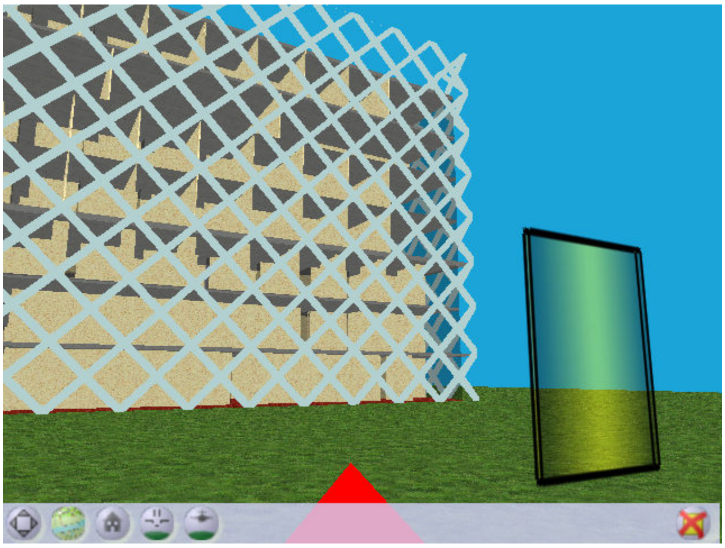
Centre for Geo-Information

Thesis Report GIRS-2004-033

MUPPET - A 3D DISCUSSION ENVIRONMENT

Steven M. Ottens

July 2004



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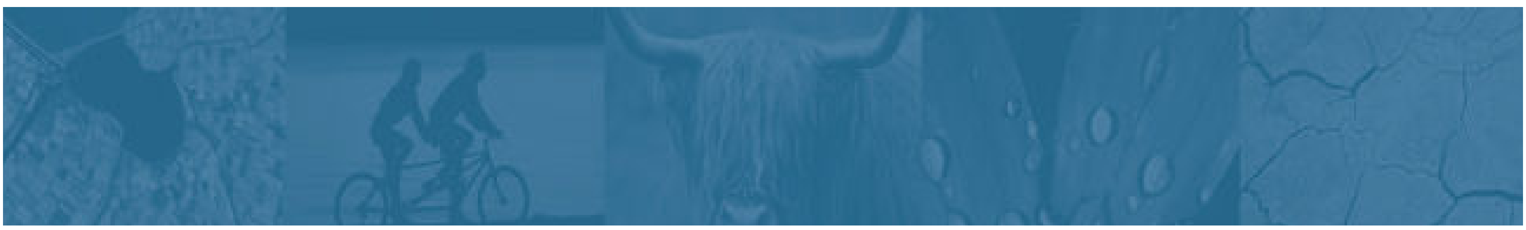

MUPPET - A 3D discussion environment

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A thesis submitted in partial fulfilment of the degree of Master of Science at Wageningen University and Research Centre, The Netherlands.

July 2004

Wageningen, The Netherlands

Thesis code number: GRS-80328
Wageningen University and Research Centre
Laboratory of Geo-Information Science and Remote Sensing
Thesis Report: GIRS-2004-033

Foreword

When I first showed up on the GIRS department they excited me with visions of wonderful 3D GIS applications. In this thesis I did my part to bring those visions to reality. Even though I have managed to get more or less the application I had in mind I think there is still a long way to go.

I worked from November 2003 until July 2004 on this project. During this time I have seen and read about the most amazing projects around the world. This part of GIS is definitely moving. My experience in Portugal came very handy during this thesis since I learned to work with Virtools and got quite some pointers on programming there. I am impressed by the possibilities of Virtools and I have seen ways to expand these possibilities more to GIS functionality. It is wonderful as a visualization and education tool. But at the same time I do not think Virtools will be the way forward for full blown 3D GIS systems. It is much more a prototype and proof-of-concept build application than an application build application.

Having said that I must say I did do fun projects with Virtools during my thesis; together with Rik Olde Loohuis I made wonderful interactive visualization applications. For instance Rik made a 3D model of the new Atlas university building and we put it into Virtools and Muppet; the result is shown on the frontpage of this report.

Several people have been very helpful during my thesis, especially my supervisors Aldo and Ron, he was also the one who told the visions in the first place. The system administrator Marjanne Fontijne who spend 3 hours installing a very important application which I only needed for 5 minutes, but the result of these 5 minutes (a Virtools building block) has been used intensively. Also the members of the staff, Jandirk Bulens, Arend Ligtenberg, Henk Kramer, Wies Vullings and Aldo, Rik and Ron who were willing to spend an hour to test my application.

All in all I had a lot of fun and have come out of this thesis with much more ideas what is possible and how to do it then I had to start with.

Steven M. Ottens

Wageningen, the 4th of July 2004

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Summary

This report describes the development of Muppet (Multi User Participative Planning Environment), a prototype for SceneTalk. The prototype consists of two parts; a discussion forum and a 3D environment. The messages in the discussion forum are stored together with their 3D position and orientation. In the 3D environment this data is used to visualize the messages.
The report describes different concepts and developments in the fields of geodata visualization, participation & (group) communication and geo collaboration. The concepts are used to build a conceptual model for the application.
The application itself is described in the second part of this report. It has three discussion functions; 'View message', 'New message' & 'Reply message'. Inside the 3D environment it is possible to navigate around with both mouse and keyboard. To help users to navigate at high speed there is a technique called speed coupled flying. It works with two speeds where the high speed provides a bird's eye view and the low speed a ground level view. A small group in a fictive spatial planning setting has tested the application. This case study and its results are also described.

The development of this application has not been without problems. The most important ones are that it is not a true multi user 3D environment and the link between the messages and their visualization is broken. These are the result of the limitations of the chosen software. There are also some usability issues mainly involving the interface to the 3D environment.

It can be concluded that it is possible to develop a 3D discussion environment. Also that it is difficult to develop a good interface to navigate and orientate in 3D environments. The application is just a prototype and it needs to be developed further. Important future research directions include:

- To develop a direct link between the 3D environment and a database to allow for dynamic world generation
- More (usability) testing and interface design.

1 Introduction

1.1 Background

At the end of the last century there has been a trend from government-only spatial planning towards a more participative and interactive planning approach. (Uwimana, 2002) Participative and interactive planning are now perceived as important spatial planning tools. The research focus has shifted towards the amount and level of participation needed. (Lammeren, Van et al., 2003) The spatial planning problems are becoming increasingly more complex. They require a multi-disciplinary approach and the involvement of the stakeholders. The stakeholders do like to actively participate in the planning processes that affect them. New tools are required to facilitate the increased collaboration of stakeholders. The Centre for Geo-Information has developed such a tool together with Wageningen Software Labs. It is called MapTalk and it is a collaborative GIS-based design tool for 2D maps. (Vullings et al., 2004)

However, this application does not take care of one of the problems of 2 dimensional (2D) maps. Both the stakeholder and the planner have difficulties to translate these abstract 2D maps into real world scenarios. The more realistic looking artist impressions and scale-models are static and a change of plans requires a complete new drawing or model. (Nieuwerth et al., 2000)

Displaying the plan as a 3 dimensional (3D) model on the computer, provides both the stakeholder and the planner a useful tool to quickly grasp the plan and the impact of changes. (Witte, 2002 and Nieuwerth et al., 2000) The recent increases in processor and graphics power of computers has made it possible to view these 3D maps on standard computers. It should now be possible to build an application that can be used as a 3D discussion environment where multiple users can log in and discuss the 3D environment. This 3D environment can represent any kind of spatial plan.

An important aspect of the application will be its collaborative capabilities. Participative planning is a group effort and a participative planning application has to support group work. Since users do not feel that they are involved if they use such an application on their own, without the possibility to discuss the plan with others. (Li et al., 2002)

This report describes the development of such a 3D discussion environment, or as I called it: a Multi User Participatory Planning Environment (Muppet). This application will be the starting point for the development of SceneTalk, a 3D version of MapTalk.

1.2 Problem definition

Participative and interactive spatial planning requires more communication, in earlier stages of the planning process, between different stakeholders. Communication of the plans to the stakeholders is an important aspect of this process. Current techniques for visualizing the plans are insufficient since they are either too abstract or too static.

Also the Internet is increasingly used to communicate with stakeholders. Collaborative environments are examples of this trend.

There is need for a collaborative application where spatial plans can be discussed in a 3 dimensional virtual environment. This environment should be able to run on normal PCs using the Internet to communicate with other stakeholders.

1.3 Objective

The objective of this project is to develop a prototype of a 3D multi-user collaborative virtual environment for participative spatial planning.

1.4 Research questions

- What role can this application have in the planning process?
- What type of user will use this application?
- What functions should the application have?
- How can users communicate with each other, e.g. synchronous/asynchronous, text/voice/video?
- What information on other users should be provided, e.g. location/type/changes made?
- What kind of navigation aids should be provided, e.g. compass/waypoints/paths/2D maps?
- What software should be chosen as starting point, taking into account the requirements of the application and the possibilities of the software?

1.5 Report outline

The next chapters will discuss the background, the conceptual model and the technical realization of Muppet and a discussion on its current functionality and future directions. Chapter 2 gives an overview of current developments in 3D geodata visualization. In chapter 3 the social aspects of both group work and computer aided discussion are discussed. Then in chapter 4 the technical aspects of collaborative work and multi-user GIS are described.

Then in chapter 5 the conceptual model underlying the application is presented. In chapter 6 these conceptual choices are transformed into a set of function described in the functional model. Chapter 7 describes the final implementation of the functional model, with all technological hurdles. The application is put to the test in a case study, which is described in chapter 8. The results of that test and of the implementation it self is discussed in the final chapter, chapter 9. Which will also include suggestions for further development and research.

2 Geodata visualization

2.1 Introduction

Already in 1988 Van der Schans noticed that the development of computers made it possible to create a revolutionary separation between the storage of geodata and the visualization of geodata. Before that development both were stored in the same drawing. (Schans, Van der, 1988) Since then, the computers have only increased in computing power and storage space. Now it is possible to not just merely use a digital version of a drawing, but to model the geodata in 3 dimensions.

This separation is described as a separation between data model and visualization model. Van der Schans shows that the separation is trans-dimensional (figure 2.1). A 3 dimensional (3D) data model can be visualized with a 2 dimensional (2D) visualization model, for example a map. (Personal communication)

With the arrival of 3D visualization and in particular Virtual Reality (VR) a new problem has arrived. Not only the (geo)data has to be visualized but the person who explores the data has to be represented as well. He is no longer outside the visualization model; he is an integrated part of it. He has to move himself through the 3D data, instead of moving the map. (Hanson et al., 1997)

In this chapter I will discuss current developments in 3D data models and 3D visualization models. At the end I will discuss ways to represent the user in a 3D visualization model. To limit the range of developments I will only look at the so-called reality-based 3D models. Reality-based 3D models try to create a 3D environment with a high level of realism, using photo-realistic textures and other techniques.

		visualization model	
		2D	3D
data model	2D	map	extruded map
	3D	top view of a 3D model	true 3D model

figure 2.1 The different possible data model and visualization model combinations. (Free to Schans, Van der, 1988)

2.2 3D data models

Two types of 3D data models (geometrical and topological) have been examined in many studies. The geometric model contains information on the shape and size of the different spatial entities and the topological model contains information on the relationships between spatial entities.

Geometrical models are more intuitive and easier to implement than topological models. Several mainstream Data Base Management Systems (DBMSs) support spatial objects organised in geometrical models. Most of the time they can only display 3D objects in 2D, hence only 2D spatial operations are supported. A real 3D geometrical DBMS has yet to be development. The development of 3D topological models is even more complex than the 3D geometrical models. Many GIS applications work with 2D topological data models. But the third dimension introduces a number of new issues in representing the objects and in detecting their relationships. Different applications require different 3D topological models; there is not (yet) one

3D topological model that suits all applications. For each application one has to consider the type of model required. A model that is good for 3D spatial analysis may exhibit a dissatisfactory performance on 3D visualization and navigation. (Zlatanova et al., 2004)

Van Oosterom et al. (2002) propose a solution for the required choice. They suggest the use of a generic topology meta data table and stored procedures, which use this metadata to realize the geometry. This makes it possible to have the advantages of a topologic model, e.g. no redundancy, and that of a geometric model, e.g. faster presentation.

I also looked more in depth into one of the 3D topological models. This is the Simple Spatial Model presented by Zlatanova et al. (2000). Their aim was to develop a new data model that supports 3D topology, for spatial analyses, and quick and correct 3D visualization on the Web. The key characteristics of the proposed data model are; support for 3D geometry & topology for extended spatial analysis and facilitating interactive visualization.

The core of the conceptual model is to represent the geometry of the data. They used four geometric objects, *point*, *line*, *surface*, *body*, and two constructive objects, *node*, *face*. Each geometric object can be associated with thematic meaning. The constructive objects were used to build the geometric objects. The omission of arcs made the conceptual model much simpler than other 3D models.

Every object has its own unique identifier. To fully describe a spatial object the attributes, relationships, behavior and scenario are considered, divided into a geometric and a thematic domain. The attributes denote semantic, geometric and radiometric properties, radiometric properties define the rendering of objects. Everything is stored into a Relational DBMS (RDBMS), providing standard SQL querying. (Zlatanova et al., 2000)

While 2D GIS focuses primarily on cartographic presentation, 3D GIS focuses on presenting the data with a high level of realism. This requires a more complex 3D data model. For instance, a reality-based 3D object typically consists of a considerable number of 3D elements, each with their own semantics and appearance information. A reality based 3D GIS requires also multi-resolution or multi-representations, in one view there are objects of different resolutions. (Nebiker, 2002)

This increased realism together with the more complex topology of the third dimension requires complex data models that still have a good performance on visualization and navigation.

Zlatanova et al. (2000) reduce this complexity by simplifying their geometric model. They store all the attributes of these objects together with the object unique ID in a dedicated RDBMS. Such a RDBMS can both store large amounts of data and perform SQL queries on it.

2.3 3D visualization models

The visualization of data in 3D has continued to grown in importance. One reason is just that is possible. Another reason is that the third dimension helps in displaying complex spatial information. The familiar look of well-known objects helps the viewer to concentrate on the analysis problem. (Hilbring, 2002)

There are different techniques available for visualizing data in 3D. An important limitation is the hardware available for the users. Although immersive 3D, e.g. CAVE, 3D goggles and gloves, probably captures the public's imagination the most, it is not an interesting technique for this application. The targeted users, normal citizens and local governments, do not typically own the required hardware nor have easy access (Bhunu et al., 2002) They do own standard desktop PCs or have relative easy access to one.

There is a trend towards systems that work on those standard PCs. (Haklay, 2002) Typically these systems use VRML to create a 3D visualization (Rhyne, 1999), but other techniques like Java3D (Manoharan et al., 2002), 3D game engines (Fuchs et al., 2001) or home-made 3D engines (Nebiker, 2002) are used as well. Every 3D visualization model needs a 3D render engine to display the 3D environment on screen. But it needs to incorporate more than just a render engine. The following list shows some issues that the 3D visualization model needs to address:

- 3D object appearance: Quite often a 3D object might have different appearance settings, depending on the application and the context.
- Viewpoint information: This includes information of the position of the viewer, the orientation, and viewpoint descriptions but also object specific information.
- Scene lighting: A reality-based visualization should include support for different lighting settings, both local and global.
- Navigation: The user should have a degree of freedom to navigate and explore the data. (Nebiker, 2002)

In the book of Fisher et al. there is a chapter on a research to visualize sustainable agricultural landscapes to facilitate discussions with stakeholder about different scenarios. One of the research aims was:

"*To evaluate the potential of GIS and virtual reality techniques as means of visualizing alternative future landscapes for stakeholders.*" (p104, Lovett et al., 2002)

The research focused on a small part of the UK, from which they obtained landuse data and elevation data. Using this data they came up with two visualization methods, large 2D color maps and 3D VRML models. For each of the four alternative landscape scenarios they created such a map and a VRML model. Basically that was a vector map draped over a DEM. To further enhance the realism of the VRML models they added 3D trees, hedges and houses where needed. It was possible to navigate freely around using the inbuilt navigation controls of the VRML viewer. They also provided a set of predefined viewpoints and an animated tour. The latter was found very useful since it was now possible to let the tour run for a few minutes while the different parties discussed the visualized scenario. The maps and models were presented to the participants and were asked for their comments. The VRML models got mixed reviews from the stakeholders, they had the potential to be useful but additional details and textures were needed for better recognition. Furthermore it was too slow and there was need for links to extra information.

2D visualization has been relatively easy because computers are basically 2D, they have 2D input devices (mouse and drawing pad) and 2D output devices (monitor and printer). Visualizing the third dimension requires much thought on how the user is going to interact with it. (Hilbring, 2002)

The purpose of the visualization done by Lovett et al. (2002), was mainly to show the landscape to the different stakeholders. They chose performance over realism, so the visualization model is kept simple without the use of photo-realistic textures. (figure 2.2)

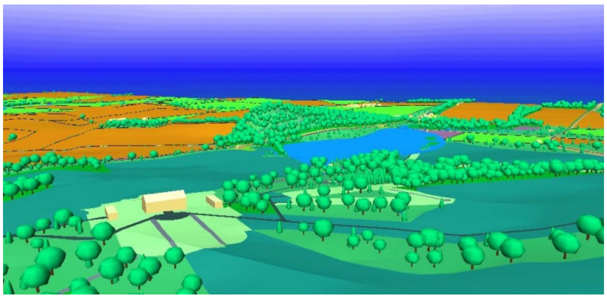

figure 2.2 View of the study area (Lovett et al, 2002)

2.4 User visualization

Virtual models can be viewed from different viewpoints: both bird's eye views which quickly give survey information and eye-level perspectives from the vantage point of pedestrians can be generated. (Bhunu et al., 2002) The user is not outside the data anymore, as they used to be with maps, but inside the data. The user has to be visualized in the 3D environment as well. This is obviously the case in a multi-user setting where the different participants can meet each other. But also in a single-user case it has its advantages.

It is shown that users quickly loose their orientation in a 3D virtual environment. (Fellner et al., 1999, Hanson et al., 1997) A common way of getting lost is to accidentally end up inside an object without any doors or windows. This happens when there is no collision detection, creating non-solid walls where the user expects solid walls. (Fellner et al., 1999) Collision detection is only possible if the program knows where the user is located, it needs to be visualized for the program, and as such there is need for user visualization in a single user setting.

Avatars are humanoid embodiments representing a user in a virtual environment. Since each avatar is both part of the perceived environment and represents the user that perceives, inhabitants develop a strong sense of mutual awareness. Since the avatar represents the user it can give direct feedback to other inhabitants regarding the location, orientation and possibly other information about a user. However this does not imply that a good avatar is a very realistic human like avatar. A more abstract approach may be more appropriate.

There are three approaches to control an avatar in a virtual environment:

1. Directly controlled: Face and body movements are captured and the avatar is modified accordingly

2. User-guided: The user defines tasks and movements through a secondary device, e.g. mouse or keyboard.
3. Autonomous: The virtual human is assumed to have an internal state that depends on its goals and the environment. The user modifies this state, e.g. re-defines goals and start new tasks.

(Fabri et al., 2000)

The first approach requires motion capture devices, which rules out this approach, since it is not available for the targeted users. Other than that it does not rule out the risk of getting lost. Especially when the avatar is flying and the user is not.

The second approach produces some challenges, since it typically uses a 2 degree-of-freedom controller, such as a mouse to control free 3D navigation, which is 6 degree-of-freedom navigation. (Hanson et al., 1997) There have been several attempts to solve this problem. (Hanson et al., 1997, Tan et al., 2001 & Fellner et al., 1999) The most common solution is to limit the degree-of-freedom in some way. One way is to keep the user stuck to the ground and allow him to move as if he was walking. Another is to predefine a path that the user travels while looking around.

The third approach opens some interesting possibilities. Imbert et al. (1999) propose to

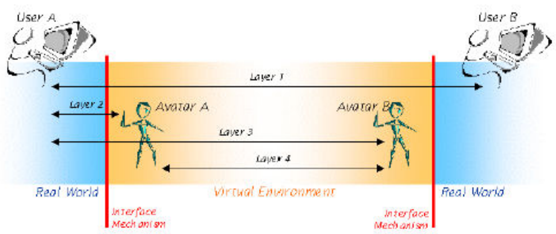

figure 2.3 User and avatar communication in a virtual environment (Imbert et al., 1999)

use the avatar as an autonomous agent to gather information for the user, but also to make contact with other users, by means of their avatars (figure 2.3). Nakanishi (2004) suggest that computer controlled agents can aid in discussions. He created a virtual meeting environment where people could walk around and their avatars were "TV-like" showing video and audio output of a webcam and microphone setting. (figure 2.4) A computer-controlled agent monitored discussions and when a discussion fell silent it would try to help to start the discussion again.

figure 2.4 Freewalk: three dimensional virtual meeting-space (Nakanishi 2004)

2.5 Conclusion

One has to choose both a 3D data model and a 3D visualization model. In both cases there is not yet one ultimate model that can be applied in every situation. In the next chapters I will elaborate on the choices I made during the design of the application. For now it is sufficient to say that I will focus on speed and not on 3D topology, the approach of Lovett et al. is probably a suiting one.

The user visualization will depend on the amount and type of interaction the users will have with each other. In the next chapter I will discuss different aspects of group interaction in collaborative work and participative planning.

3 Participation and communication

3.1 Introduction

My application is aimed to aid the public participation process in spatial planning. In most planning projects local citizens, societal organizations and pressure groups are involved together with one or more governing bodies. (Lammeren, Van et al., 2003)

These different groups will need to work together and communicate with each other. A lot of research has been done on collaborative work and group communication. In this chapter I will discuss some aspects of collaborative work and group communication, but first I will explain what public participation is and at what level of participation my application is aimed.

3.2 Participative and interactive planning

Spatial planning processes are becoming increasingly more complex. Stakeholders are becoming more interested in getting involved into the planning of the environment they live in. (Vullings et al. 2004) Involving these stakeholders requires participative and interactive planning methods. Kluskens (2000) defines participative and interactive planning as follows:

> *'1. the 'participatory' part I define as the process through which the government develops (new) spatial plans in co-operation with the citizens who are concerned, or associated, with the impact of the spatial plan. Participatory expresses the involvement of both the government and the citizen.*
> *2. the 'interactive' part of the new trend I define as the close and continuous mutual co-operation in which knowledge and information is exchanged between the participating individuals (actors). Interactive expresses the relationships between government and citizen.'*

(p22, Kluskens, 2000)

Van Lammeren and colleagues (2003) have compared several levels of public participation found in literature. There are similarities and differences between the different typologies of public participation in the planning process. But they found that all the levels defined by the NRLO/Edelenbos & Monnikhof correspond with a number of levels defined by others. They chose to use these levels for their research. I will do the same since the same reasons apply for this research as did for their research, e.g. suitable for the Dutch situation, suitable for rural areas.

Kluskens (2000) gives a good overview of the 5 different levels of participation as defined by NRLO/Edelenbos & Monnikhof. These levels are: Inform, Consult, Advise, Co-Produce and Co-Decide.

Inform: Actors are informed of the plans by planning-organization. The communication is one-sided, the organization informs the actors, and most of the time it is mass-communication.

Consult: Actors are asked for their opinions by means of questionnaires and such like. The communication is more interactive.

Advice: Actors give their opinions during meetings and provide other actors with new information. The given advice can be used to adjust spatial plans.

Co-Produce: Actors participate in joint analysis, which lead to new plans. It works with small interdisciplinary groups.

Co-Decide: Actors participate in the decision process. This is the highest level of participation and the actors are co-responsible.

My application is aimed at the "advise" level of participation, although it might be useful for the "consult" level as well. This means that it is important for participants to be able to communicate with each other. Since this involves typically more than two persons it is good to have some understanding how group communication and group processes work.

3.3 Group communication

Preece et al. (1994) make a distinction between communication involving two individuals and communication involving more than two individuals, group communication. They also make a distinction between mediated and non-mediated communication. They observe that the extent to which we can understand and communicate with each people varies considerably depending on the presence and type of media that is used. In non-mediated communication the control and sequencing of conversation is facilitated through the use of non-verbal communication. Mediated communication often lacks these clues. On the other hand, people who find it difficult to talk in face-to-face meetings can find a computer conferencing system less threatening.

MacEachren (2003) elaborates on the distinction of group communication. He also makes the distinction between non-mediated and mediated, calling it same place and different place communication. Although it is technically not the same distinction, they are comparable. In non-mediated communication the persons have to be in the same room and with same-place communication there can be communication without mediation by devices. The other distinction he makes is between same-time and different-time communication. (figure 3.1)The four possible spatial-temporal situations are: Same Place Same Time (SPST), Same Place Different Time (SPDT), Different Place Same Time (DPST) and Different Place Different Time (DPDT) communication.

According to MacEachren et al. (2004) interaction among participants within geocollaborative environments involves (at least) three interrelated factors. (figure 3.2)

First there is *group-size and aggregation*; how many participants are collaborating and in what, if any, subgroups are they organized into? Preece et al. (1994) also notice that group size matters. They observe that the efficiency of communication decreases with

	Same Time	Different Time
Same Place	emergency response coordination	air traffic flow control center
Different Place	multi-university team data exploration	threaded asynchronous discussion

figure 3.1 Spatial-temporal situations for group work (MacEachren, 2003)

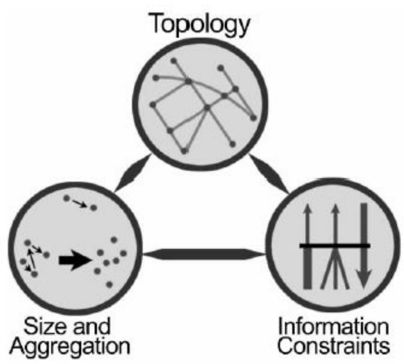

figure 3.2 Three key factors in group interaction (MacEachren et al., 2004)

an increase of the number of participants. **Second** there is the *topology of connections* among group members or subgroups; who is connected to whom? Possible connection types include situations where everybody is connected to everybody, e.g. students using a multi-participant chat, hierarchical networks, e.g. military where communication between units goes through the unit leader and many others.

Third there are *constraints on form and flow of information* among participants, what promotes or impedes information dissemination crucial to collaboration? While partly a technological issue, these constraints are often the result of social structures. For example, communication from a crisis management team will include both information and directives, while the communication to the crisis team will only contain information. According to Novick and Walpole (1990, in Preece et al. 1994) these constrains can improve the efficiency of multi-party communication. Participants find it difficult to manage the increased amount of coordination that is required when multiple participants are involved. Social protocols, constrains on form and flow, enables the participants to cope better.

The efficiency can also be improved depending on the type of communication network established in the group. Leavitt (1951) found that a 'wheel' arrangement (figure 3.3), whereby the communication was channeled through a central person, was

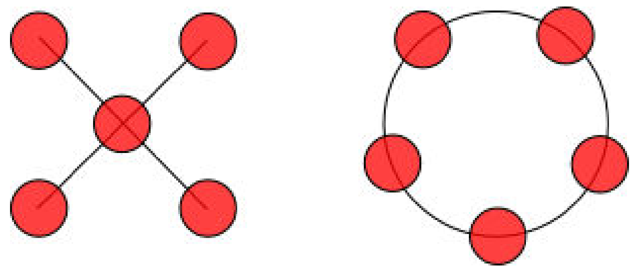

figure 3.3 wheel and circle communication networks (Preece etal., 1994)

3.4 Digital social interaction

Working in groups is not a trivial task; communication is getting more complex when more people are involved. Using mediated communication makes that process even more complex. In the field of collaborative learning several people have done research on social interaction within collaborative computer environments. An important topic in these researches is the effectiveness of collaborative learning. Kreijns et al. (2003) identify one key element: social interaction. If there is collaboration then social interaction can be found in it, and vice versa, if there is no social interaction then there is also no real collaboration. Stein et al. (2003) link interaction with social presence.

"*Social presence involves the ability of people to be perceived as real, three-dimensional beings despite not communicating face-to-face.*"
(p195, Stein et al., 2003)

The greater the perceived social presence the higher the interaction will be.

For designers of collaborative environments, Kreijns et al. (2003) identify two pitfalls. The first is that social interaction is taken for granted. The majority of educators think that because in face-to-face learning groups social interaction is 'easy' to achieve the same applies for distributed learning groups. But social interaction can no more be taken for granted in computer settings than it can be in face-to-face settings such as lecture halls. The expectations on social interaction in a computer setting are already unrealistically high and the computer introduces new barriers by limiting the number of cues and senses that can be involved.

The second is restricting social interaction to cognitive processes. This might not be enough, Wegerif (cited in Kreijns et al., 2003) noted that "*forming a sense of community, where people feel they will be treated sympathetically by their fellows, seems to be a necessary first step for collaborative learning. Without a feeling of community people are on their own, likely to be anxious, defensive and unwilling to take the risks involved in learning.*" (p341) This suggests a social dimension to social interaction that relates to the socio-emotional aspects of group forming and group dynamics. (figure 3.4) In other words, it relates to the processes related to getting to know each other. And Computer-Supported Collaborative Learning (CSCL) environments may not provide adequate opportunities for social interaction and the development of friendship.

Veldhuis-Diermanse (2002) has researched the use of CSCL in education. She focussed on asynchronous systems, where the participants react upon each other on different moments, DPDT communication. She discovered that the use of a CSCL increases the knowledge of the ideas of other participants. Furthermore the use of moderation helped to focus the attention of the participants on the content of the task. The moderation strategies were divided into social and critical moderation. Social moderating is directed at keeping the discussion alive and enhancing outcomes or products of the communal effort. Critical moderation is directed at deepening ideas; students are triggered to think critically and to clarify their concepts. She argues that moderation is important for computer-aided discussion. Although social moderation sorts no significant effect, critical moderation does increase the productivity. CSCL systems often come in the form of a threaded discussion platform. A threaded discussion refers to an asynchronous method of communicating in which comments on the original post are listed below and indented under the original post. Although it is frequently used some problem can be noticed.

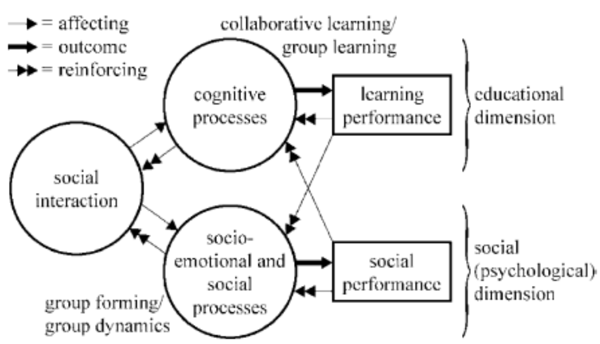

figure 3.4 The two functions of social interaction (Kreijns et al., 2003)

First, threaded discourse discourages convergent discourse operations. Before posting a message into a thread, the user has to identify the note to which his note is referring. This reduces the change that the user will consider reacting to several notes simultaneously. A related is problem is the so called 'tunnel vision effect' and refers to situations where the focus of the user is narrowed to the extent that earlier conversation is neglected.

Secondly, threaded discussions become gradually more diffuse. Inherent to the organisation is that each note refers to at most one earlier note. Threads become very long and as a result the discussion can become disordered. Another problem is that it is easier in a thread to refer to one post instead of multiple posts. This reduces the change of connecting multiple ideas.

Possible solutions suggested by Hewitt (1998, as in Veldhuis-Diermanse, 2002) are: Avoid sustained growth and introduce new topics when the old ones become to long or disordered. An additional solution could be to label the contributions to quickly identify the type of comment.
Create an option to organise notes not only on threads but also on date or author, to create an awareness of what other members are working on.
Appoint a moderator and organise face-to-face meetings to counteract the focus and tunnel vision problems.

3.5 Conclusion

My application is aimed at the "advice" level of participation, although it might be useful for the "consult" level as well. This means that it is important for participants to be able to read each other's comments and respond to those. In a consult setting the application should contain the questions the government wants to ask to the citizens, the citizens can only respond to those questions, and do not know how other people respond.

At the advice level multiple participants discuss together from different places and possibly at different times.

It is important that the application is embedded in a setting that provides social moderation or community building. This setting could very well be provided by a website and should be initiated by the government, who can provide a moderator as well. Both Preece et al. and Veldhuis-Diermanse state that the use of a mediator or moderator has a positive effect on group-discussion.

The three factors of MacEachren et al. (2004) should be taken into account by the central organisation. They are mainly social factors, which have little to do with the technical design of the application as such. Veldhuis-Diermanse does give a remark on the technical design, which influences social processes. She argues that threaded discussion platforms have some flaws, which might result in disordered discussions and tunnel vision.

4 Collaborative GIS

4.1 Introduction

In the previous chapters I have discussed the concepts of 3D geodata visualization and computer aided collaborative work. In this chapter I will describe some examples of geocollaboration as found in literature.

The group of MacEachren at Penn State University has done a lot of research on geocollaboration (MacEachren, 2003, et al., 2004, Fuhrman et al., 2003) MacEachren (2003) distinguishes three primary functions for visual representation to support group work. **First**, the visual representation can act as the object of collaboration; it can be discussed, created or manipulated. **Second**, visualization can support dialogues about information, plans, methods, strategies or decisions. **Third**, visual representation can support coordinated activities by compiling information, carrying out plans or executing decisions.

4.2 Visualization of the object of collaboration

The most obvious role for visualization is to represent the object of collaboration - a place, pattern, geographic scale process, etc. Most of the research thus far has been done on same-time collaboration to facilitate group understanding of the information. Problems discussed in research include:

a. The fundamental computing and IT challenges of making multi-user single displays work.
b. Computing, IT and social challenges of supporting teleimmersion and distributed geoprocessing
c. The HCI challenges of presenting information to groups and to facilitate (rather than impede) group work

a.
To be able to work with multiple users on one display, Ishii et al. (1997) introduce the concept of tangible user interfaces (TUIs). TUIs use physical objects to control virtual ones. (figure 4.1) These objects can be manipulated and the computer interprets these changes into actions. TUIs are very well suited for multi-user interaction on one computer. Because there is no central generic pointing device, many users can interact with the system in parallel. (Brave et al., 1998)

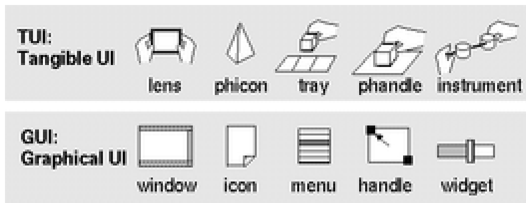

figure 4.1 Components of a TUI compared with those of a GUI. (Ishii et al., 1997)

An example of such multi-user single display application is HI-SPACE. (figure 4.2) "*HI-SPACE is a large-screen, rear projection, table display environment that supports hands-free, multi-user, untethered interaction with an electronic information space. Two unique aspects of HI-SPACE are its support for multiple, simultaneous cursors and its ability to support*

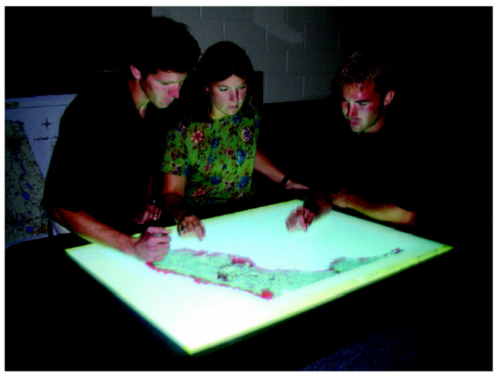

figure 4.2 Vision of HI-SPACE group interaction environment.(MacEachren et al., 2004)

integration of physical objects, known as phicons, as part of the rendered scene."
(p5, MacEachren et al., 2004)

Extending from same-place to different-place collaborative environments introduces additional challenges. A core issue is the underlying reference model for generating the visualization, with single shared, single replicated or multiple linked applications as options. A fourth option can be considered to be a single multipoint application. This is an application that runs on one computer with data and video links to other computers. All the users can participate in the audio/video discussion but only the one person behind the computer with the software in focus has control over the software and the data.

b.
Teleimmersion, as defined by Sawant et al., (2000) is the integration of audio and video conferencing, via image based modeling, with collaborative virtual reality (CVR) Sawant and colleagues implemented a teleimmersion application that tackles the problem of group work with distributed datasets using client-server architecture that supports multiple independent applications. Each client has its own local subset of data that it can interact with independent of the others. The strength and weakness of this approach is the flexibility - users can do private work before a discussion but coordinate work becomes more difficult because each user has its own view on the data and might even be working with a different subset.

c.
Ma (1999) addresses the challenges on HCI issues for different-time collaboration. He discusses a non-spatial example for different-time collaboration; image graphs. Image graphs are scene graphs (that define the sequence of transformations in moving from data to display) in which the nodes consist of images and the corresponding visualization parameters used to produce it. (figure 4.3) Ma discuss ways in which these image graphs can be shared to facilitate asynchronous discussions in exploration of datasets.

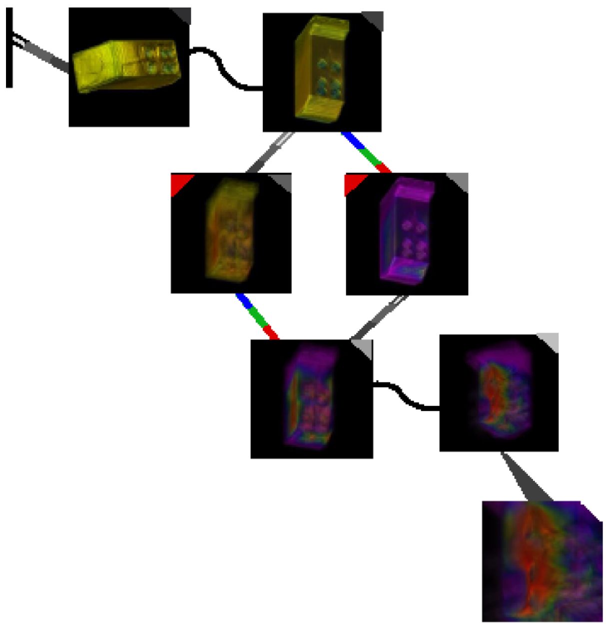

figure 4.3 An imagegraph of some images of a dataset. The image in the top left corner is the initial image, and the bottom most image shows the result of applying rotation, different color and opacity maps, rotation, and zooming. (Ma, 1999)

4.3 Visualization to support dialogue

Graphics are routinely used in discussions. However most research is focused on geovisualization as representation of information rather than the complementary role in enabling productive dialogue. Four possible roles for visualization in support of dialogue are:

1. To depict arguments (e.g. maps, image or diagrams that provide evidence, a point of view or logical proof)
2. As an organizing framework for arguments (e.g. maps or images that set the context and/or diagrams that explicate the sequences of points in an argument)
3. As vehicles to mediate between different semantic frameworks (e.g. diagrams to show how concepts or ontologies are similar or different)
4. As representation of participant actions and interactions (e.g. diagrams that signify who the collaborators are and their level of activity)

An interesting research carried out in this field is for instance the one carried out by Rinner (1999). He introduces argumentation maps. These maps provide an explicit linkage between online maps and arguments. They are designed for DTDP discussions. Participants of spatial planning processes can link an argument supporting, for instance, a new industrial zone directly to the location of that zone on the map. Users can query the application on ongoing discussions, for instance they can get all arguments involving the industrial zone.

Manoharan et al. (2002) have developed Collaborative Urban Planner (CUP); an application to support city planners in their planning. It is a combination of a collaborative visualization system and a direct manipulation interface. The system integrates much of the information planners need. Users can add their own models and proposed plans to the system. All the important information and changes are stored in a central database, making it available for the users who need it. The user can view the different proposed plans, change view settings like light and discuss with other participants using text and voice chat.

Erikcson & Kellogg (as in MacEachren, 2003) state that a collaborative application should be socially translucent.

"*Socially translucent systems make participants in group activities, and their behaviors, visible to one another.*" (p10, MacEachren, 2003) They suggest the use of a social proxy graph (figure 4.4). Each user is depicted as a circle and those involved in a conversation are within the large circle. The level of recent activity is indicated by the distance from the center.

Nakanishi (2004) describes a social interaction platform that is socially translucent. The participants can look around in the virtual space and see if people are grouped together or standing alone (see also figure 2.4). Nakanishi describes that in the second version of the platform an agent

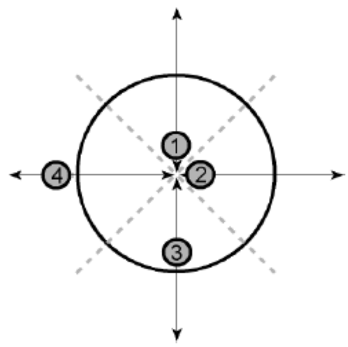

figure 4.4 Social proxy graph (MacEachren, 2003)

was introduced that would look for stalled conversations and try to restart a conversation. It looked for people who were engaged with each other, but where there was silence. It would move towards these people, but would stop if these people moved away from each other or would start talking again.

4.4 Visualization to support coordinated activity

Particularly for remote collaborations, visualization has considerable potential as a mechanism for supporting coordinated activity (activities in which participants have different roles and tasks to carry out). A prototypical example is provided by the context of emergency response, where one individual (or group) is working in a command center using visual display to obtain a comprehensive overview of a crisis situation and multiple individuals are in the field communicating remotely with the command center, using visualization tools to guide navigation, field data input and situation assessment. The goal of visualization in this context is to help participants understand the geographic context within which they will be working, assess the current situation for the place(s) their work is being carried out, determine what to do when, monitor their own progress toward key tasks and coordinate their individual parts of the joint project.

An example of such a system is DAVE_G (figure 4.5) (Fuhrman et al., 2003). This is a multi-modal system, it uses both voice and gesture control, with a single large display. This system can be located in a command centre and provide rapid access to spatial information. It also provides an interface that can be used by multiple persons at the same time.

figure 4.5 DAVE_G being used to discuss an approaching tornado (Fuhrman et al., 2003)

4.5 Conclusion

The most obvious role for visualization is to represent the object of collaboration. A lot of research is been done in that field, especially in inventing new ways to visualize and access the data. Some of those ways involve special hardware and are not interesting for this application, but might be useful for later versions.
The image graphs of Ma are particularly interesting because they provide a way to share the exploration of a dataset. And as such allow for different time discussions.

But this research is not just about how you can visualize data but also how you can use it in discussions. The argumaps of Rinner are a good example of a way to use geodata in discussions. My application could be a 3D version of the argumaps.
Also in this chapter is, just like in the previous chapter, the importance of being able to see other participants and their behaviour stressed. Being able to see each other might strengthen the 'social presence' of participants.

5 Conceptual model

5.1 Introduction

In the previous chapters I have discussed the developments in geovisualization and geocollaboration, the problems with spatial planning and group communication. In this chapter I will explain the concepts I used to design my application upon. This will result in a set of preconditions limiting the functional model, which I will describe in the next chapter.

As I have explained before, Muppet is aimed at aiding participative spatial planning in developed countries. This means that one can assume that people have access to modern computers, running at 1GHz or more and broadband Internet-connection. Also that they are used to work with computers, the Internet and maybe even 3D environments like games.

5.2 3D data model

Muppet is aimed at the consult and advice levels of participative spatial planning. In this setting the users of Muppet are stakeholders who discuss a plan with each other and the government, or any other organization proposing a plan. The organization proposing the plan will need to build a 3D version of their plan and present it in the application. The 3D presentation of the plan is supposed to be a more realistic representation of the plan than a 2D map and a more flexible one than scale models. Hence the representation has to be as realistic looking as possible, it should provide a virtual environment where the users can walk around. In it the users are not supposed to alter the plan itself but only to discuss it. Hence the focus of the application is on visualization and not on manipulation of the data.

This visualization is done on the computers of the stakeholders and they access the application over the Internet. This has four important implications on the 3D environment used. Firstly it means that the 3D environment has to support fast and realistic rendering. Secondly that the 3D environment can be installed easily and preferably without additional costs on the computers of stakeholders. Thirdly the 3D environment has to be able to access data online to support discussion between multiple stakeholders. And finally the 3D data model can be kept simple, since is "read-only" but it should provide a simple way for the planning organization to change it.

Taking these four conditions into account any freely installable 3D visualization model that supports networks or has multiplayer capabilities can be considered. Since to focus is on visualization one can also look to modern day 3D game engines. Following that thought I have chosen for Virtools. Virtools is a 3D game-development platform with a free browser plug-in and multi-player support. Being not merely a 3D game engine but a game-development platform it is easy to write programs within it, using so called "building blocks" and scripts. It can import 3D objects from common 3D modeling applications like 3DS MAX, providing an easy way for organizations to change their 3D models. It does not however have any support for geo-referencing or any other typical GIS functions. It does have its own 3D coordinate system, but it is limited to 6 digits per coordinate and lacks a 'global' coordinate system. Hence worlds are often located around the zero-point and manually geo-referenced.

5.3 3D data visualization

The application is designed to show the stakeholders how the proposed spatial plan will look like once realized. Hence it is important that the users can get a good impression of the proposed situation. The common way people perceive a landscape is on eyelevel, so it should be possible to walk around in the environment to have a look at it. This directly solves one of the bigger problems with virtual 3D environments: 3D navigation. 3D navigation is quite tricky; many people are not used to freely move in three dimensions.

They get easily disoriented and might get stuck floating upside down in midair. Advanced 3D devices like 3D mice, virtual reality gloves and VR-goggles are not an option here since they are not commonly available on standard PCs.

Walking around is a good way to explore a small area but it is too slow for large areas. High speed 'walking' has the disadvantage that it is difficult to see where you are going. Tan et al. (2001) came up with a solution for this. It is called 'speed coupled flying' and has to navigation modes. The first is a low speed walking mode where the user is on eye level moving around with a low speed. The second is a flying mode where the viewpoint is moved upwards in a birdseye view, where the user can see an avatar representing his position on the ground and can move around at a high speed.

To visualize the plan in 3D I will use a similar technique as Lovet et al. (2002) They use a orthophoto draped over a DEM to provide the underground and enhance it with 3D objects and models. Using a DEM and orthophoto provide a mean of geo-referencing the virtual world. The orthophoto and DEM could be replaced by datasets representing the future situation if necessary.

5.4 Collaborative aspects

The application should support discussion and multi-user access but does not need to support multi-user editing. This way the dataset of the spatial plan can be send to individual computers and they can work with a local copy of the dataset. This reduces the network traffic and simplifies the data model. The data model does not require the capability to synchronize spatial data; to check if changes in the data have occurred and incorporate those changes. The main thing the data model should do on top of the 3D data model is to store the comments of the users and provide them to others. To be able to have discussions, people should be able to respond to comments made by others.

Thus the multi-user aspect of the data model consists of tracking users and storing their comments. To handle multiple users Virtools provides the multi-user extension pack, this should make it possible to keep all users posted of the location of others. The discussions are supposed to be about the spatial plans and the users should be able to post a comment at the location of interest. Hence these comments have to be stored together with the location of posting, so that other users are able to see the specific area the discussion is about. For visualization purposes, the comments should be stored together with the posting time, the location and orientation of the user and, if it is a reaction on another comment, a reference to that comment. The discussion, together with all the metadata, can best be stored in an external database. This way people can join a discussion, without the need of downloading all the 3D data every time a new message is posted.

5.5 User visualization

There are two aspects of the user that need to be visualized, their whereabouts and their comments. It is important to know where other users are, but not necessarily where users have been, although this could be interesting for certain behavioral analyses. The comments on the other hand have to be accessible even when the original poster is not logged in anymore.

To show the whereabouts of other users you could use a map showing where other people are. The users can also be represented by an avatar. An avatar is an object in the virtual environment showing the current location of the user it represents. These objects can be anything, but humanlike avatars are considered to be better for discussions. (Fabri et al., 2000 & Vertegaal et al., 2000) It is thought that it is easier to understand what others are talking about when you can see what direction they are looking at. They also argue that it is easier for people to see what direction a face is looking than for instance an arrow.

Rinner (1999) introduces the argumentation map as a tool for spatial discussions. This map shows what people think about certain aspects of the map by adding comments to those areas. This might be a good approach for this application, introduce virtual memos within the 3D world. People can leave a memo at a position and other can view that note. The visualization of a complete discussion requires quite some thought.

The memos have to appear in the virtual world, but that does only provide an overview of the location of the memos, but it does not provide an overview on the time of posting or the topics. A common way to have discussions on the Internet is with a threaded forum. Combining a threaded forum and the 3D environment provides an interface where you can easily see local memos and still get an overview of all messages, sorted by date or topic. Each memo in the virtual environment represents a message in the forum. When a user select a memo in the virtual environment it is shown in the forum and when he selects one in the forum he is also shown the location of it in the virtual environment.

5.6 Conclusion

The application will consist of two parts. The first part is a 3D environment that runs locally on the computer of the user. This 3D environment will be designed in Virtools. It will use a DEM as a base and additional objects can be added to enhance the realism of the 3D environment. The user will be able to move around in this environment as if they are walking. They will perceive the environment on eye level at a walking speed. They can use the mouse and keyboard to navigate.

The second part is the discussion environment. This has a central database where all the messages and metadata is stored. This database is accessed via the Internet and multiple users can log in on it and add new comments. Since the database is accessed via the Internet, the most logical interface is a webbrowser.

These two parts are not separate, the messages have to appear in the 3D environment and the position of a user in the 3D environment has to be broadcasted to other users participating in the discussion. Within the 3D environment only the position of messages have to be shown, with for instance floating memos, everything else is shown in the discussion environment. The position of users only has to be shown in the 3D environment not in the discussion environment. The users have to be represented in the 3D environment as human-like avatars.

These two parts have to be incorporated into one application since they are intertwined. The best way to do so is by embedding the 3D environment into the webpage, by means of the Virtools browser plug-in. This will result in a split interface where one part deals with the 3D environment and one part with the discussion.

6 Functional Model

6.1 Introduction

In the previous chapter I have discussed the conceptual choices I have made. In this chapter I will describe the functions that Muppet should incorporate. This functionality is supposed to be feasible but due to limitations of the specific software I used, not all the functions are implemented in the final version. The limitations and workarounds will be discussed in the next chapter.

The Muppet functions can be divided into two groups; discussion and navigation. Before discussing these two groups I will sketch the general outline of the application. And describe the main components of the application.

6.2 The application

In the previous chapter I argued that the application should use Virtools, a browser and an external database. Furthermore I proposed a dual interface that will consist of a 3D environment and a discussion environment. (figure 6.1) The 3D environment will be the Virtools player embedded in a webpage using the Virtools plug-in. The discussion environment will be a threaded webforum where all the messages are stored in a database on a server. This database can be used for analysis of the comments made by users.

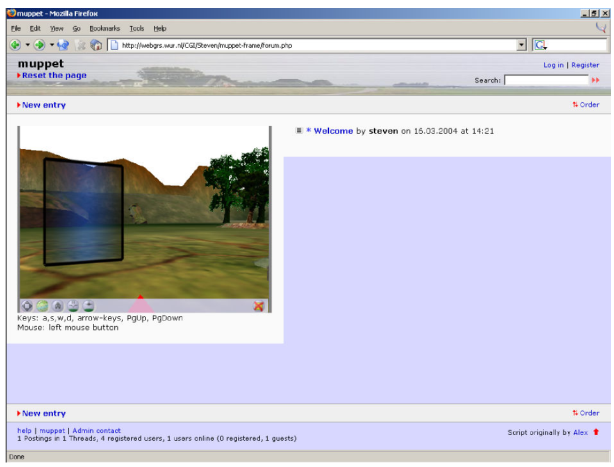

figure 6.1 Browser window showing the application.

The application will run in a **browser** (like Internet Explorer or Mozilla Firefox) with the Virtools **plug-in** installed. And will consist of a **forum** and a **player**. In the player there will be **memos**, they correspondent to the **messages** in the forum. The list of messages will be shown in the **thread**. (figure 6.2)

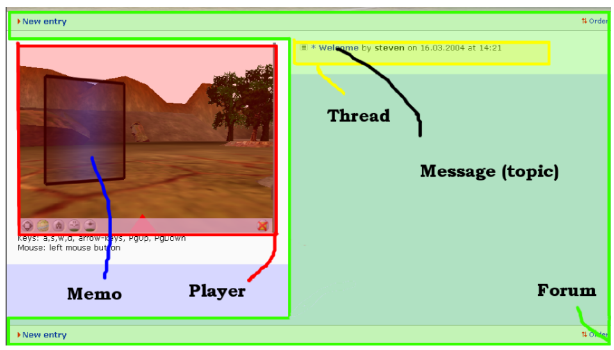

figure 6.2 The different parts of the application

Muppet will be a multi-user application. Within the forum multiple people can log in from different locations and read each other's messages. The forum will show how many people are using Muppet at a time. These people can meet each other in the Player. Human-like avatars inside the player will represent the users. A map will show the location of all the users within the player.

6 Functional Model

6.3 Discussion-functions

Muppet is being designed for discussion in a 3D environment; as such the discussion functions are the most important functions. As stated before I will use a threaded webforum to display the discussion. A threaded webforum displays the messages in a list where replies on messages are displayed by increased indent. (figure 6.3)

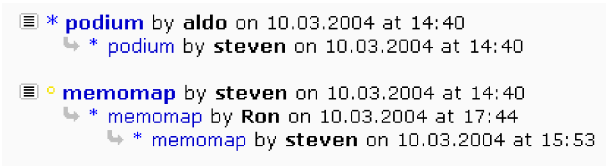

figure 6.3 A threaded discussion, showing two threads

There are different types of comments the user can make. They can be general comments or judgemental; positive, neutral or negative. The user will be able to choose what kind of message he is posting. The color of the memo and the message title will reflect the type of message. Blue for general, green for positive, yellow for neutral and red for negative. There are three actual discussion functions:

- View message
- New message
- Reply message

View message

With this function the user will be able to read a message. There will be two ways to view that message. The first will be by clicking on the entry in the thread. The second way will be by clicking on the memo in the player. In both cases the user will be transported to the location of posting in the player and the entire message will be displayed in the forum.

New message

This function will enable the user to add a new message to the discussion. This will be only available in the forum. The current location of the user in the player will be used as the geo-location and all the data of the message will be stored in the database on the server. A memo is loaded into the player to show the location of the message.

Reply message

With this function the user will be able to react on a message. It will be similar to the new message function but it will also store a reference to the original message. In the thread it will show up below the original message with a small indent. A memo is loaded into the player and put behind the memo of the original message.

6.4 Navigation-functions

Forum

Since the forum will be based on the existing concept of webforums, the navigation is already more or less predefined. There will be a list of messages where the user will be able to select one by clicking on it. The message will be displayed and if available an overview of the discussion-thread of the message will be shown. The user will be able to go back to the list, select a different message in the

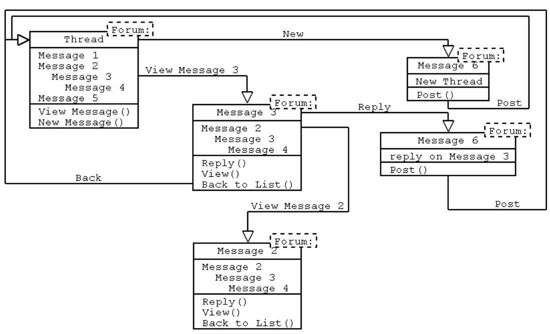

figure 6.4 Diagram of the navigation functions in the forum

thread or reply to the current message. An overview of the navigation functions of the forum is given in figure 6.4.

Player
Within the player the user will be able to move around using the mouse and/or the keyboard. The controls will be based on those found in 3D games like first person shooters. They often use a combination of mouse and keyboard to control the character. Within Muppet the user can use both the keyboard and the mouse to control the movement in the 3D environment (figure 6.5)

With the keyboard the user can turn and walk at a constant speed. He can move in all three dimensions and turn left/right and upwards/downwards.

With the mouse the user will be able to move forward/backward and turn left/right at the same time, by dragging the mouse. The speed of movement and turning will be dependent on the distance the mouse is dragged.

To aid the user in finding his way around in the 3D environment there will be a few extra functions. There will be a map to show the current position, the location of other users and the location of the memos, predefined viewpoints to hand the user some starting points and a special function called speed-coupled flying. This function will consist of two movement modes, a slow ground level mode to experience the environment as a human being and a high-speed overview mode to experience the environment as from a helicopter. (figure 6.6)

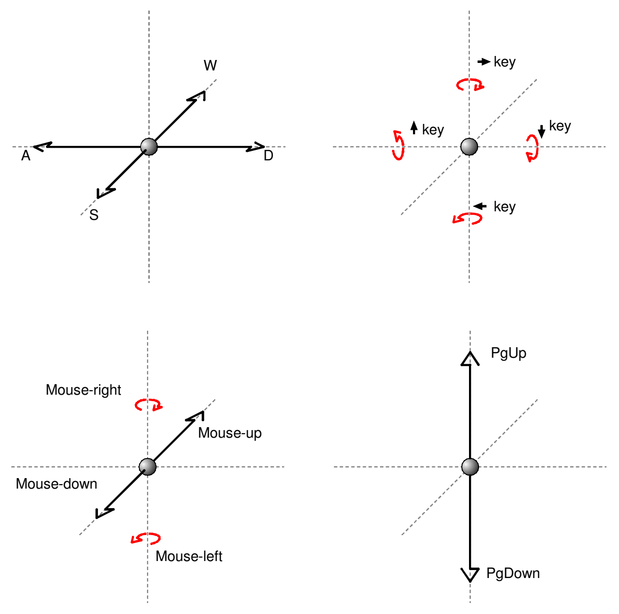

figure 6.5 Keyboard and mouse controls

figure 6.6 Left image; low speed mode, near to the ground, providing a eye-level view right image; high speed mode, at high altitude, providing a broader overview

7 Implementation

7.1 Introduction

In the previous chapter I have described all the functions this application should have. In this chapter I will describe the final application. I will describe how the main functions are implemented. There have been some problem while implementing the functions. These problems and the workarounds, if they exists, will be discussed at the end of this chapter

7.2 Software choices

In the previous chapter I divided the application into a discussion environment and a 3D environment. For the 3D environment I have chosen Virtools for reasons explained in chapter 4. In the previous chapter I already chose webforum as the discussion environment. I did not specify what software I will use for my webforum. I could either write my own forum or use an existing one. There are many webforums available on the Internet. They are written in a plethora of programming languages and use all kinds of databases. To pick one I made the following rules:

- PHP/MySQL based
- An Open Source license
- A simple featureset

PHP/MySQL because it is freely available, robust and runs on most, if not all, webservers. Also because I have prior knowledge in both installing and using PHP and MySQL.

Open source license because this means the source code is available and you are allowed to edit the sourcecode and redistribute it.

A simple featureset because the forum only has to have 3 functions. Furthermore since I have to hack the script to get it communicating with the player a simple featureset usually means that the sourcecode is less complex and easier to hack.

These three rules narrowed the choice quite a bit and after trying a few forums I decided to use 'my little forum'. It is a GPL'd webforum script written in PHP and it uses MySQL to store the messages. It supports threading and a few other messageboard specific features that I will not use. It comes with an install and a setup script where you can switch off features you do not need. The script looked well organized and hackable.

7.3 Requirements

Muppet is a client-server application, thus it needs a server and a client. On the server there has to be a http-server, like Apache or IIS with PHP > 4.1 installed and MySQL. The client has to be a modern computer, 1GHz or more and a 64MB or more 3D graphics card, running Windows. It needs a browser and the Virtools browser-plug-in.

The setup is shown in figure 7.1.

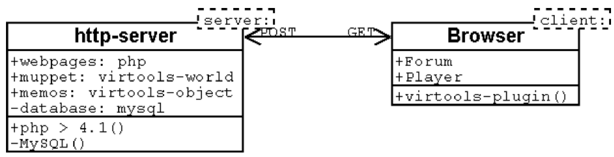

figure 7.1 Diagram of the client-server setup

7.4 The application

Like I said Muppet consists of a part that runs on a server and a part that runs in a browser as a website. The website has three areas; the thread area, the player area and the comms area. The last one is invisible for the user and manages communication between the server and the plug-in. The player area contains the Virtools-plug-in for the displaying the 3D world. The thread area contains the discussion,

The application can be divided into four separate programs that communicate with each other. These four programs are:

- plug-in (Virtools)
- browser (for windows)
- server (http with PHP module)
- database (MySQL)

The plug-in runs the Virtools world file (muppet.vmo) and can execute the Virtools scripts. The Virtools plug-in can also execute javascripts from the webpage where it is embedded. This is done with the BrowserScript buildingblock. (figure 7.2)

The browser can also execute javascripts. The javascripts executed by the browser are either for loading special parts of the website or for communication with the plug-in. (script 7.1) This communication is

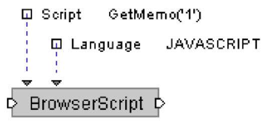

figure 7.2 BrowserScript - Virtools buildingblock to execute scripts in the browser, this will run the script 'GetMemo('1')'

```
Function Demo()
{
var load = "SendMessage" + " 'Target' " + "'msg' ";
document.Virtools.DoCommand(load);
}
```

script 7.1Javascript 'demo' - script to send a message from the browser to the 3D environment in the plug-in

limited to sending of messages and the managing of attributes within the 3D environment. The browser also communicates with the http server. It either sends a GET request to get a certain page or a sends a POST request to send data to the server.

The server manages the GET and POST requests. For a GET request, the server executes the PHP that belongs to the requested page and send the resulting page to the browser. For a POST request the server will use the attached data where needed while executing the PHP. If needed PHP will contact the MySQL database to retrieve or store data.

7.5 Starting Muppet

After everything is installed, both on the client and on the server, a session can be started. The user has to point his browser to the location of Muppet. Depending on the settings of Muppet, the user might need to log in first. When this is all done, the browser is redirected to load **forum.php**. This is actually a frameset with five different webpages. Three of those webpages belong to the **thread** part, one is the **player** and one is hidden is called **comms**. The first two parts are requested from the server, it will process the PHP scripts and request data from the database. The two parts are send to the browser and the browser will start the plug-in and load the 3D environment. When the plug-in has finished loading, it will request all the current memos in the database from the player. The player has the important information; locations, orientations, types and IDs already embedded in its webpage. It will use the comms part to load them one by one, this way the information of the different memos will not be mixed up by the plug-in. (figure 7.3)

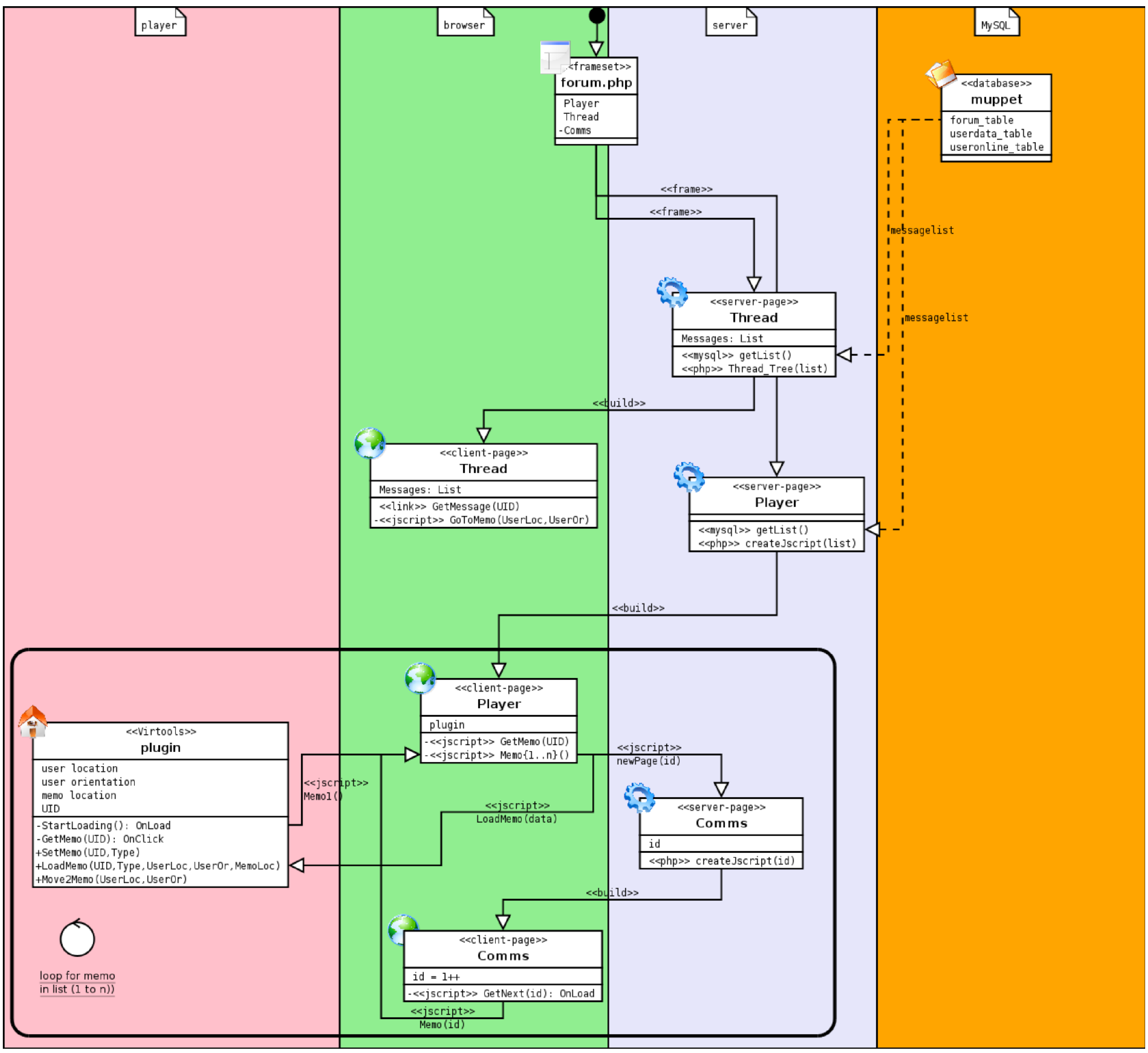

figure 7.3 Application diagram showing the starting of Muppet

7.6 Discussion-functions

The discussion functions described here are View entry (forum), View entry (player), New entry and Reply entry. For each of the functions I have made a diagram showing how the different parts of the application work together. There are no diagrams of the specific scripts within Virtools. It is best to view the application in Virtools Dev to see how they work exactly. The different Virtools scripts listed in the diagrams either move the avatar to the new position, or load one or more memos. The move-script is shown in figure 7.4; the position of the memo is given, then the direction is calculated and the avatar is turned into that direction, moved to the location of the memo and given the orientation of the memo.

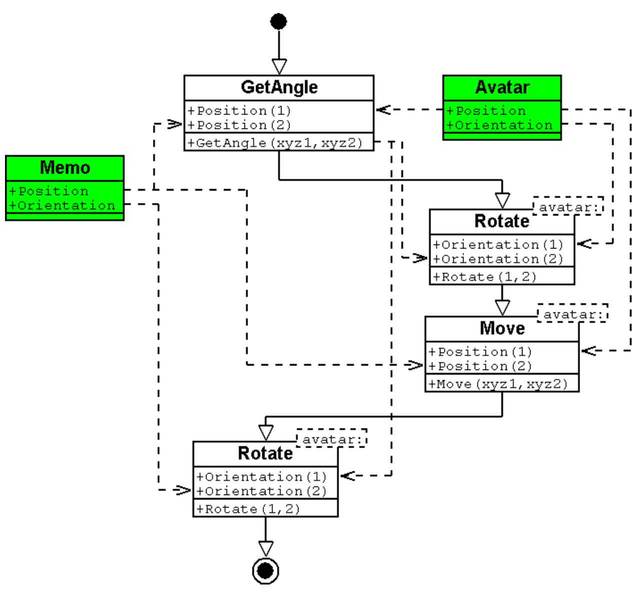

figure 7.4 Application diagram showing the process of moving the avatar to a memo.

7.6.1 View entry (forum)

To view a message from the forum the user can click on it. The browser will request the page from the server and run a javascript to request the plug-in to move towards to location of the accompanying memo. The server will process the request and get the data from the database. The data from the database will be used to generate the page with the message, this will be send to the browser, which will then display it. (figure 7.5)

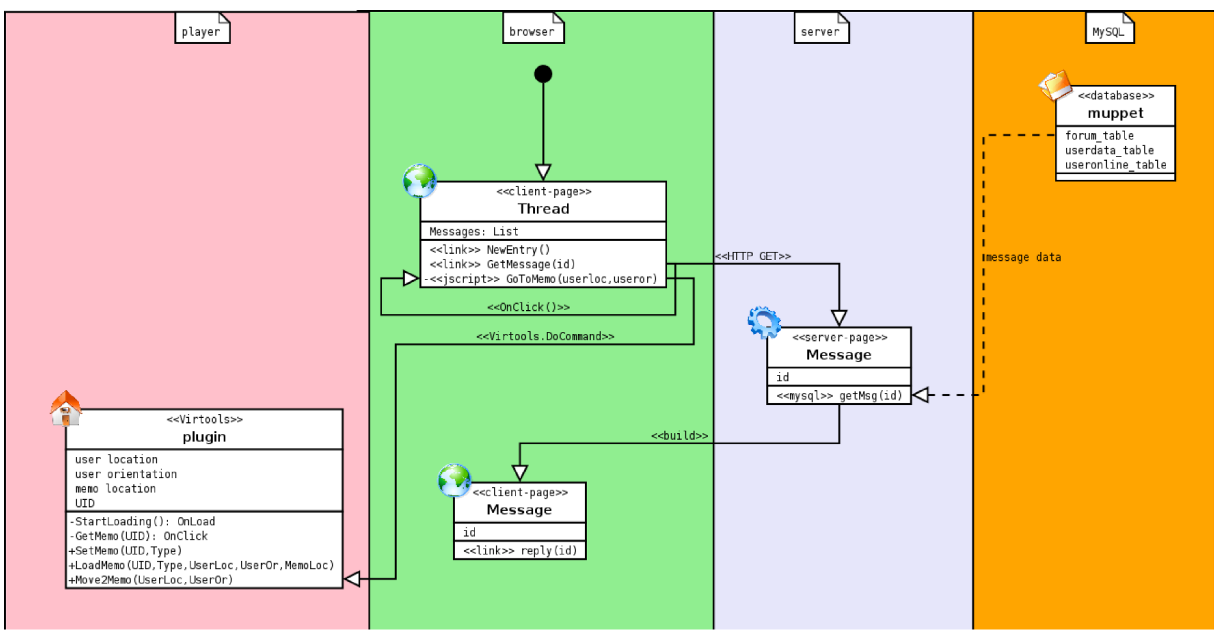

figure 7.5 Application diagram showing the process of viewing a message from the thread.

7.6.2 View entry (player)

To view a message that belongs to a memo in the player, the user clicks on that memo. The plug-in will move the user to that memo and execute a javascript in the player to get the message from the server. The server will process the request and get the data from the database. The data from the database will be used to generate the page with the message, this will be send to the browser, which will then display it. (figure 7.6)

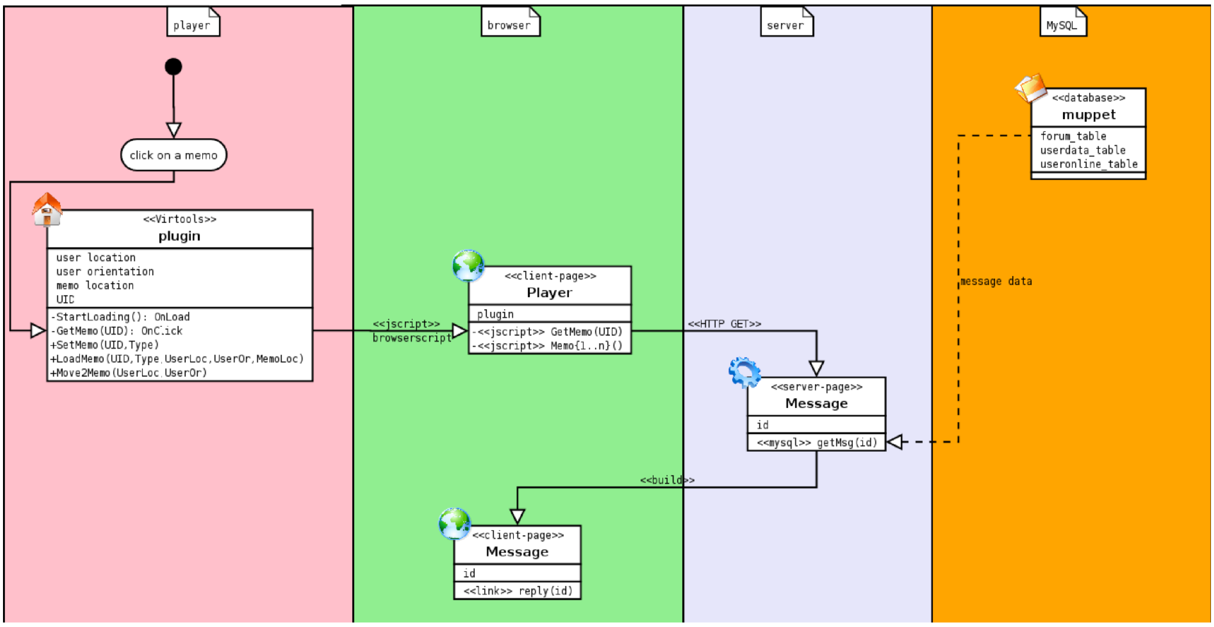

figure 7.6 Application diagram showing the process of viewing a message belonging to a memo.

7.6.3 New entry

Currently the new entry function is only available to users who are logged into Muppet. It is also possible to allow any user to post a message. In my diagram, I did not include the user handling, since it is a standard procedure and makes the diagram needlessly complex.
To create a new message the user clicks on NewEntry in the forum. The browser asks the server for the posting page. The server uses the user-name to retrieve the user-information from the database. The posting page is send to the browser. The user can type his/her comment and click on the submit button. When the submit button is clicked a javascript is started to retrieve the location-information from the plug-in. All this information is send to the server. The server creates a new message ID and stores the message data with that ID. It will generate a message page and send it to the browser. Upon loading that page a javascript is run to load a memo in the plug-in with that new id. (figure 7.7)

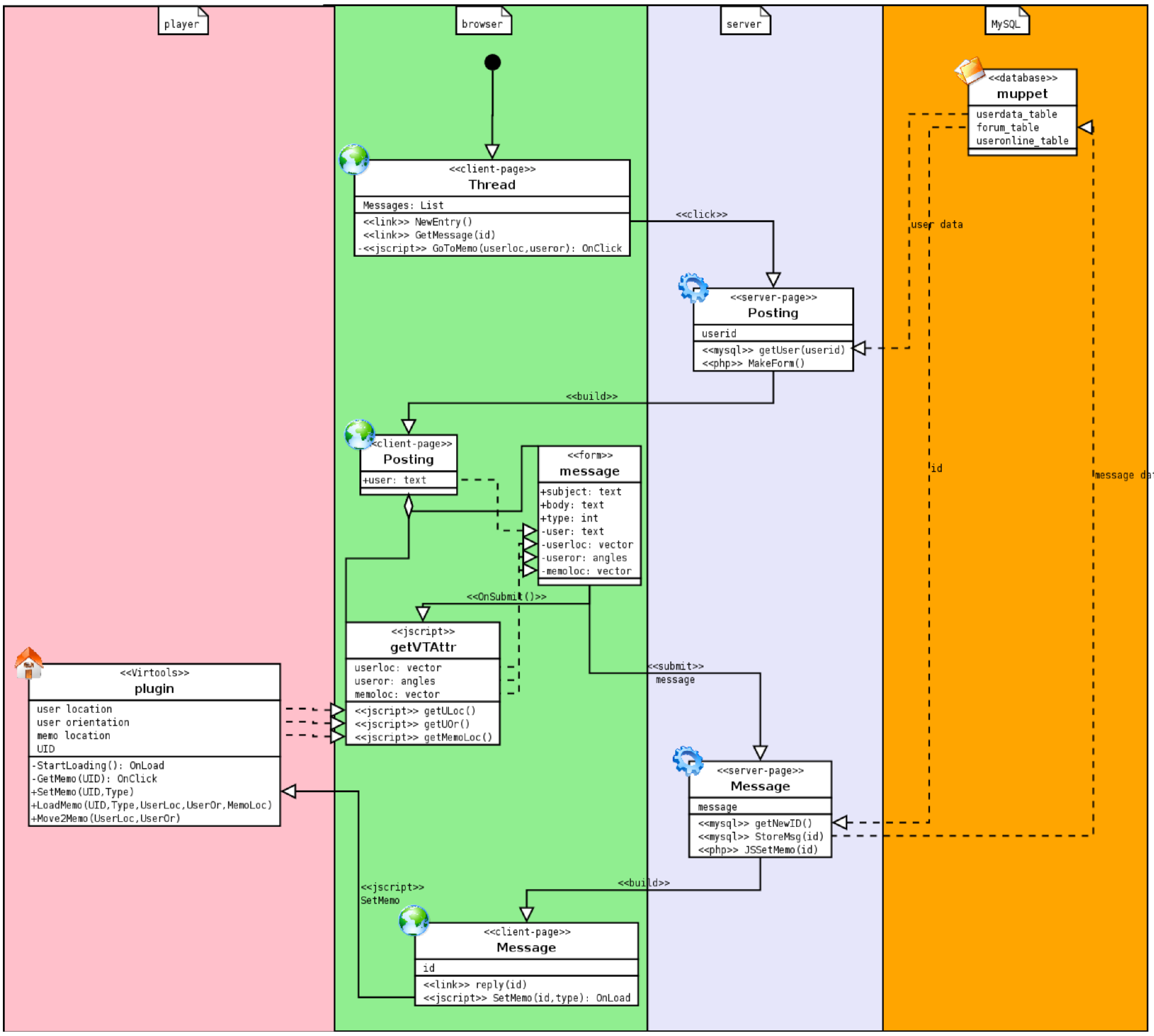

figure 7.7 Application diagram showing the process of posting a new message.

7.6.4 Reply entry

If a user is viewing a message he has the option to reply. The browser asks the server for the posting page and sends the ID of the current message. The server uses the user-name to retrieve the user-information from the database. The posting page is send to the browser. The user can type his/her comment and click on the submit button. When the submit button is clicked a javascript is started to retrieve the location-information from the plug-in. All this information is send to the server. The server creates a new message ID and stores the message data with that ID and the ID of the original message. It will generate a message page and send it to the browser. Upon loading that page a javascript is run to load a memo in the plug-in with that new ID. (figure 7.8)

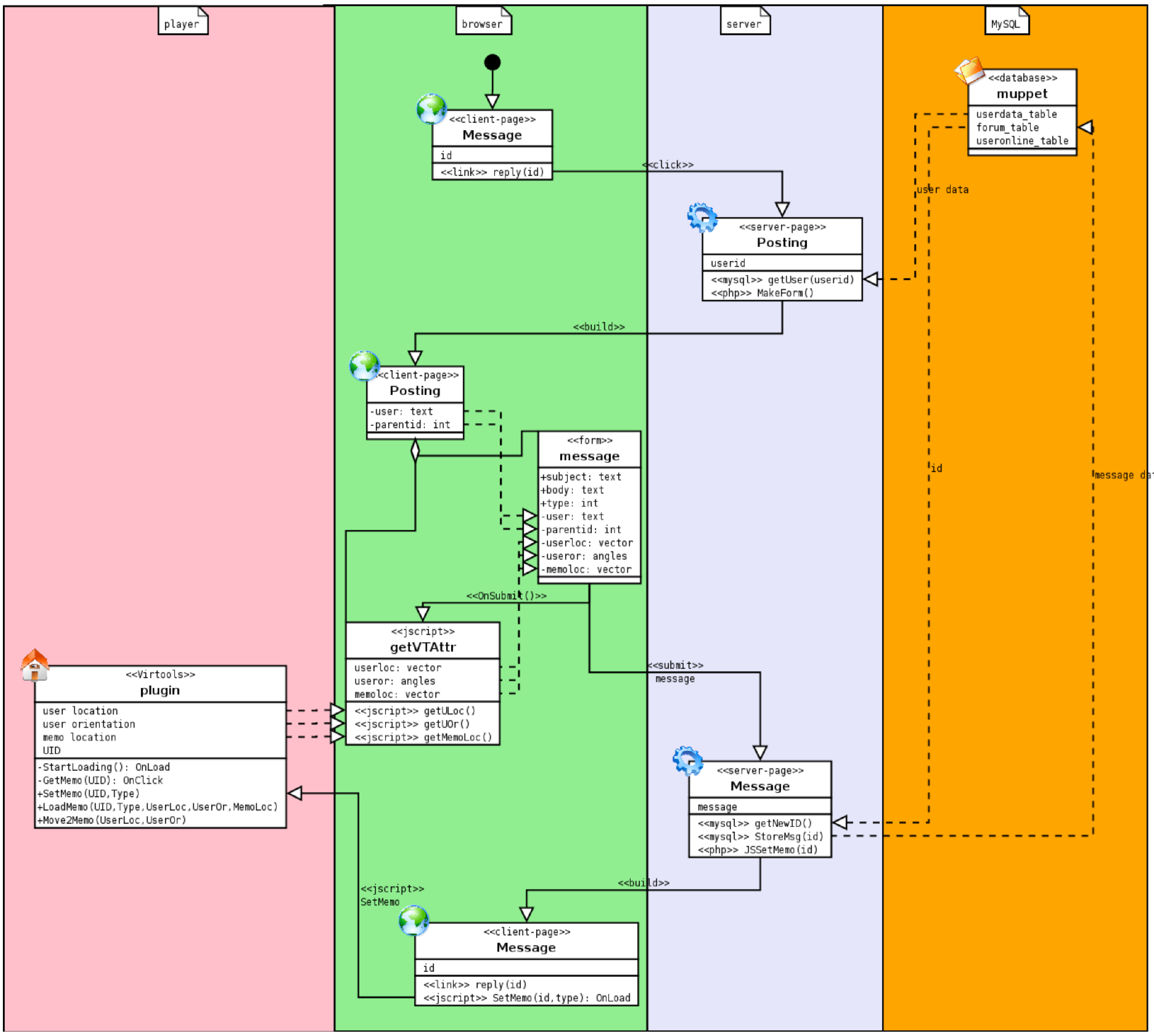

figure 7.8 Application diagram showing the process of replying to a message.

7 Implementation

7.7 Navigation-functions

There are two ways to control the navigation in the player, keyboard and mouse. The main difference between the two is that keyboard navigation uses fixed speeds and mouse navigation dynamic speed. I will describe the latter here. There are two ways to go through the environment, at high speed and at low speed. The transition technique between these two is speed coupled flying. Which I will describe as well.

7.7.1 Mouse navigation

Mouse navigation works by translating the movement of the mouse into translation and rotation in the player. It stores the location of the mouse pointer when the mouse button is pressed and calculates the difference with the current mousepointer position. The vertical mouse movement is used to calculate the forward/backward avatar movement. It takes into account the distance the mousepointer has from the starting point, it will increase speed at greater distances. The horizontal component is used to calculate the angle of rotation for the avatar.
The 'Binary Switch' building block is used to check if the mouse pointer is pressed over the player area. This is a simple way to prevent the avatar to respond to mouse movements outside the player area. (figure 7.9)

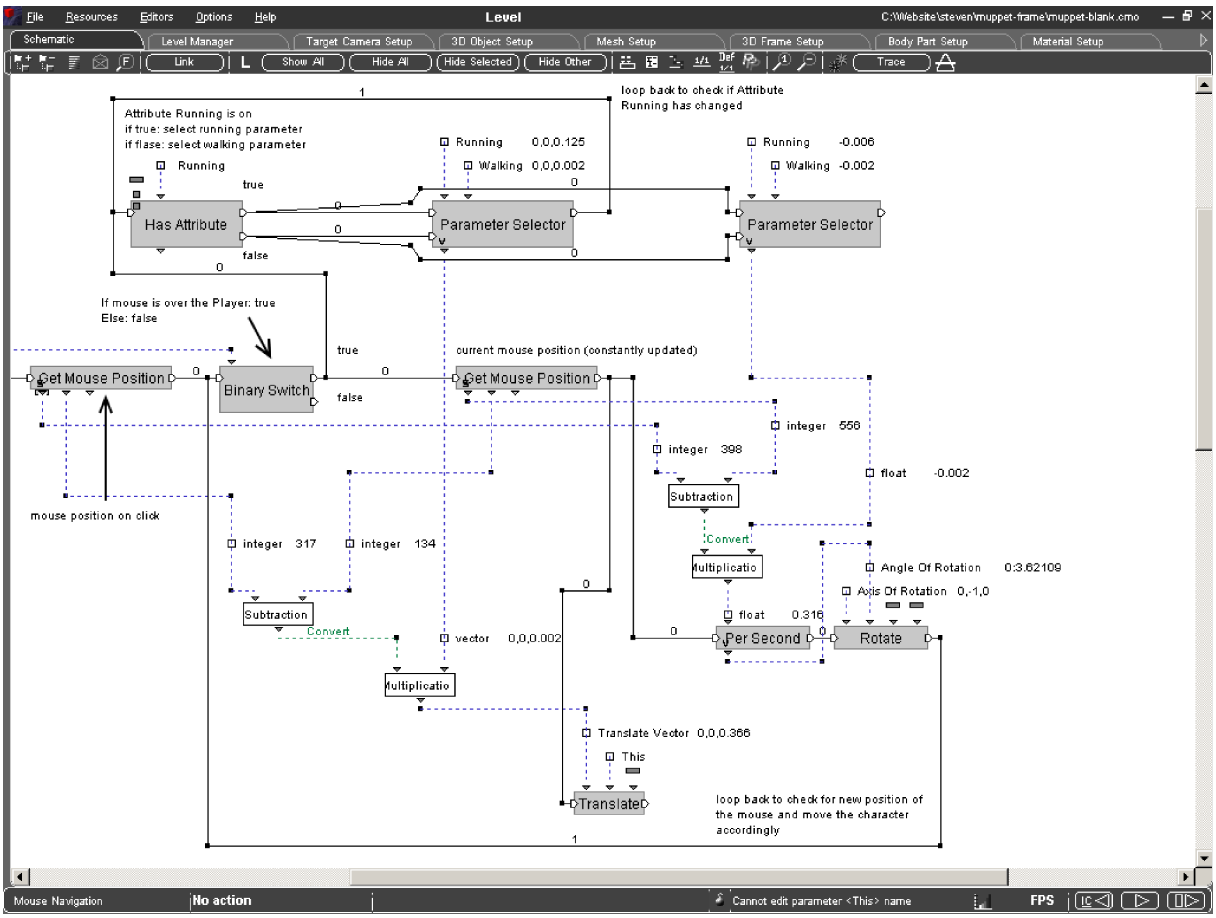

figure 7.9 Virtools script for mouse navigation with built in detection to prevent responding to the mouse when the mouse is not over the player.

7.7.2 Speed coupled flying

Speed coupled flying works with two speeds, a high speed and a low speed mode. The high speed mode is a high altitude view, much like flying, the low speed mode is a ground level view, much like walking. The transition between the two modes is smooth, the view position of the user is gradually moved, following a curve. The orientation of the user is slowly adapted towards the end orientation. (figure 7.10)

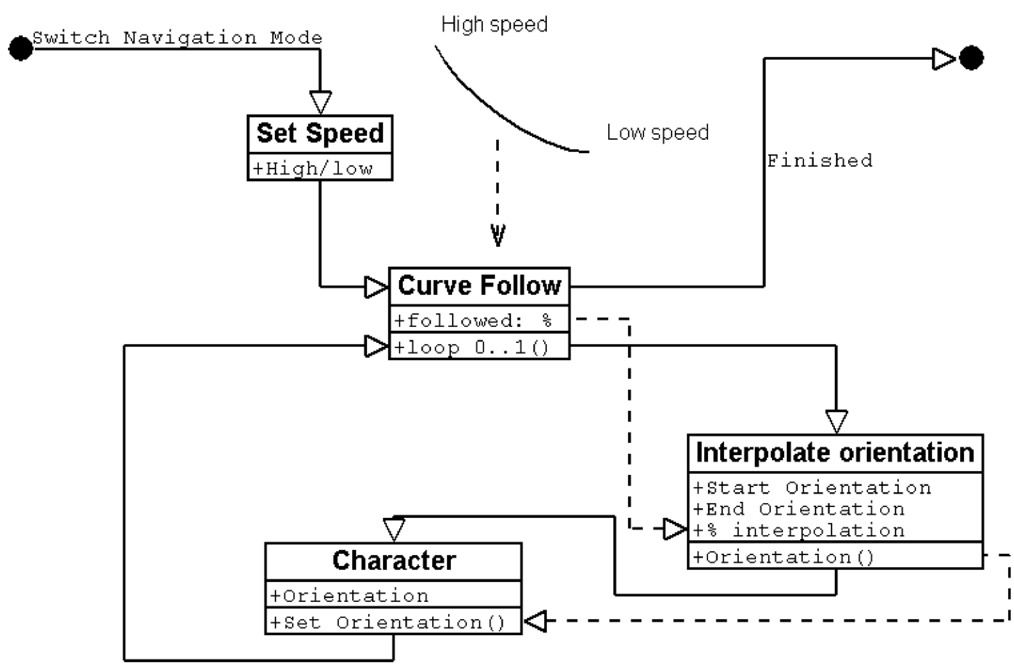

figure 7.10 Application diagram showing the transition between the two speed modes.

7.8 Discussion

There have been several problems in implementing the functional model.
The most important feature that is missing is the multi-user part in the player. Because of this the user cannot see other users, neither their avatar, nor their location in the map. Another problem is that it is impossible to load a Virtools object online. This way it was not possible to use separate Virtools objects for the different memo types. This was solved by using hidden memos in the Virtools world and to copy those when needed.

corrupt the data inside the player.

The only way to communicate between the plug-in and a webpage turned out to be javascript. The forum itself is build with PHP, they are two fundamental different languages. Javascript is entirely run in the browser and the server only can generate it but does not know how to handle it. PHP is generated and run on the server and the browser does not see anything of it. (see for comparison server-side and browser-side script 7.2)

PHP (server-side)

```
<p class="author"><?php echo $forum_author_marking;
if ($entrydata["edited"] > 0 && $entrydata["edited"] > ($entrydata["time"] + $edit_delay) &&
$show_if_edited == 1)
{ ?><br /><span class="xsmall"><?php echo $forum_edited_marking; ?></span><?php } ?>
at <a href="#" OnClick="GoToMemo('<?php echo wp($entrydata["userloc"]); ?>','<?php echo
wp($entrydata["userorient"]); ?>','<?php echo wp($entrydata["memoloc"]); ?>','<?php echo
wp($entrydata["id"]); ?>');"><?php echo wp($entrydata["userloc"]); ?></a><br>
```

HTML (browser-side)

```
<p class="author">written by <b><a href="user.php?id=1" title="Show user data of steven"
target="_top"><b>steven</b></a></b>, 25.03.2004, 13:56 at <a href="#"
OnClick="GoToMemo('7.85725,3.20232,23.5716','0:-150.411,0:-82.3176,0:-180','6.1053,2.96601,20
.6113','201');">7.85725,3.20232,23.5716</a><br>
```

script 7.2 PHP script to generate the header of a message showing the author, posting-time and memo-position and the corresponding part of the HTML source, including a javascript to go to the memo in the player.

The plug-in cannot access an (online) database either. This makes it much more difficult to keep the information inside the player and the forum synchronized. To complicate matters more the only way to load a batch of data at once is by loading a text file into a Virtools array. But the plug-in cannot access online text files for that purpose. Next I tried to send all the data in quick succession per memo. Virtools had problems in keeping up and mixed the data of the different memos. I ended up loading the data one by one in a slow way, but without any integrity check. Hence it might be possible that a combination of a slow computer and fast connection might

The only way javascript can access the data from the database is by being generated by PHP. This means that if there is new information in the database, some page has to be reloaded to generate a new javascript that can send that data to the player. But at the moment neither the forum nor the player remembers what memos are loaded into the Virtools world so there is no way to know which memos are missing in the player. To reload all memos every few minutes makes the application very slow and memos might disappear and reappear while the user is walking around. The solution I came up with is that the user can manually reload everything.

8 Case study

8.1 Introduction

The application as described in the previous chapters has been put to a small test. This test involved 7 members of the staff. They were asked to spend half an hour working with the application on their own computer. After that half an hour there was a general meeting where the application was discussed. In this chapter I will describe the case study, the results of it and the comments the participants had on the application.

8.2 Description

Since it is a multi-user application it was important to test the application in a multi-user setting. To do so I designed a small case study that was done with the participation of several members of the faculty staff. For the case study I used the 3D design of a small fictive valley with Easter Island like statues, some huts and trees. (figure 8.1)

figure 8.1 View of the casestudy area with in the middle the statues

The valley consisted of a small village, agricultural area, the statues and a patch of forest. A pass provided the only access to the valley. The road to this pass and the pass it self were in poor condition. The people in the village were mainly farmers and they used the forest for wood and other resources, without depleting it.
The valley was part of a larger island and the government had decided to promote tourism on the island and specifically to the statues in the valley. To do so they had to improve the accessibility of the valley. They came up with three scenarios:

- Improve the existing road over the pass
- Build a tunnel through the mountain
- Create a small airfield

For the case study three different parties were identified, the government, the locals and the environmentalists. Within the 3D environment memos showed the locations of the village, the forest, the pass and the statues. Also the proposed locations of the tunnel and the airfield were indicated. The messages belonging to the tunnel, the airfield and the pass had a short description of the plan, with pros and cons and the estimated costs. The messages belonging to the village, the forest and the statues give a short description of these items.

The participants were asked to join the discussion for half an hour and afterwards evaluate the application for another half hour. They were given a short description of the case study and were asked to imagine being one of the stakeholders and discuss the different scenarios as proposed by the government. They were all accessing Muppet from their own office at the same time. After the evaluation they were asked to fill in a short survey about the application.

8.3 Technical issues

The users did not report any problems starting the application. They were only given the URL of the application and were required to install the plug-in themselves if it was not yet installed.

One of the biggest concerns was the question if the database could keep up with a multitude of postings in a short time, a typical situation in same-time discussions. There were no problems reported in the message handling by the server, in both storing and retrieving them. The server did however have some problems in generating the footer page, this had no negative impact on the use of the application, since the header page provided most of the functionality of the footer as well. A simple reload always solved the problem, so it is probably a server-performance problem rather than a design problem. When posting a message a coordinate needed to be retrieved from the Virtools plug-in, no problems were reported there and I did not see any either.

However loading the message data in to the Virtools plug-in was very problematic. The plug-in started to mix data from different records, resulting in false combinations of IDs and locations. This was anticipated, but it was worse than expected. It sometimes put the wrong ID to a memo, so it was impossible to trace what the original message was. It was anticipated that the location could be wrong, but that the ID was correct. This however had little negative impact on the discussion, because most participants did not use the memos to go to a message.

8.4 User comments

In general people did not have any difficulties working with the application and liked it. They found that the case study was too complex for the short time the study lasted. There were too many discussion threads and it was difficult to keep up with all arguments. They recognized that this was a result of a combination of being new to the case study and the short time available for the test. They thought that the application was more suited to slower different-time discussions. It could also prove useful in a brainstorm session, where everybody can post his or her thoughts on a plan.

The unfamiliarity of the participants with the case study made it difficult to orientate themselves within the 3D environment. The map embedded inside the player had too little detail to help them to get to know the area. An external site providing a detailed map together with extra background information on the case study was considered useful. One participant said that the fly modus was discomforting, it follows the terrain and he preferred it to stay at one altitude. The small size of the player was also found as a barrier to get to know the area. The fullscreen-view option of the plug-in was considered to be a suitable solution.

A much requested feature was the ability to edit the environment. In the current setting the proposed plan was not drawn within the environment. The participants had to imagine the future situation instead of it being visualized for them. The participants wanted to have to ability to toggle between the current situation and the proposed plans. Also they liked to be able to draw objects within the player.

Other suggestions include the possibility to do a 3D tour with discussion topics, this was considered to be a good system for same-time discussions. The users are automatically transported from one point to another and at each point asked a question or confronted with a statement, upon which they can react. Also an online chat function was considered to be useful for same-time discussions. The current visualization of message types in the forum was not very obvious; a more visual representation of the message types in the forum was thought to be useful to quickly grasp the trend of a discussion. Also there were some remarks on the visualization of threads within the player. The memo should somehow visualize the thread; suggestions include relating the size of the memo with the amount of messages, putting messages in 3D tree structures and the use of color to show the trend of a discussion.

8.5 Questionnaire

After the general discussion the participants were asked to fill in a short questionnaire (see Appendices 1 and 2). The questions were focused on the combination of the forum and the player. It was a multiple-choice questionnaire where the answers ranked from 1 (bad) to 5 (good). After some general questions on the background of the participant questions on the use of the forum, use of the player and specific parts of the application, memos, map and flymode were asked.

Generally the users were more experienced with 3D environments than with online discussions. These 3D environments did not have special hardware to control it. They all started to explore the player but ended up spending most time in the forum.

This is reflected in the set of questions on the forum and the player. The forum was most used for reading messages (4.25) and responding to messages (4). They did use it less for posting new messages (3.25) and rereading messages (3.25). It was not used to link threads with each other. While this is technically possible, it was not implemented as an obvious feature and it was not expected that anybody would do so. The player was mainly used for exploring the area (4.25) and not so much for discussion-related tasks (1.6 average). Only one user used the refresh-player function to load new memos extensively (5), the others did not really use it (1.7).

The general feeling towards the application was that it was good (3.75). But it requires better orientation and navigation aids, especially the map needs more detail.

8.6 Discussion

On the software side, the server setup passed this test; the messages were posted with a frequency of about 1 message per minute, without problems. There were a few minor glitches in generating pages, but that is most likely a hardware problem. On the client side there were the anticipated problems with keeping the data in the player synchronized with the data in the database. This can most likely be solved with the new version of Virtools.

On the user side, there were no major problems reported. The most reported problem was that the map had not enough detail. This could be solved with an external site with more information on the project being discussed. The player had mainly a function as visualization tool to get to know the area and the discussion was almost entirely done in the forum.

There were many suggestions of features to implement in the application. Most of them were focused on the player and were mainly aimed to turn the player more into a discussion tool. Another requested feature was the ability to change the landscape, either by switching on and off layers with information, or by drawing or adding new items within the environment.

9 Discussion

This project has resulted in Muppet, a working prototype for SceneTalk. It is a 3D discussion environment to be used in advice and consult settings (see chapter 3.2) in participatory spatial planning processes. The application consists of a discussion forum with a central database on a server and a 3D environment running inside the user's browser. Within the 3D environment a 3D model of the proposed plan can be shown and the user can navigate through it. It can read and reply to messages left by other users or post a new message. The location and orientation of the user in the 3D environment is stored with the message in the database. This way it is possible for other users to reproduce the view the original poster had when posting his message. The messages are also visualized as memos in the 3D environment providing an alternative way to locate messages.

Currently it has one important bug. When there are many messages, the Virtools plug-in starts to mix data of different memos. The result is that a memo does not always link to the correct message or has the correct information on position and message type. However, during the case study the users did not report that as a problem. They were warned that it could happen and most of them did not use the memos to read messages

One of the functions of the functional model (see chapter 6) that is missing is the multi-user support of the 3D environment. This way it is not possible for the users to 'meet' each other in the 3D environment. They also cannot see each other location on the map. This is because the current version of the Virtools plug-in does not have multi-user support and we do not have the Virtools Server, which does provide that.

Using Virtools Server might also solve the bug described above. Since Virtools Server is running on the server and also provide ways to communicate with databases it should be easier to keep the data in the Virtools plug-in in sync with the data in the database. Alternatively the new version of the Virtools plug-in has better support for communication with servers, it provides for instance ways to download files from the server. You could use this to download a text file with all the necessary data of the memos.

During the evaluation of the case study (see chapter 8) several suggestions were made to enhance and expand the application. Many of these suggestions have been implemented in the Meerstad application, which I have seen during my practical period at Ydreams in Portugal. This application was also build in Virtools and as such it is possible to implement those functions in Muppet. These functions include the use of layers to be able to show and hide information, the use of viewpoints and paths and more navigation controls. The problem with implementing these is that, unlike the Meerstad application, the window to the 3D environment is small. Meerstad was designed to run on full screen, where as my application is embedded in a website.

Future work should first and foremost focus on solving the memo-bug. The best way probably is to install Virtools server and port the application to the newest version of Virtools. When the bug is solved it would be interesting to do some more testing. The current test was a DPST test and the application is supposed to be designed for DPDT discussion. (see chapter 3.3) As explained in chapter 3.4 there is an important social factor in the success of such an application. Social interaction and social presence are thought to be essential for true collaboration. More thought and research should go into how to stimulate this for this application. Veldhuis-Diermanse suggests breaking with the classic way of threaded discussions and providing inter-thread linking. It seems technically feasible to implement this in Muppet. Also it is good to seek the most optimal setting for using this application, taking the three factors of MacEachren into account. (see chapter 3.3)

At the moment the GIS functionality of the application is very limited. The 3D visualization model is reasonably good. It does have support for all four issues Nebiker listed. (see chapter 2.3) They are not fully functional though, for instance Virtools does support viewpoint information, but it is not in Muppet at the moment. The main issue here is how to implement it in the application, without cluttering the interface. At the moment the application is purely aimed at visualization. The data model is not available, because it is built in the closed source of Virtools. This makes it impossible to enhance the built in data model. This also makes it much harder to get full GIS functionality. It might be possible to store the different objects as NMOs (Virtools object file) in a database and generate the landscape at startup. If you store NMOs with information like location and orientation it should be possible to do GIS queries on the database and quickly alter the landscape. This way it is also possible for users to add objects to the landscape, providing that they can generate NMOs.
Using a database with NMOs it should be easier to add 'time' to the application. If you store the time at which an object is visible you could travel through time and see objects appear and disappear. A possible problem however is that you need a lot of bandwidth to communicate with the server and downloading the NMOs. A more interesting approach is to build models, like plant growth models, as Virtools building blocks. The user can choose what stage of the plant growth he wants to see and Virtools generates that on the fly.

The current visualization of the memos is very basic. Each message has a memo, which differs in color depending on the type of message. It is interesting to enhance this visualization. The participants of the case study suggested visualizing threads, by stacking them behind each other, as a 3D message tree or increasing the size of the memo according to the number of replies. I also came across OpenSpace (salford.ac.uk) an application very similar to Muppet. It provided different subject areas in which users could post and each subject area was visualized differently, for instance traffic related messages were visualized as cars.

Currently there is one version of the application, which is similar for all users. It might be a good idea to create a 'leader' version, just like MapTalk. That version can overrule the others and guide them. This is particular useful for SPST discussions. A SPST version might also benefit from the special hardware as described in chapter 4. Using TUIs is a very intuitive way of discussing together. Phicons can be directly linked to the NMOs in the database and this way a small group of people can discuss a plan, while others can login and see these changes and comment on them.

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salford.ac.uk: http://www.ties.salford.ac.uk/pg/xiao/openspace-main.html visited june 2002

Conference websites:

ACRS 2002: http://www.acrs2002kathmandu.gov.np/

CHI '97: http://www.acm.org/sigchi/chi97/

CHI 2001: http://www.acm.org/sigchi/chi2001/

COSIGN 2001: http://www.cosignconference.org/cosign2001/

COSIT '99 :http://www.cosy.informatik.uni-bremen.de/events/cosit99/

EEUC 1999: http://gis.esri.com/library/userconf/europroc99/html/e_start_fs.html

GW '99: http://www.limsi.fr/GW99/

IEEE Visualization '97: http://www.erc.msstate.edu/conferences/vis97/

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SAC 2002: http://www.acm.org/conferences/sac/sac2002/

Virtual Agents 99: http://www.nicve.salford.ac.uk/va99/home.html

VRML 1999: http://www.c-lab.de/vrml99/home.html

List of abbreviations

2D	2 dimensional
3D	3 dimensional
CSCL	Computer supported collaborative learning
CUP	Collaborative urban planner
CVR	Collaborative virtual reality
DBMS	Database management system
DEM	Digital elevation model
DPDT	Different place different time
DPST	Different place same time
GIS	Geographical information system
GPL	GNU public license
GUI	Graphical user interface
HCI	Human computer interface
MUPPEt	Multi user participatory planning environment
RDBMS	Relational database management system
SPDT	Same place different time
SPST	Same place same time
TUI	Tangible user interface
VR	Virtual Reality
VRML	Virtual reality modelling language

Appendices

1 Case study questionnaire
2 Questionnaire results
3 Muppet manual

Appendix 1 - Questionnaire

Background

1. How much experience do you have with online discussions in a 'threaded' environment (eg. webforums, newsgroups and mailinglists)? None 1 2 3 4 5 A lot

2. How much experience do you have with first person navigation in virtual 3D environments (eg. 3D computer games, Virtual worlds)? None 1 2 3 4 5 A lot

3. Did these 3D environments have more advanced controllers than a mouse and/or keyboard (eg. glove, movement tracking, 3D mouse)? Yes No

The test

4. How much time did you invest in the test? ... minutes

5. What part of the application did you use first? 3D-environment Forum

6. What part of the application did you use most? 3D-environment Forum

Forum

7. How did you like discussing via the forum? Not 1 2 3 4 5 A lot

8. How well was could you follow the discussion via the forum? Not 1 2 3 4 5 A lot

9. How often did you use the forum to:

a. Read new messages? Never 1 2 3 4 5 Often
b. To respond to messages? Never 1 2 3 4 5 Often
c. Post new messages? Never 1 2 3 4 5 Often
d. Reread messages? Never 1 2 3 4 5 Often
e. To link (parts of) threads with each other? Never 1 2 3 4 5 Often
f. Other, namely ... Never 1 2 3 4 5 Often

10. During the usage of the forum, how often did you use the 3D environment at the same time (eg. to see where a message is located)? Never 1 2 3 4 5 Often

3D environment

11. During the usage of the 3D environment, how often did you use the forum at the same time (eg. to check what the memo is about)? Never 1 2 3 4 5 Often

12. How did you like the 3D environment? Not 1 2 3 4 5 A lot

13. How much did you think the 3D environment added to the application? Nothing 1 2 3 4 5 A lot

14.How often did you use the 3D environment to:

a. Explore the terrain?	Never 1 2 3 4 5 Often
b. Search for individual messages?	Never 1 2 3 4 5 Often
c. Search for discussions?	Never 1 2 3 4 5 Often
d. Gather new arguments?	Never 1 2 3 4 5 Often
e. Start a new discussion?	Never 1 2 3 4 5 Often
f. Other, namely: ...	Never 1 2 3 4 5 Often

Memos

15.How often did you 'refresh' the 3D environment to load new memos?
Never 1 2 3 4 5 Often

16.How did you like the visualization of the messages as memos in the 3D environment?
Not 1 2 3 4 5 A lot

17.How much did you think the memos added to the application?
Nothing 1 2 3 4 5 A lot

Map

18.How often did you use the map function in the 3D environment?
Never 1 2 3 4 5 Often

19.How did you like the map function in the 3D environment? Not 1 2 3 4 5 A lot

20.How much did you think the map added to the application? Nothing 1 2 3 4 5 A lot

Flying mode

21.How often did you use the flying mode? Never 1 2 3 4 5 Often

22.How did you like the flying mode? Not 1 2 3 4 5 A lot

23.How much did you think the flying modus added to the application?
Nothing 1 2 3 4 5 A lot

Other

24.Where there enough aids to orientate yourself in the 3D environment?
Too few 1 2 3 4 5 Too much

25.What aids missed and/or which are not needed?

General

26.What is your overall impression of the application? Bad 1 2 3 4 5 Good

27.Do you have comments or suggestions?

Appendix 2 - Questionnaire results

Question	Person 1	Person 2	Person 3	Person 4	Average
1	1	2	2	3	**2**
2	3	5	5	2	**3.75**
3	no	no	no	no	**no**
4	30	5	10	30	**18.75**
5	3d	3d	3d	3d	**3d**
6	forum	forum	forum	forum	**forum**
7	2		5	4	**3.7**
8	3	3	4	3	**3.25**
9a	4	5	4	4	**4.25**
9b	3	4	5	4	**4**
9c	4	2	5	2	**3.25**
9d	3	3	5	2	**3.25**
9e	1	1	1	1	**1**
9f	-	-	-	-	**-**
10	4	2	3	2	**2.75**
11	2	1	2	2	**1.75**
12	4	4	4	3	**3.75**
13	4	3	3	3	**3.25**
14a	4	5	3	5	**4.25**
14b	2	1	2	2	**1.75**
14c	1	1	2	1	**1.25**
14d	2	1	2	2	**1.75**
14e	1	1	3	2	**1.75**
14f	-	-	-	-	**-**
15	5	2	1	2	**2.5**
16	4	3	2	2	**2.75**
17	4	2	3	2	**2.75**
18	5	4	2	3	**3.5**
19	3	3	3	2	**2.75**
20	4	4	4	3	**3.75**
21	4	3	3	3	**3.25**
22	3	3	5	3	**3.5**
23	3	3	3	4	**3.25**
24	3	3	3	1	**2.5**
25	-	-	-	-	**-**
26	4	3	4	4	**3.75**
27	(see note below)	-	-	map more detailed	

Nothing too much, but they should be enhanced, eg. more detailed map. I missed the option to add objects

Appendix 3 - Muppet manual

Installation

To install Muppet on the server you need a HTTP server with PHP installed, PHP can be downloaded from www.php.net. Also a MySQL database have to be accessible by PHP. MySQL can be downloaded from www.mysql.com. The instalation instruction for PHP and MYSQL can be found on their respective websites. It is important that a writable MySQL database is available for Muppet.

The file **muppet.zip** (available on the CD) contains the folder **muppet** with the script files. Unzip this file and load the folder **muppet** to the server.
Start install.php on your server (http://www.domain.tld/muppet/install.php)and follow the further instructions.

To customise the layout, edit the files **template.html** and **style.css.** There are already alternative stylesheets included. You can select them in the Admin area. (see also http://www.mylittlehomepage.net/forum_script.html)

To install Muppet on the browser, point a browser to the location of Muppet (http://www.domain.tld/muppet/) and it will ask to install the Virtools plug-in, follow the further instructions. Once the plug-in is installed Muppet should be up and running.

Usage

To navigate through the 3D environment, use the keyboard and/or mouse. You need to keep the mouse pointer over the player-area otherwise the keyboard will not respond. You can use the keys W,S, A, D, PgUp & PgDown to move forward, backward, left, right, up & down. You can also use the arrow keys to turn left, right, up, & down. You can also use the mouse to move forward & backward and turn left & right.
There is a map button which will toggle a map. You can click on the map and you will be brought to that location. There is a speed mode button it will toggle the speed coupled flying. In high speed mode you will be moved upwards and the speed will be increased and in low speed mode you will be brought back to the ground and slowed down.

To read a message click on any of the message topics in the thread. You can also click on a memo in the player, it will should you the accompanying message. (**beware that this is currently broken!**)
To post new messages you can use the 'New entry' link in the forum, or 'Post reply' link below on a message page. In the last case you will respond to a certain message and you message will be shown in the thread below that message.

Admin

For the administrator there are more options available after he logs in. If he does so on the right-top side of the page a link to the 'Admin area' will show up. In there he can change several of the forum settings. Including who is allowed to post or read messages and who is allowed to register new users.

Appendix 3 - Muppet manual

Virtools Dev

To change the landscape in Muppet you need to have Virtools Dev. Load muppet-blank into it and next load the Virtools object files representing the landscape. It is important that the objects that are destined to be a floor contains the string 'vloer' and no other object does, since Virtools will automatically turn these objects to floors. Also a map texture has to be loaded and applied to the 'MapMaterial' material.
Once the Virtools objects are loaded the 'setup script' and 'georefence script' have to be checked. In the setup script the map origin, map size and map scale has to be filled in. In the georefence script the differrent attributes have to be set to transform the local Virtools coordinate system to a 'real' projected (xyz based) coordinate system.