carrying the cat away from their child.

Concluding

Concluding, it can be stated that the engagement with the world was high, and that it was believed to be very real. Also the virtual world was perceived as part of the 'real world', as behaviour of virtual world characters and objects was naturally understood by means of the physical world.

The use of physical world behaviour in the virtual world could very well be used for educational purposes. Behaviour of the virtual world could teach children about behaviour of the real world; both in a physical as well as social perspective.

5.5.2 Interaction with the virtual world

Multi-functionality of the device

One of the things that caused concerns beforehand was the idea that the device performed so many functions. Browsing the environment, hearing the virtual world and talking back to it, as well as containing virtual objects and interacting with these objects were all done with the same device. As the visual appearance of the device was static, the function of the device had to become apparent by a combination of the progress in the story and the haptic and auditory behaviour of the device.

During testing however, none of the participants appeared to have any problems or confusion concerning the multiple functions of the device. Listening and talking through the speaker was done by all participants, and it appeared to be immediately clear that something could be carried inside the device when they were given the bell.

This indicates that the multi-functionality easily accepted and is likely not to cause any problems.

Exploring the environment

Point to search

The point-to-search flashlight analogy appeared to work intuitive for all participants. It was however stated by one of the parents that if you don't know the platform, you quickly need confirmation whether you are using it correctly. This was now lacking as it took a while before feedback on the browsing activity occurred. This was the case either because they were looking in a place were no virtual character was present, or because the system failed to detect a location every now and then. When the system is fully functional and there are many more characters inside a room, this is likely not to be a problem as you will quickly find a character and receive the desired feedback.

Identifier sound

The identifier sound that could be heard when pointing at a character was easily understood. However, there were only three characters available in this scenario. In a world of many more characters, this may become more complicated. However, when 'living' in the world for a longer period of time; one is also more likely to be able to recognize and distinguish more character sounds.

Vibrations

The vibrations that were to indicate the proximity of the character did not contribute to finding the characters. It was considered a confirmation that they had found the character, whereas it was intended to give directions for how to get closer to the character.

This was likely to be caused by the difference between the prototype and the concept. The vibration frequency and strength in the prototype were not related to the distance, but to the time the participant was in the line of sight. This meant that if they were in the line of sight; they had essentially completed their task.

In earlier tests, it appeared that a combination of vibration frequency and strength could indicate proximity and direction of a virtual object. This should have been directly implemented in the final prototype if it were to give clear guidance on where to find the virtual characters.

Communication with the virtual world

In the evaluation setting with the prototype, the communicative capabilities of the characters were limited to a predefined set of sentences. Problems were expected with children randomly talking to the characters and the characters inability to reply. This did however not occur during testing. In general, the communication went fairly smooth, especially as the instructions of the characters were considered to be very clear, and the answers from the children fairly simple. In cases where the child did not respond to the question, the parent naturally stepped in to help and asked the child the same question again.

In one case, the participants were unable to find the cat, and they returned to Lilly to ask her where to look. Lilly was unable to answer in this case so the evaluator helped out. However this could have been solved by giving Lilly the possibility to give hints on the cat's whereabouts.

This indicates that it should be possible, at least for separate challenges, to work with a relatively static communication platform. However if the world becomes more complex, better Artificial Intelligence would be desired.

Carrying and using virtual Objects

To indicate whether or not the person was carrying a virtual object, the weight of the device should appear to become heavier. This was achieved by shifting the centre of gravity forward, away from the hand; creating an arm for the weight. In early tests, this appeared to work rather well. However in the final prototype, the shifting weight was rather small relative to the weight of the device itself. This meant that participants were unable to feel the weight shift as an indication for whether or not they were carrying a virtual object.

Some parents as well as children indicated that it was very clear when they received a virtual object. They mentioned they could 'feel something moving' in the device (the motor shifting the weight). Combined with the textual feedback saying they had the milk, bell or cat, and followed by more auditory feedback when shaking or tilting the device, this gave enough feedback to make them understand what they were carrying.

The one things that was mentioned to be unclear by one of the children was how to pick up the cat. In contrast to other virtual actions, no particular physical action was required, except for being near the cat. Therefore the children did succeed

one of the children in search of the cat

and understood that they had picked up the cat, but only after it had already happened.

No visual feedback

The lack of a visual aspect to the device and game was not considered to be a problem by any of the participants. It was in some cases not even noticed, and in other cases considered to be a very positive aspect. One of the parents said that the imagination that was sparked by the lack of a visual aspect sets this apart from other game platforms. It was mentioned that it would have been handy to be able to see the current state of the device (what is being carried in the device) by some sort of visual aspect. This should however be covered by the haptic feedback of the shifting weight that was insufficiently present in the prototype.

Concluding

The interaction through the device in general went fairly smooth, except for where the prototype failed. Moving around the physical house was considered to be a fun activity. The multi-functionality of the device and the use of virtual objects did not lead to any problems. The haptic feedback is a nice start, but should be worked out better in a next version.

The imagination that is left to the child is one of the strongest points of the design, and should therefore remain a central point.

The conversations that were available during the evaluation were enough for the purpose, but if the system were to be a real virtual world, better AI would be required. This can currently be seen in other virtual worlds; especially games.

5.5.3 Device's form and appearance

The shape and colour made for a device that they had not seen before, meaning that they had no expectations to it, other then their perception of the object and the instructions they had been given at the start. The 'channelling' shape of the device was quite clearly understood as such and that the participants used it as was intended.

The size of the device was rather large for the children. None of the children indicated this problem, and most did not seem to have real troubles carrying it, but still it was not really ergonomically suitable for the children as could be seen when they were holding it. One of the children (the 5 year old girl) did find the device rather heavy and wanted her mom to cary it some of the time.

5.5.4 Cooperation and communication between parent and child

It came as no surprise that the way parent and child interacted with one another and together with the game, varied from person to person, depending on their personal relationship and the personality of the child. Nevertheless, all couples displayed roughly the same behaviour concerning the division of their roles. In all cases, the parents took a passively guiding role. The child did the primary conversations and took all the decisions that could be made, while the parent guided by asking rhetorical questions.

One of the parents also noted she experienced it as a social game, both in the way they cooperated, as well as in their communication with the characters. She called it a type of role-playing, where it was the role of the child to help the characters, and her role to help the child.

The cooperative nature of the game was considered to be a very positive aspect, both by parents and children. Compared to existing games that the participants played, this was the first game where they could actually work together as a team. Other games could either be played by one player that was helped by a bystander, or could be played by two players in competitive mode. One of the parents noted that especially with children who do not like loosing, it is even more important not to have a winner or loser, but a collective achievement.

5.5.5 Comparisons with existing activities

When asked about similarities and differences with other existing activities, most comparisons were made with hide and seek for its explorative and surprising nature. Both parents and children saw these similarities. Children saw them mostly because of the searching aspect; whereas one of the parents saw most similarity in the physical activity; walking around the house. One child also compared it to a game of treasure hunter, which also mainly referred to the explorative nature.

The comparison with reading to a child was also made by one of the parents, with the annotation that the interactivity of this game added a great advantage when compared to reading to a child. The main similarities here were the imaginative aspect, the extent to which the story is experienced together and the division of the roles in this experience.

Comparisons were also made to other computer games. Similarities here were mainly the way you can progress through a story and the 'quest'-like setup. Also having artificial characters was a similarity that was mentioned by some of the parents. Differences were mainly the interaction.

Another interesting comparison that was made was the comparison with child-theatre. Mainly the interaction between child-theatre actors and the children in the audience, as well as the use of imagination by the child were similarities.

5.5.6 General conclusion

All together, the concept can be considered potentially valuable. All parents indicated that, assuming the proper workings of the system and an elaborate virtual world, they would be interested in the product. Their main arguments were the imaginative aspect and the cooperative nature of the system.

Also the fact that the system -or world- is not bound to a single location, was perceived as a valuable asset. On of the parents stated "it's nice to really go and 'do' something together, rather then sit behind the screen". She made a comparison to playing hide-and-seek outside.

Value transfer and creation

From the evaluation it is hard to say directly whether this concept would open up possibilities for value transfer or creation. However, as is stated in the aim of the evaluation; the appreciation of the experiences in the virtual world, as well as the communication between parent and child could be indicators for value creation. In the evaluation, this appreciation appeared present and therefore indicates the potential for value creation.

Whether or not the value from the virtual would be transferred to the daily lives is also hard to tell directly from the evaluation. However, it also became apparent during the evaluation, that the boundaries between 'in-game' and outside of it are not so evident anymore. This could indicate that values that originate in the virtual world could naturally become part of the physical world.

Augmented Home

The concept and the way it had been worked out was appreciated. Nevertheless, it was clearly not fully developed. Especially the haptic feedback is in the first stage of development. The modalities used for interaction however were considered very positive. All in all, for the concept to become a product, more needs to be worked out, but a solid first step is made.

6. conclusions and discussion

6.1 Blurring the Boundaries with the Augmented Home

6.1.1 How it is achieved

For the Augmented Home, the boundaries that are blurred are between the virtual world of a child and its home environment. The current virtual world of a child can range from a game-like world such as 'the Sims' to a private imaginary world. In these worlds, important values are the playful and risk-free, social and educational qualities.

By taking these qualities into a new virtual world that is part of the physical environment, the augmented home blurs the boundaries for these children and the people in their environment.

The qualities are now combined with physical world qualities and allow the experiences to be valuable beyond the virtual world itself.

6.1.2 Limitations to the design

The Augmented Home could be a desirable product; however in terms of the integration of virtual and physical it is only a first step. A virtual world like Second Life has many other values that are not exploited in the Augmented Home. Being who you want to be, not having physical limitations and the ability to create anything you can fantasise, are some of these values that are not present in the Augmented Home.

The concept is inherently bound to a physical location which means that you have to go somewhere to experience it. The lack of physical limitations is one of the advantages of Second Life. It does not matter how you look, what you are capable of or where you are in the world.

Being able who you want to be and being able to hide behind the mask of your avatar are also two advantages that were not used in the concept. The illusion of the mask could allow for very open conversation between parent and child. Also deciding upon your own identity is a method for identity development that could be used.

Also the creative possibilities are limited; not in an imaginary sense, but in a constructive sense. You can not build or program anything into the world that did not exist before. This could however be possible if the concept were to be extended.

As the project started with Second Life as a target world, it is important to state that the Augmented Home is a new world, and does not provide a 'solution' for the existing virtual worlds.

6.2 Recommendations for Future Work

6.2.1 Design improvements to the Augmented Home

The most important thing for further development of the concept would be to create a larger and more dynamic virtual world. More challenges and characters and more possibilities for development within the storyline. This would allow for a longitudinal evaluation of the concept, which again allows for a better evaluation of value creation and transfer.

Secondly looking into -especially the haptic side of- the interaction would be an important job. How can we improve the 'feeling' of the virtual world, and how can the virtual world get more physical aspects?

Without completely changing the concept, I think there is one additional aspect that may be worth looking into. As was mentioned before, the networked aspect of online virtual worlds is important. In my view, adding this component to the augmented home may further enrich it. This would allow children to continue the interaction with the world beyond the boundaries of their house, and allow them to have experiences with friends and other non-family members as well.

6.2.2 On the integration of the virtual and physical

In the future, other projects should aim to go beyond the pre-created world in the home environment for children. This contains three aspects.

Go beyond the house. In the current concept, the world ends at the walls of the house, and a next home may have a similar world. Much more desirable would be one reality in which all users live together. This would allow for more social interaction and make the world even more 'real' as more different people influence the world and affirm the reality.

Broaden the target group. The target group of the Augmented Home was chosen to frame the project and to be able to steer the concept development. Now the target group can be broadened again and more people could benefit from the world.

Let the users create. This larger 'Augmented World', could be much more dynamic and start to live a life of its own if it could be created by the inhabitants themselves. This would also further stimulate the creative aspect of the world.

All in all, such a world could contain much more then challenges and games, it could be a virtually augmented reality containing information and a portal towards people, events or things.

6.3 The Future of Virtual Worlds

I believe that the integration of the virtual world inside the physical can truly allow the virtual worlds to become more valuable in daily life. In essence I think that spending time in the virtual world may over time no longer be seen as an escapist activity that detaches you from you daily life. On the contrary I believe it will be seen as a tool for development in the one reality we all live in. After all, play and imagination are important tools for self-actualisation, at the age of a child but also when we grow older.

Over the past years, our world contained more and more virtual elements. This trend is not likely to stop anytime soon and in my view it should not. The richness of these virtual elements is beneficial to our development and, as long as we adopt them and try to make them part of our lives, we can progress because of these virtual elements.

Virtual concepts have often played a similar progressive role in society. Hierarchies, countries, role-divisions, literature or money are all examples of such concepts. They show how agreement upon something imaginary can help us to move forward. What they also show is that abuse is bound to happen. In my view that can not be a reason not to develop them. I believe these virtual concepts are a natural system that we use to understand and control our life on earth.

The development of new virtualities in our physical world will happen in the years to come and I believe we are at a point where we can steer this development. It is up to us to determine how our lives in the future will be influenced by these worlds and to what extent we will be able to benefit from them. This project posed an idea on how to do this and made the first steps in the direction of synergy between virtual and physical through integration.

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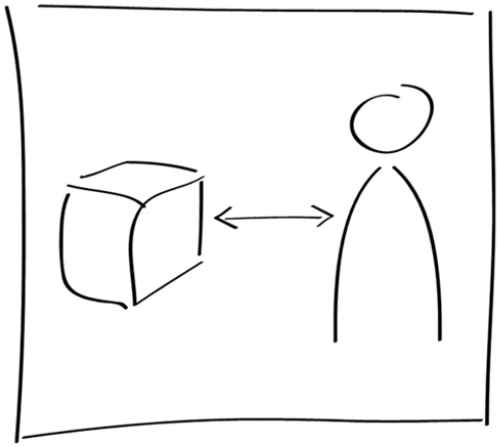
Appendix 1: An Inquiry into Values

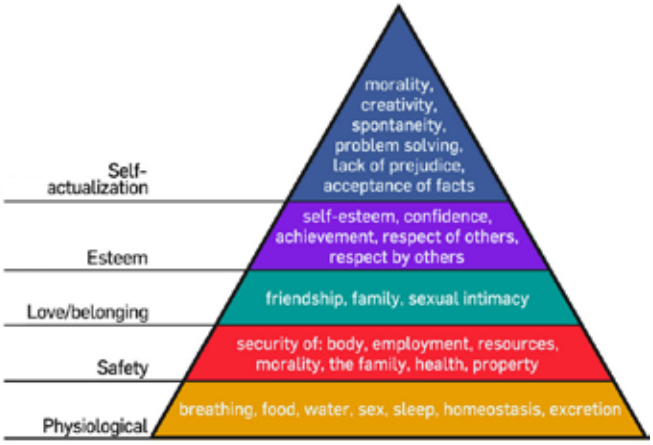


1 Perspectives on value

In literature, the concept of value is recognized as an important motivational construct and a base for evaluation criteria (Maslow, 1943, Rokeach, 1973, Schwartz, 1992).

All our values can be seen as means that in the end contribute to fundamental human needs (Maslow, 1943) that concern our health and safety, social life and development. The values that relate to these fundamental needs can be viewed from two perspectives; (1) values as beliefs (our personality contains what we think is good) and (2) value as experienced (the judgment of our experiences). For this project, most relevant is what creates the value as experience as this is what shapes our perceived environment.

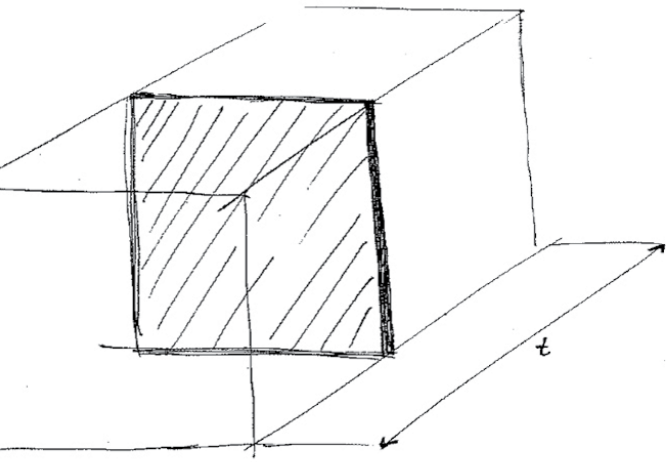
The experience value will be treated as a concept generated between subject and object. Value is not the property of an object nor is it a subjective concept about an object. Rather, value is a momentary relation between object and subject. The subject here is the perceiving person; the object is what is experienced. This can range from a physical object to a person, but can also be an imaginary concept.



Abraham Maslows Hierarchy of Needs; image source: wikipedia.org

The context in which this happens is another important aspect influencing the value as both the physical environment as well as the personal situation of the subject influence this relation. The relation with an object, for instance a chair, will have different values in different situations. In one context it can be an opportunity to rest; in the other it may be a beautiful object. This is also a reminder of the temporal dimension as both the context and the relation are ever-changing. One could therefore speak about the 'value instance' to describe an object-subject relation in context in time.

This 'relation in context' approach is taken because it recognizes both the importance of the human perspective in a certain context, as well as the properties of the object. This approach was based on R.M. Pirsigs inquiry into values 'Zen and the Art of Motor Cycle Maintenance' where he states that value resides not in the object nor in the subject, but between them [Pirsig, 1999]. In her paper on competing theories and models on value; Boztepe states that experience as value is the approach that takes in consideration what the user values in contrast to utility (use, exchange) or meaning (sign) driven approaches [Boztepe 2007]. She affirms her vision with similar visions from prior work by Dewey 1938, Frondizi 1971, Holbrook 1999, Pine & Gilmore 1999. In her paper she also contrasts this view with more objectivist approaches that see value as something inherent to a product (a.o. Marx 1990, Levitt 1981, porter, 1985). These are



value in the temporal dimension; the value instance

however easily viewed as inadequate as they do not take into consideration the subject nor the context.

2 Before and after the value instance

As we only live in the 'now' the value relation is momentarily and has an important history and future that in turn create their own value.

What remains after the value instance is only two things; our memory of the instance itself and its influence on our new present. The object with which there was a relation is both a tangible trigger for our memory, as well as a part of the new present.

Concerning the future, there are only possible or potential values. Considering our present we see potential tracks towards the future. These can be seen as imaginary values. Through our creativity, we can imagine a relation in a certain situation which we value to a certain extent. This can in turn be a value and a motivation.

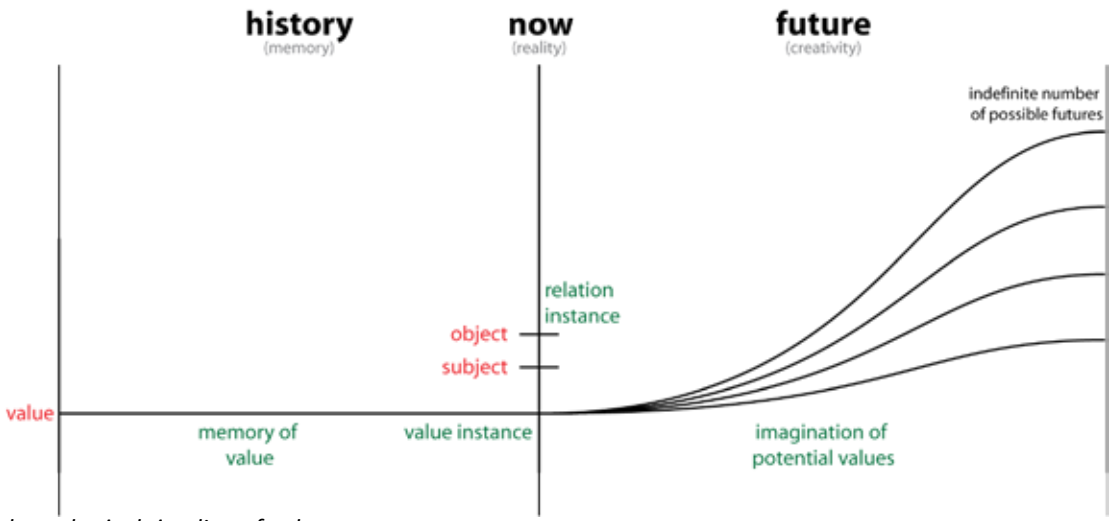
The history is the path of value instances that we have been walking up to this point. Looking back at these instances may revive the values or create new values because of sharing or the combination with new insights or experiences that one has gained over time.

3 Values as experienced

There are various approaches to the value as we experience it. These approaches address different aspects of the value. Boztepe identifies Use, Exchange, Sign and Experience as different approaches. All of these approaches concern user-value or the value as we experience it; the relation between object and subject.

- Value of use (U) concerns how beneficial a certain object can be to its user. It concerns the effort that one has to put into using it and the gain that one will get from using it.

- Value of exchange (E) is concerned with what one would be able to get in return if he/she would exchange the object.



hypothetical timeline of value

- Value of sign (S) is about what the object signals. This is highly important from a social perspective.

- Value of experience (X) is a fairly all-encompassing and concerns the complete experience.

These approaches can be used to split a value into manageable elements and allows for an understanding of why someone values something.

The value as experienced can also be characterised in a 3-dimensional continuum (Holbrook 1999). The polarities here are intrinsic-extrinsic / self-other / active-reactive:

X = intrinsic – extrinsic
Intrinsic is the value that is a destination in itself; extrinsic value (or instrumental value) allows one to achieve an intrinsic value.

Y = self – other
Describes whether the value benefits ourselves or someone else. Benefit should not be confused with the direct relation as that is always between the self and the object.

Z = active – reactive
Describes whether the relation with the object is primarily active or reactive/reflective.

The types of value emerging from experience and placed within this 3D space can be (Boztepe 2007) [16]:
- Utilitarian (convenience, economy (efficiency), quality)
- Social (belonging, helpful)
- Emotional (aesthetic, meaning (cognitive), emotion)
- Altruistic (spiritual, luck, sacredness)

These value types could be seen as a more in depth explanation of the approach 'Value of experience'. Like with the approaches to value, the types are not mutually exclusive.

4 Values as beliefs

Values as beliefs are embedded in our personality; they are actually part of it. They are what we think is good; the moral values that one has. This is important as it influences both our actions (which lead to experiences) as well as our evaluation of our experiences. Schwartz (1992) has written extensively about this topic and states that values influence behaviour and experience. He considers values to be abstract goals that can be ordered by importance for an individual. Achieving these abstract goals contributes to the achievement of the universal requirements of human existence. Schwartz identifies three of these principles which are similar to Maslow's five basic human needs.

In his work, Schwartz presents a universal value framework. Schwartz identifies a set of 10 human value types. A set of 57 more specific values is placed within these 10 value types. The values are spatially mapped such that their distance represents the compatibility with one another. This map can be used to identify what a certain person values. There is also a method available that can be used to identify the priority of values for a person.

5 Summary

Framing all theories in my view results in a framework where all different approaches to value together contribute to the achievement of our fundamental human needs.

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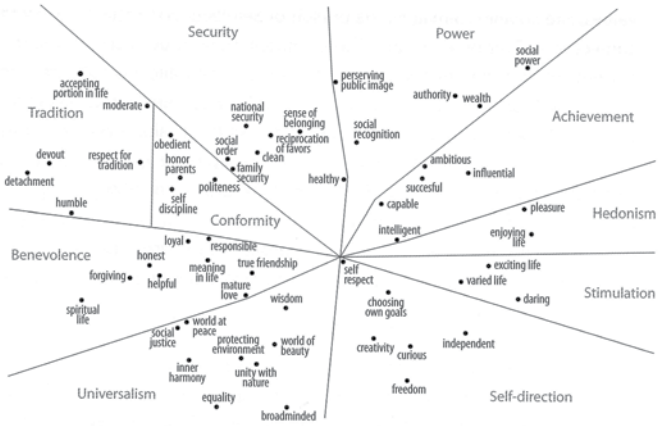

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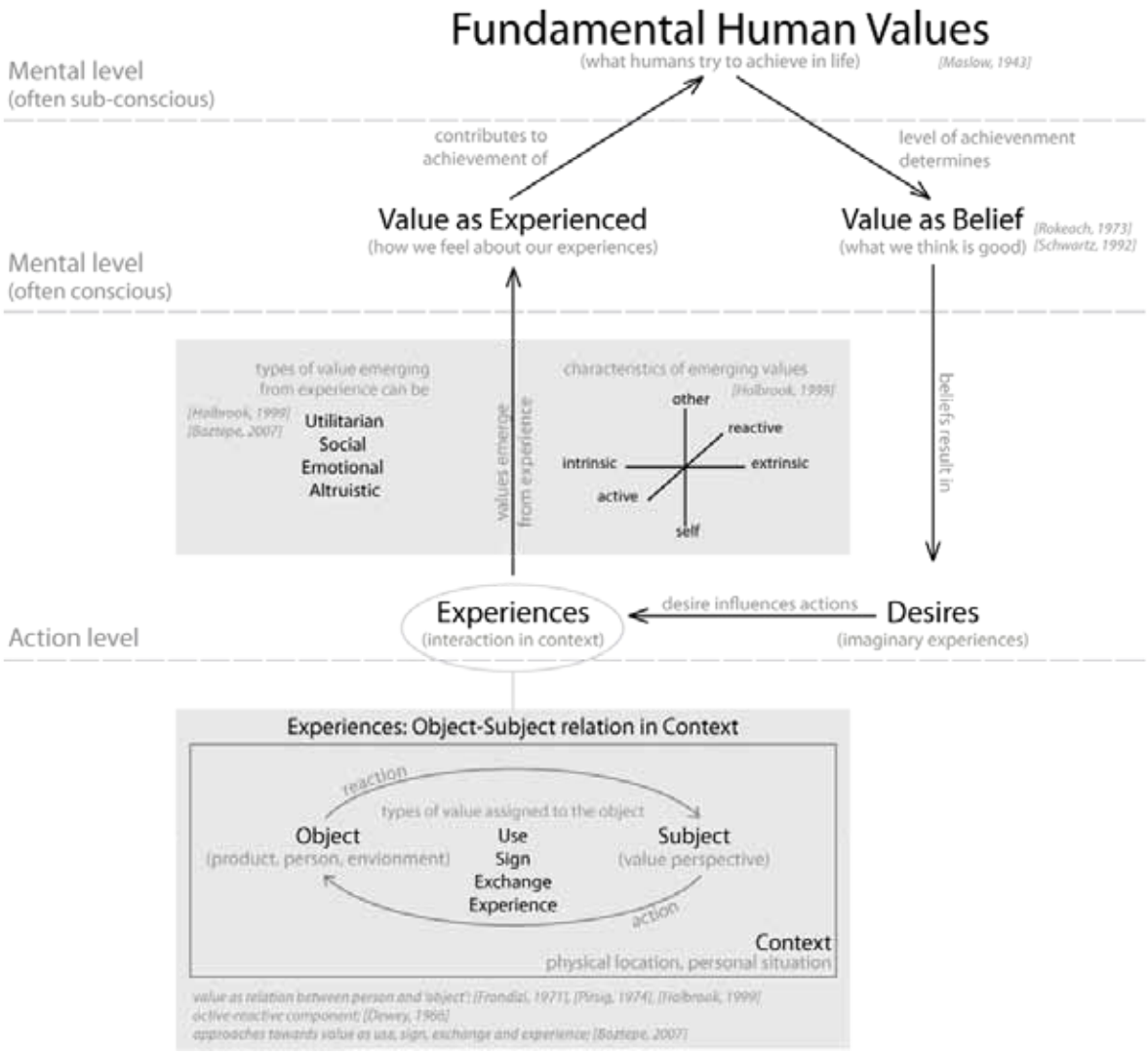


an overview of different approaches to value

Appendix 2: Second Life Interviews

Answers in the interviews are a combination of what the interviews litterally said and an interpretation by the interviewer.

Franky Cosmos

General 'demographic' questions:

- Age: 25; male
- In SL since: 6 Nov 2006
- Hours in SL per week?
  - Top days: 8 – 12 hrs/day
  - Average: 2 hrs/day
- How did you get started?

He was familiar with other virtual worlds and wanted to see how SL was different. Also after his father passed away he was looking for a get-away and an opportunity to express creativity.

Content questions:

- What is the best thing about SL?
Making things; the creative possibilities. Extension of the social network.

- What do you think is important in SL?
Freedom! Like when the Internet cam up; a whole world opened up for people. Over time the freedom on that web became less. Second life goes through a comparable trajectory.

- What does SL have that you don't have outside SL
The creative possibilities of the virtual environment. He is also a web developer and likes the relatively endless possibilities of the virtual world over the webbrowser.

- On what do you spend most of your time in SL? And money
Creating things. He used to visit events and have a large social network. Now the social network is also mainly concerned with creating things. He starts to see Second Life more and more as a tool. Nevertheless, he also spends a lot on buying clothing and acceasories, things you always wanted to have; a helicopter or a car. Mostly through www.xstreetsl.com.

- What are you most proud of in SL?
The Role-play Simulator that he has created. This is a city in Second Life where people can play a role-playing game. They wear suits and masks and pretend not to be their regular avatar.

Franky Cosmos

during the interview I get the chance to check out some of his merchandise; a coffin in this case

Also his shop is something he is proud of. He sells stuff from this shop.

Currently he is also working on a project that uses Second Life as a platform for e-learning of real-world applications. An example is teaching mechanics about certain machinery such as a power plant. For a company he created a 3D replica of a power plant that is used to teach future mechanics in a controlled environment.

- What would you like to share with people outside SL?

He likes to point out the opportunities to non-residents. He uses examples of projects by himself and other people to do this. Also things like e-learning, entrepreneurship and the possibility of having an alter-ego are things he would like to point out.

- How do you think your SL influences your FL?

He partially lives from the money he earns in SL. He also has a network of virtual friends with whom he also discusses things outside SL.
After intense periods, he often looks at the outside world with the eyes of an SL resident. He looks at objects and buildings counting the number of Prims. When he worked on shirts a lot, he got a much higher sense of fashion in the First Life.

- What are things that you take outside SL

Money is one thing; he partially lives from his income in SL and aims to extend this.
Also skills developed in the creative process; conceptual skills, but also in terms of tools such as scripting, photoshop etc are things that go beyond Second Life.
His online First Life company “Mojovisions” also promotes his development in SL on its regular website. It has an entire section devoted to it. He also has a flickr.com page containing images of his work.

- What are things that you take into SL from the FL?

Inspiration. He looks a lot around him in the real world and gets inspiration for new creations in SL.

Also other people try to take things into the world; a band that performs in both worlds: “What the...?” (www.what-the.com). He also created ther website, and through someone he knew from that project, he got involved in an e-learning project. All examples of how the worlds are being mixed.

- What kind of SL residents are there, could you define them?

Roughly the creators and the consumers. Although a lot of people create stuff; most people are simply consuming.
There are a lot of other different personality traits; a lot of beginners are silent and watching; others are very rude; they think it’s virtual so you can do anything. This appears not to be true when very real problems arise with friendships and relations.

- How much do you value the separation between the two worlds?
Less and less. In the beginning it was a place to get away to; now its becoming an extension of his development toolkit and still a little bit of an extension of his social network.

Medesca Markova

General 'demographic' questions:

- Age: 31; Ffmale
- In SL since: 1 year (march 2008)
- Hours in SL per week: 5 hr/day
- How did you get started?

Well I've been an online gamer for about 10 years, mainly played fantasy roleplay games. Well I had gotten bored with those types of games and started to play SIMS and SIMS2. I loved being able to create my own environment, but disliked having no interaction with people to show off my work, lol. So my roomate came to me one day and said he had tried this game, but it wasnt his speed, since he saw a rabbit with a 1' long penis hopping by. But he knew I was a bit of a freak and said I should give it a shot. That was in march of last year and I've been playing ever since.

Content questions:

- What is the best thing about SL
Meeting new people from different cultures, really living together with them and understanding more of their culture is something that would never be possible outside SL.
She gives an example about understanding Indian arranged marriages from a friend she has in SL.
Also being able to do what you want to do; make what you want to make, and make your dreams come true. Like having a home together with someone you love (to the extend that SL allows you to love). She has a home together with her boyfriend that she knows through Second Life. After she comes home from her First Life job, she spends time with him in their virtual home.

- What do you think is important in SL?
Honesty; about your intentions, who you are. It's a lot easier to be open here in second life, share your life with people and such without reservations.
Also social relations; meeting people.


Medesca Markova and her boyfriend Buck Wirefly

- Can you name/describe a special experience that you had in SL?
Falling in love for the second time in 31 years

- What does SL have that you don't have outside SL
A social life. I live in a small town. Not much to do but go out drinking, and I'm not much of a party girl in my RL. So for me it's all about interaction. In Second Life she is hostess of a beach-party club.

Buck Wirefly: It is also fun because you can go out on a weekend night and hang at a club, listen to some great live music, talk to people and have a few drinks and never drive or leave your house.

I am actually living the life I want to in my SL at this moment, and I love very minute of it! I have all that I've lacked in my RL here. It can be addicting because as Buck says, you can do all those things from the comfort of your home.
That is part of what lures me here time and again anyways.

- On what do you spend most of your time in SL? And money?
The social aspect, a bit of building my own environment; having my own place. She spents about 100 USD a month.

- What would you like to share with people outside SL?
It's a place to meet new people that she wouldn't meet otherwise, and do things she would never dream of in the real world.

- How do you think your SL influences your FL? And vice versa? And what do you take in and out of SL?
Well my SL experiences have really made me open my eyes to a lot of things in my RL, in the way I treat people and expect to be treated in return. Truely the only way my first life effects my SL at this point is how much money I bring into the game.

Buck Wirefly: I agree it has opened my eyes but it does also affect my real life, I dream about SL sometimes. In general mostly money and time ar the things that are spent in the other world.

- What kind of SL residents are there, could you define them?
There are many different archetypes here in SL, probably too many to explain but for example, there are those who want to relive their childhood and actually do so through Child avatars (scary in my opinion but to each his/her own). You have people who are married in RL but lacking in something so they come in search of it here, you also have people like me who are very lonely in their RL and coming here helps ease that burden. just so many really...

- How much do you value the separation between the two worlds?
Not too much. I stay pretty open minded to most things, you almost have to in SL, there's such a difference in people's lives. Many married people play, and have to separate their SL from their RL for obvious reasons. I, on the other hand am Single, and dont have to do that as much.

part of the interview took place on deck-chairs in her rather idyllic backyard

Appendix 3: Analytical Session

Session Program (13.30-14.30)

Introduction (13.30 – 13.35)
Goal of session: Identify what we value and how values are transferred from one world to another

Project aims to transfer values from virtual to physical world and vice versa

Values are 'Anything we value' – Experiences, things, situations, all

Define worlds (13.35-13.40)
- Virtual World & Physical World – Not parallel worlds, but part of the same

- Other sub-realities as well as they are essentially the same world with two differences:
    1. The role people play (identity)
    2. The context (rules)
    e.g. Sports, Holiday

- ACTIVITY: (2 minutes)
Define several worlds you live in (can be more or less specific). Try at least 4

Find values and activities (13.40-13.50)
- Find what are the values in these worlds and define the activities in the world that relate to the value.

- ACTIVITY: (5 minutes)
For each world:
    - What do you think is important in this world?
    - What value? (use: Schwartz Value framework)
    - Go specific; choose an activity where that value is best generated

Find value transfers in worlds (13.50-14.15)
- ACTIVITY: (15 minutes)
Do the following for two worlds:
- Choose 2 Worlds; try to think how you benefit from the other world (may be other worlds if necessary)
- How do you benefit?
- What values are transferred?
- Use values defined above
- May also use others; that you can think of; e.g. discount with sports card
- Fill in From / fill in Value Frameworks

Transferring from SL (14.15-14.30)
- Similar value transfer from second life to first life

- May use value transfers / transformations that you made in the previous task

- Supply participants with Values in SL
    - Creativity
    - Social recognition (belonging)
    - Appreciation for the world

- ACTIVITY: (10 minutes)
Fill in form and Schwartz framework

Fill in Personal Schwartz Framework - What is important in your life? (3 – 5 things)

Session results

Worlds

Ivo
- Performing as a DJ
- Going to the movies
- Chilling at night
- Restaurant

Chris
- Football
- Playing Guitar
- Dancing

Rick
- Going out
- Public transport
- Commuting by car
- Restaurant

Saskia
- In the supermarket
- Work
- Saturday night on the town
- Sauna
- Cycling
- At parents

Values

Ivo
- Sharing what you appreciate
  (dj > music)
- Experiencing together (movie)
- Physiological thrills (thrill of dj-ing)
- Relaxing
- Being together
- Being respectful

Chris

- Feeling of belonging and togetherness (team spirit with football)
- Contact with society (football against non-student teams; makes you see other layers of society, broadens your social scope)
- Dreaming (about being a very good guitar player)
- Increasing skill (guitar)
- Enjoying life, beautiful world (dancing)

Rick

- enjoying friendship (going out, food)
- Traveling from A-B (public transport, car)
- Fun experience (Driving)
- Enjoying food (restaurant)

Saskia

- Relaxing (sauna)
- enjoying friendships (sauna, family)
- Keeping up friendships (family, going out)
- Food (supermarket)
- Traveling from A-B (cycling)

<u>Value Transfers</u>

Ivo: Restaurant > Cinema

- Respect for context

>> identical value (no transformation) - taken with self

Chris: Guitar > Education

- Relaxation: Playing guitar creates relaxation which allows for better performance in the education
- Confidence: The fact that I taught myself to play the guitar makes that I feel confident in my study about my ability to achieve anything if I try hard enough.

>> Value transformation – taken with self

Rick: Going Out > Other contexts (friends, family, work)

- Conversational topics
- Expanding social network

>> Value is fairly similar – taken with self

Saskia: Going out > Volleybal

- Get to know things about people; reuse in other context

>> Identical value – taken with self

Transfers with SL

Ivo

Communication skills
Identity properties

Chris

Direct transfer of skill (musical skills in PR to VR)

Rick

SL as a communication tool (programmed cell-phone in SL)

Saskia

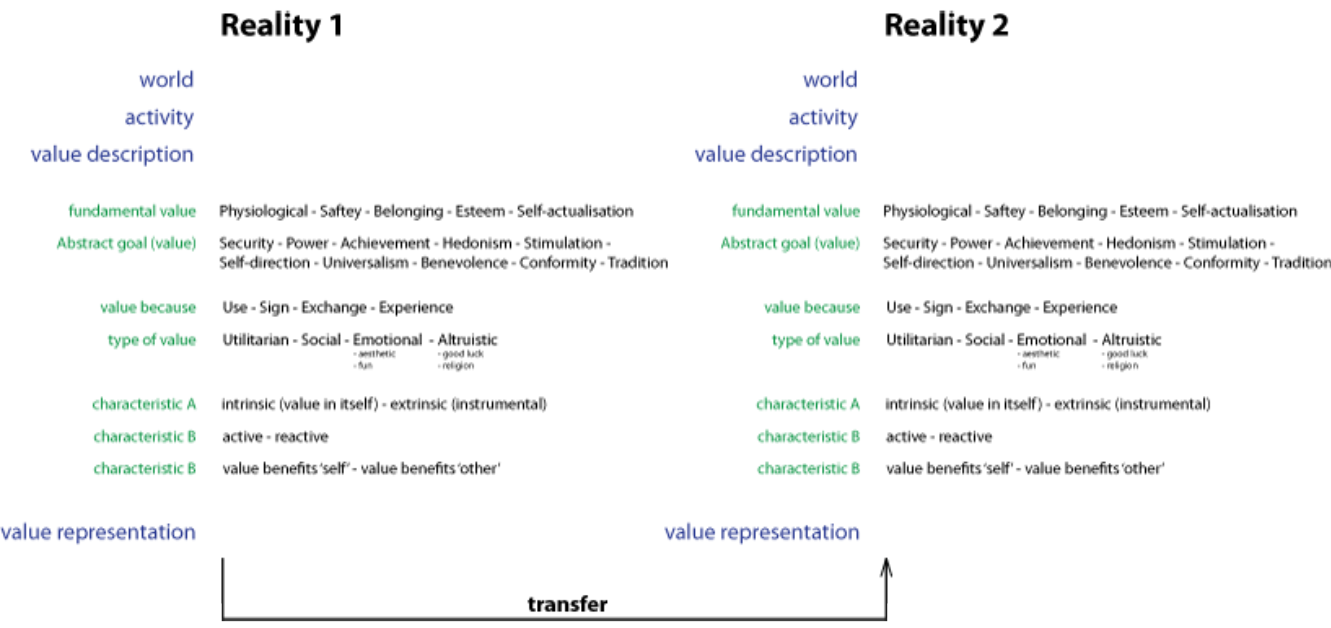
Doing something with an unexpected side-effect which makes you realise you want to do more of that.
e.g. Creating something in SL that benefited a lot of people, the satisfaction gained from that is a motivation for doing good in the FL.
Duplication of the side effect's value in the other world

Conclusions:

- All value transfers concern personal development; hardly any practicalities

- Almost all concern Transfers and no Transformations

- No Media were used in the transfer; all values were taken with the person itself



the transfer analysis-form used in the exercises

Appendix 4: Creative Session

Brainstorm Setup

5 min Explanation

- Project: Transfer value from one world to the other so that it contributes in the other
- Now; make concepts that use things from Second Life in Normal Life and vice versa.
- Value can be anything that you would value (Social Network, Musical Skill, Experiences, Money)

10 min Group Brainstorm Inputs

- Medium (Photos from camera, e-mail messages; recognize words, objects, typed texts, written text, speech capture, purpose-build object)
- Message/Value (Friends, photos, projects)

5 min Explain: Mixed representations of valuable experiences in both worlds

- Focus on Social and Creative / Achieving values
- Input through mutual object
- Representation through 2 objects; physical and virtual
- Input could be purposely made or a collection of existing material
- Output could be via one representational object; or via an object able to create new representations
- Media could vary

15 min Generate 2-3 concepts

- In the direction of mixed representations
- Each on 1 sheet
- Think about input and output (representations)

10 min Present Concepts and choose 3 in total

15 min Discuss and Improve 3 Concepts
- Identify the quality aspects
- Take OUTPUT into consideration

Brainstorm Results

Friend Counter (Saskia)
- Esteem by the number of friends in both worlds
- Representations show friends in both worlds relative to one another

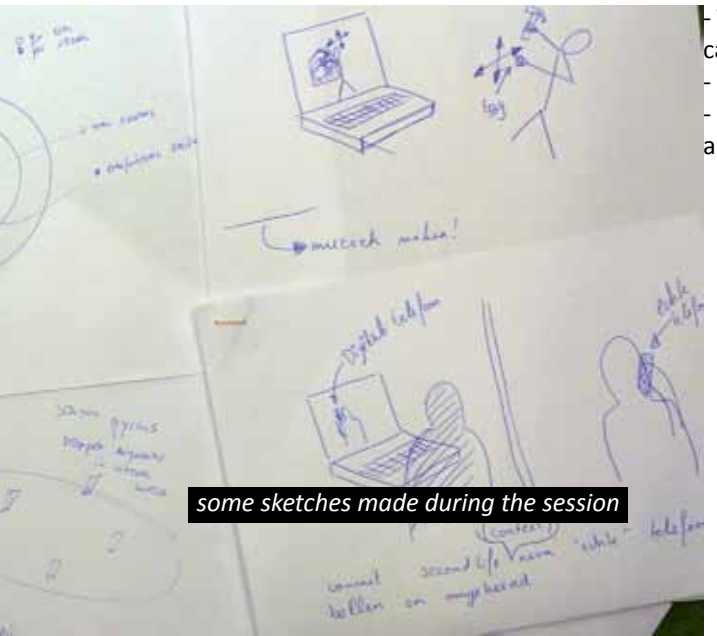
Smell (Saskia)
- Capture and transfer smell as a strong reminder

Google Earth (Chris)
- Show where you've been or want to go
- Maps of both worlds
- Merge maps
- Visit places in both worlds: paris, amsterdam

Metaphorically Crippled (Chris)
- Show how you are doing in the other world through a metaphor
- Limping in SL means a sad day in RL

Access Hat (Chris)
- Enter the virtual world through a physical object

Mood Change (Rick)
- The person's mood is visualized in the VR
- Also in the PR; e.g. through lighting



some sketches made during the session

Power Tools (Rick)
- A skill or capability can be acted in the PR and effective in the VR
- e.g. Making music
- Could be an alternative controller for a specific function in SL; taking pictures with a camera?

Phone (Rick)
- Call from one world to another

Phone (Ivo)
- Call from one world to another

Info Trails (Ivo)
- Receive info about places you have recently been (e.g. last 30 min)

LocalNodes (Ivo)
- Drop nodes in certain places (tags)
- Feeds from these locations can be used in both worlds
- Representations for instance with light

FriendsRadar (Ivo)
- Radar indicating the proximity of both your virtual and real friends
- Proximity may be based on geographical position, online status, etc.

LocationLink (Ivo)
- Tag locations by content in both worlds – place cam in SL
- Merge input from both
- Create movie with feeds from a real camera and a static SL cam

Appendix 5: Concept Development Brainstorm

Program

5 min Explanation of Concept: Augmented Home

- A virtual Layer over the normal house
- A world that is always active, also when you are not in it
- Integrates the virtual world in the physical
    - The world is invisible
    - Can be interacted with via modules in the home
    - The virtual world – a lot like XP-based games (WOW/FC)
- is about the development of a player character
- Development can be made by doing challenges / meeting people
- The world contains NPC's
    - The world is called Allegory
- You aim to be king and have to prove yourselves through challenges
- Challenges are used for the development of the child; social and educational

20 min Brainstorm: Activities for Children; challenges

- Educational
- Social
- With virtual Characters
- With family members

5 min Break

30 min Brainstorm: Expressions of the Virtual World; interaction

- How to see the virtual world?
    - via objects
    - light / sound
    - etc
- In-/output for challenges
- Interaction with NPCs
- Information
- Input
- Senses
- One or multiple devices / room awareness
    - The challenges vary in difficulty
    - The challenges may require cooperation with parents
- Abstractness of the representation

Session Results

Cool Games

- Levend Stratego
- Tjoekbal
- Skilled co-op
- Hockey
- Tennis
- Jeux de Boules
- Frisbee
- Boomerang
- Diabolo
- Magic
- LEGO
- Narrative
- Sjoelen
- Tafelvoetbal
- Frogger
- Skateboarden / Zeepkisten
- Machiavelli
- Apekooien
- Nachtwacht
- Triviant
- Verstoppertje
- Muizenval
- Spookslot
- Betoverde Doolhof
- Dynablaster
- Call of Duty
- Mario
- Pictionary
- Kolonisten van Catan
- Who's the Man
- Speurtocht
- Vossenjacht
- Quests
- Zelda
- Voetbal

Loose ideas

- find clues in your environment
- Support by characters
- Create three modules
    1. Portable with screen (watch / mobile phone) controls own avatar
    2. Generic Room-based in/output
    3. Robot as a representation of several characters
    4. PC interface for overview (with dedicated interaction device)

Game Ideas

- Virtual Games with physical interface

- Grow a virtual plant / tree
    - Certain elements need to meet certain conditions to reach a desired result
    - Light, water and temperature need to be optimal
    - Tools placed in the right position in the house create the right conditions.

- Music Maker
    - Use stairs as tones
    - Use general input device
    - let the Algries make music, tell them to jump on a virtual drum in a certain rhythm etc.

- Puzzle

- Watch out where you step; 'minefield'
    - Virtual mines,

- Block building
    - Build a certain shape (tangram?)

- Find the Algries
    - photograph them
    - Find new 'spiecies'

- Codebreaker
    - Create correct conditions with certain elements to unlock a safe.

- Elements can be for instance, right lighting condition in the kitchen (light sensor), water / weight etc.
- Do things in different rooms; cooperation with parents or friend will save you a walk

- Quests
  - Refer to ther NPCs ;
  - Help, find my dog
  - I have last seen… in the…
  - Treasure hunt

- Catch physical objects

- Sort physical objects

- Help other Algries as a category of quests!
- At a higher level you willl be approached by other algries because ethey have lost their … or need help to…

- Hide and seek

- Have a job
  - Taxi Driver (take them from one place to another; small scale?)
  - Deliveries
  - Finder
  - Create circumstances

<u>Interaction Ideas (output)</u>

- A carrier to take an NPC with you, he can go into your carrier
  - Bag, Watch, Necklace, Hat
  - Hold carrier close to et them hop in
  - You can take them on holidays and talk to your friends at home

- Little eyes (leds) on the wall; a light strip / tube

- Augmented reality with fiducials

- Augmented mirror

- Shadows
  - On the wall
  - Silhouette light projections with scanner and gobos

some sketches made during the session

Interaction Ideas (intput)

- Gloves

- Magic Wand

- Cape; includes in and output

- 'Button-badge'

- Touch sensitive floor-mat

- Representational Robot
    - Represents various characters from the VW
    - appearance differs per character

- Auditory
    - The whole world can be listened to

- Brillegory
    - Glasses with augmented vision
    - Glasses can also include eye-tracking

- Bag / box with tools
    - The box contains tools; for games / interaction
    - The outside of the box may have a screen

- Watch

- Biofeedback: Use biofeedback as input
    - Skin conductivity, heartbeat
    - Can be used to develop ZEN
- Accelerometer

- Audio chip

- Basic display (lcd or LED's)

- They live in the windows

- Use screens already available in the house

- Painting as a window to the VW

Appendix 6: early evaluation of browsing interaction

Description

Quick Qualitative evaluation of 'browsing virtual space' with 5 fellow students

Students were asked to look for virtual object in the room.

The device vibrated with pulses; orientation towards the object determined the frequency of these pulses. Facintg the object would result in a constant pulse. Facing it with the back resulted in a 1,5 second pause between the pulses.

The intensity of the vibration illustrated the distance.

The device worked with a 'Wizzard of Oz' remote.

Evaluation Results

All students were able to find the object.

Finding a second object appeared more easily when they already understood the mapping.

Differences in vibration strength were hard to observe. The frequency difference was easier to observe, though a bit 'delayed'.

Pulsing is a problem if you rotate very fast; before it changes, you have passed the object you are looking for.

Direction; which direction to turn to? You have to rotate in a direction to find out if that's the right direction to turn to.

People who were familiar with vibration navigation found the objects more easily.

Students were guided to a physical object. A virtual object is hard to find in the sense that you never know if you are there. You can tehrefore walk too far. This could be overcome with an audio confirmation.

New mapping

A new mapping was made to make it less complex. When facing in a direction where something is, the device gives a buzz. This buzz continues until the object is no longer in line of sight.

Audio addition

- an identifier sound can be heard once when facing it; and again when facing it again after not facing it for a moment.
- Another sound (hello) was played when the user found the object, this made it clear that it had reached the object.

Evaluation Results of New mapping

Evaluated wth 2 fellow students

New mapping was much clearer

Students could easily find the objects

Increased intensity of the buzz was not noticed, but the increased sound volume was.

Appendix 7: Evaluation Interviews and Observations

Evaluation 1; Mother and Son (7)

Scenario path
Bell > Child
Milk > Parent
Cat > Child > Dibbel

Interview Notes and Observations
Child

- Indicated he thought the Cat is walking around inside the house, while Dibbel may be outside

- Child was very well aware of the hurdles that had to be taken in order to return the cat to Dibbel.

- The child liked cooperating with mom. Usually he plays alone. When playing together, usually he and his parents are playing as opposition. This goes both for board and dice games as well as computer (Wii) games.

- The child plays games at home and saw similarities between this concept and 'Treasure Hunter' (physical play) and a computer game where tasks had to be completed to continue in the game (quest).

- It was not immediately clear how to pick up the cat; pointing did the trick. The miaowing of the cat made it clear he had picked up the cat

- The bell could not be heard (prototype failure) which caused confusion as to whether or not the cat was awake.

- The child was well aware of when it was carrying something because of the auditory feedback as well as 'feeling' it.

Parent
- Notices that it was nice to play cooperative instead of competitive; usually playing together is competitive. If a child does not like loosing; that is often a problem, especially when playing with other children that usually win.

- Child plays 'quest-like' games at home, also in pet-theme at the Wii. It is sometimes played together, but it's a single player game. The child is thus helped.

- She was conscious of her role as a parent and wanted to balance the leading role in the game as much as possible in favour of the child. She notes that she thinks that for two children of the same age, it could be even more exciting.

- Would be appreciated in the household, if the challenges are new every time and it does not become boring over time.

- Risk for addiction if the world always continues. The child could be afraid to leave the world alone. In the Wii pet game, this was already the case when a new horse was earned, even though the game could be saved and stopped.

- The lack of visual feedback was not missed (not noticed actually). However when the child is carrying the cat, it would be good to have a clear indication for the parent that that is the case.

- For the parent herself, It was very clear that she was carrying the milk because of the clear auditory and tactile feedback

Evaluation 2; Mother and Daughter (5)

Scenario path
Bell > Child
Milk > Parent
Cat > Child > Dibbel

Interview Notes and Observations
Child
- Child thinks that characters are still in the house and playing together because they are re-united.

- Child sees similarities with 'Hide and Seek'.

- Child likes 'Pet-shop' at the Wii, doing activities with the animals there.

Parent
- Parent likes the real cooperation and 'doing' something together; rather then sitting behind the screen

- Parent also sees similarities with hide and seek. Also with reading to the child; but that is much less interactive, questions are asked during reading, but now it's really done together!

- The leading role was for the parent, in this case, while usually the daughter is in charge. According to the parent, this is likely because of the setting with cameras and strange people.

- Having to walk around the house would not necessarily be an advantage, also because there would have to be all sort of technology installed in the house.

- The age (5) was considered very good, older children might feel it was too easy

Evaluation 3; Mother and Son (6)

Scenario path
Bell > Child
Milk > Parent
Prototype Failure…

Interview Notes and Observations
Child
- Child liked the game and its characters

- Child keeps coming up with ways they could have done better in the game by reasoning about the characters' properties. (While actually they did perfectly fine, and the system failed). Also the child is very well aware of the relations between the characters.

- Exploring is the considered the most fun part of the game

- The challenge was not too hard

- Child plays Mario Kart at the Nintendo, which is his favorite toy. It is not explained why, but it indicates the quality the computer ha for the child.

Parent
- The fantasy aspect is very good

- Parent states it is very real to the child

- If you don't know the platform, you quickly need confirmation whether you are doing it correctly. This was now lacking as the system failed every now and then.

- The cat worked very well, because children are familiar with the cat, and are likely to like cats.

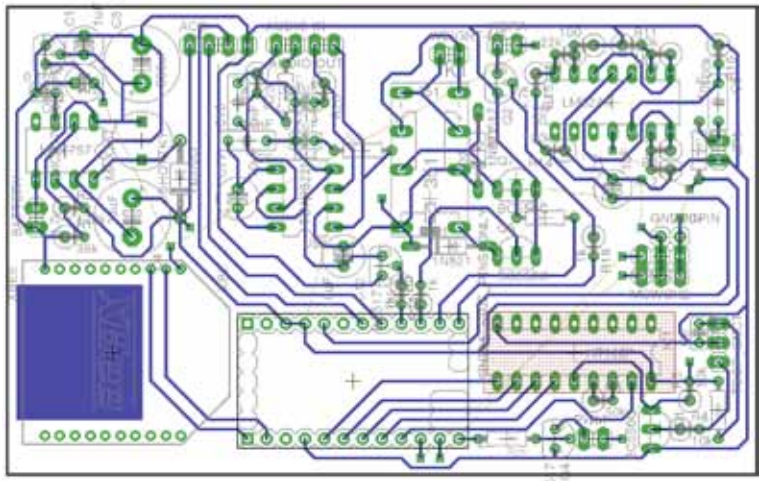
- The characters helped instructing; that worked very well;

- The lack of visual feedback was not missed. It is actually an enrichment to the system as it allows for more imagination of the child.

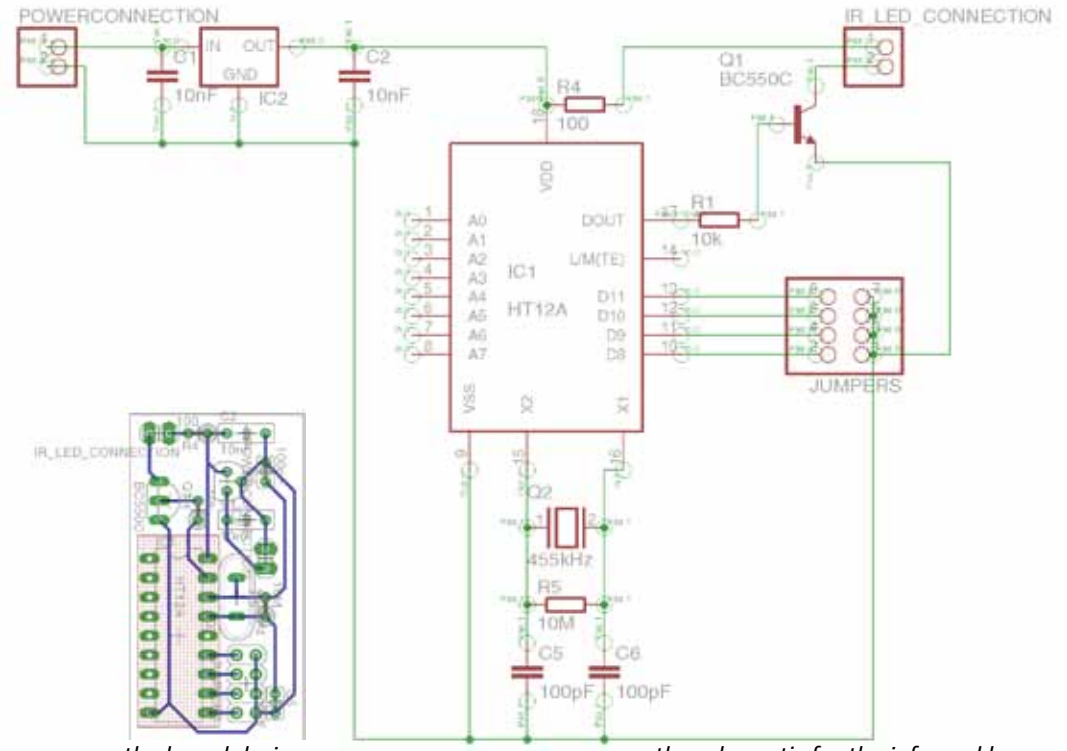
- They play together, memory, bingo, game of goose

- Parent liked the game very much (assuming that it would work properly). Mainly because of the social aspect and the amount of imagination that can go into it. Also the role-play aspect was valued. Parent states that the market is very ready for this type of game.

Appendix 8: Printed Circuit Board design



the board design for the device



the board design for the infra red beacon

the schematic for the infra red beacon

the schematic design for the device