
# Deliverable 1.1

# VRML based extended galleries - reconsidering the concept of a multi user environment

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## ABSTRACT

This paper presents our work and research findings on developing the concept of extended galleries. It describes further development of the original "Home of the Brain" VR installation developed in 1992 as a metaphor for virtual space as a public forum.

An artistic concept of a multi-user space is introduced, focusing on the notion of virtual space as a stage setting and on behaviours and interactions of people in an extended gallery space. The notion of user representation is replaced by the notion of user enactment and avatar is treated as an extended body of communication. Several artistic interaction scenarios are presented accompanied by an instinctive and invisible interface environment.

A VRML based extended gallery demonstrator, "Murmuring Fields", is presented as an mixed-reality shared environment installation for several users and as a decentralised network architecture supporting large number of users across Internet.

The work has strong links to eRENA tasks 4.1 Spatial structuring techniques, 6.1 Navigation for the senses and 6.2 Linking between real and virtual places.



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| **Au thor(s)** | Wolfgang Strauss (GMD), Monika Fleischmann (GMD), Jasminko Novak (GMD), Mette Ramsgaard Thomsen (GMD) 1.1 |

# 1. Introduction

This paper presents our work in developing the concept of extended galleries. It is concerned with four broad topics:

- the notion of a public forum as a context for the concept of an extended gallery,
- esthetics of virtual representation of space,
- virtual representation of participants,
- interaction in virtual environments.

In addressing these issues we depart from the "Home of the Brain" VR installation developed in 1992 which was understood as a metaphor for virtual space as a public forum. Extending it towards a multi-user environment we reconsider the concept of a multi-user environment by contrasting it to the concept of a shared environment, in order to expose assumptions usually being taken for granted.

We start by abstracting the notion of the public forum in order to explore new forms of mediation, interaction and communication. To this end the spatial model of Home of the Brain is further developed to better fit the realities of the new medium and the concept of virtual representation of space as a stage setting.

Addressing the problem of user representation and individual embodiments, the notion of user representation is replaced by the notion of user enactment. Avatar is treated as an extended body of communication and researched in a twofold manner: as playfigures and as embodiment of bodily gestures.

Several artistic interaction concepts - Space-Dance, Play of Worldviews, Instinctive SoundSpace - are presented, addressing the problem of what to do in virtual space and how to connect participants in real space. The interaction is not guided or targeted towards a certain goal. Instead, the environment provides an action-oriented situation in space and time, in which visitors are unconsciously transformed from accidental passerbys to instinctive travellers.

Recognising the fragility of interaction when dependent on only one sense, a new way of instinctive and invisible interface environment is presented. Through real bodily involvement it involves different kinaesthetic and synthetic senses which are crucial for fuller experience of space and presence as opposed to pure visual sensibility.

Finally, the VRML based extended gallery demonstrator "Murmuring Fields" is presented as a shared mixed-reality installation interweaving virtual and real physical space. The technical platform developed for its realisation includes MARS External User Interface Driver, MARS Simple Shared Environment Driver and MARS Simple Gesture Interface. This architecture provides independent levels of control for rendering and displaying of the virtual world, multiple user support and non-standard user input devices. For pure distributed multi-user virtual environment support GMD´s smallView platform has been further developed.

# 2. Meaning and content of "Home of the Brain"

"Home of the Brain" - conceived as a metaphor for communication with computers memory - was awarded the golden Nica at Ars Electronica in 1992 as one of the first pieces of art

working with VR technology. In 1992 it was a future vision of telecommunication and shared virtual environments. The topics explored are still relevant today: the organisation of narrative non-linear notations, the addition of a body centred sense of tele-presence - experienced as a pre-sense and the navigation and interaction of virtual space - a space of thought as an extension of the body.


Fig. 1: M. van de Rohe's Berlin National Gallery, scripture of Paul Virilio

Originally worked out as a simulation of a real symposium, "Home of the Brain" was to be situated in Mies van der Rohe's Berlin National Gallery. The concept proposed that " four philosophers living in their houses of thoughts could be visited by viewers following their philosophical debate". The concept was transferred into virtuality to convince and win sponsors in order to realise a performance-symposium on art, culture & technology where the audience could meet in a forum and watch philosophers actively in their stoa.

Stoa is the Greek word for a pillared exterior hall where philosophers would stroll around thinking, reflecting, talking - fighting about their ideas. We invited the philosophers and media thinkers Marvin Minsky, Villem Flusser, Joseph Weizenbaum and Paul Virilio. However the four invited philosophers never met in the same "real" space at the same "real" time. Therefor "Home of the Brain" was built as a shared space bringing together different ways of thinking. Substituting discussion with confronting the audience with their statements. This explains the correspondence between the furnishing of the virtual model and the real space.

## 2.1 Spatial structuring of "Home of the Brain"

The basic idea was to globally connect virtual spaces where people could **flaneur** or meet in a virtual stoa. As a result HoB is an open interior space instead of a linear "events passage" transporting viewers through three dimensional narratives. It is modelled as a passage through a landscape of **thought-constructs** where the Navigator sets a personal agenda by moving through a space of audio-visual sources.

"Home of the Brain" is inhabited in virtual terms by pioneers in media development. The thoughts of Villem Flusser, Paul Virilio, Joseph Weizenbaum and Marvin Minsky are implemented in the computer's memory. "Do we need that? Why do we need it?" sounds Weizenbaum's warnings against the power of the computer and the impotence of reason as they wrap themselves around his "House of Hope" in Moebius-like chains of thought. In Virilio's "House of Disaster" the "racing standstill" is tested under trees falling as if in slow motion. Flusser's "House of Adventure" shows his vision of flowing space: "I dream of a house with walls that can be changed at any time, of a world whose structure is no more than an expression of my ideas". In Minsky's "House of Utopia", a crystalline transformation object, future computer generations are discussed "which are so intelligent that we can be pleased if they keep us as pets".

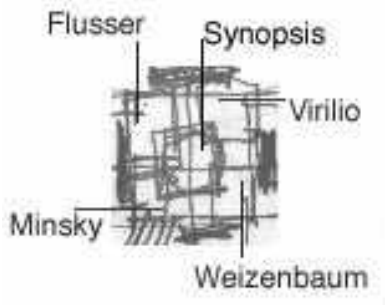


Fig. 2: Environment structure Home of the Brain

HoB was an built in installation in an existing space furnished with the following virtual objects:

- houses transforming when the user comes close
- columns or trees blowing the wind of information
- islands representing continents or language islands
- furniture as symbols
- videostreaming portraits
- letters as speaking signs

Fig. 3: Top view "Home of the Brain

## 2.2 "Home of the Brain" as a Virtual Reality installation

"Home of the Brain" is structured like a three-dimensional mandala. It was created as a VR world to experience with traditional VR interfaces providing a high degree of immersion. Every visitor can move around in this virtual environment using the virtual reality glove and finger gestures. The performer's gestures will become immediately visible to himself and his audience through the representation of his hand. The entire production can be observed on a large video screen. The performer functions as a kind of shadow artist in the virtual space

behind the screen. "The virtual hand discloses its true soul to us," explains neurologist Hinderk Emrich commenting on the virtual flight and lively movements of a physically handicapped participant in Geneva whom we are watching via ISDN lines from Berlin. Below the head mounted display he cannot see anything of the outside world and instead sees himself as an integral part of the new virtual world which surrounds him. For a short time he feels himself free of his real body. During the virtual flight he sets his own agenda and develops his own personal perspective of sound, since the objects are interactively associated with sounds, noises and fragments of text.

While the observer is only the onlooker, this "looking" is itself a kind of movement. It embodies "active observation". From a certain moment when the observer becomes immersed in the action, his "passive onlooking" is replaced by "active observation". The observer discovers that he - and not the artist - is the one creating the situation. When the situation changes and the observer becomes a player, he suddenly begins to identify himself with the situation. Observation becomes more than merely consumption. In this moment consumption ceases. With virtual reality goggles and gloves, the body is exposed to new spatial experiences. The body is the interface between the interior and the exterior, between reality and virtual reality. This feeling of presence and space was based on purely representation of the users hand in the virtual model. The moving hand in virtual space was a very clear real-time representation. A new interface paradigm was born. The body was mapped into virtual space with a interface projected onto the body. Mapping signifies reduction and transformation but never 1:1 representation.

HoB had about single 1000 visitors offering different types of viewing. The interactive viewer wearing glove and eye-phone standing behind a large screen was represented as a shadow image on the screen image. The single viewer was separated twice- behind the screen in the backstage area and hidden under the eye-phone. In front of the screen people waiting to be the next navigators framed an active chorus by annotating the play of the actual navigator. Additionally a crowd was watching as passive viewers. HoB, a vision of networked space, was designed as an installation, as a life public show based on theatre principles, enriched with interactivity using VR technology.

Fig. 4: Shadow-actor in HoB using dataglove and HMD projected on screen

# 3. Extended "Home of the Brain" as a multi user environment

Extended "Home of the Brain" (xHoB) is based on VRML, the descriptive language of a connected time based internet space. VRML spaces are not shared. The spaces can be entered and explored but does not allow for people to meet within it. VRML represents networked but not connected space.

In the extension of HoB we are developing a concept of a shared, networked space to overcome the situation of the lonely viewer. (see Chapter 6.0) Setting up xHoB as a multiuser environment enables us to create relationships between the users themselves and their experiences as well as between the single user and the world. The virtual Stoa becomes a real meeting place where visitors can exchange experiences of the philosophies presented.

The extended HoB exists as an installation in real space. Our interest has been to connect the viewers perceptions of real space with that of the virtual construction. It is in this meeting place between the virtual and the real that the visitor exists. The meeting is enabled by the development of an instinctive interface. The interface reacts to the viewers body movement, tracking both movement across the real space (camera tracking) as well as less linear relationships (theremin interface). This way the users body movements - through which he/she explores space - are transferred from the real to the virtual space. By moving, the viewer navigates the virtual space. The viewer can therefor simultaneously explore the dual realities.

It is through this relationship of movement that we liberate the viewer from the passive, sitting and typing user to a bodily active doer.

## 3.1. The new spatial structure: "Murmuring Fields"

The extension of Home of the Brain is called "Murmuring Fields". The original concepts of "Home of the Brain" exist as artistic quotations in the new extended model which takes its point of departure in the philosophical content as well as the basic spatial and audio organisation.

The spatial structure of the enclosed square of HoB becomes the inner core of Murmuring Fields. Here the statements of Villem Flusser, Marvin Minsky, Paul Virilio and Joseph Weizenbaum are presented in their respective corners. The speeches sound from their corners - or houses - presenting their ideas. Each thinker is represented by an individual series of signs. These signs express meaning in an own language remote to us. The signs relate to the difficulty of understanding also present in the difference between the languages spoken by the thinkers.

Murmuring Fields extends into a sounds space where sounds are placed in space relating spatial organisation to audio experience. The organisation is built on a tri-fold structure :

- World 1: central area with single visual objects and full audio statements
- World 2: extended area with landscapes of single words
- World 3: peripheral area with single phonemes

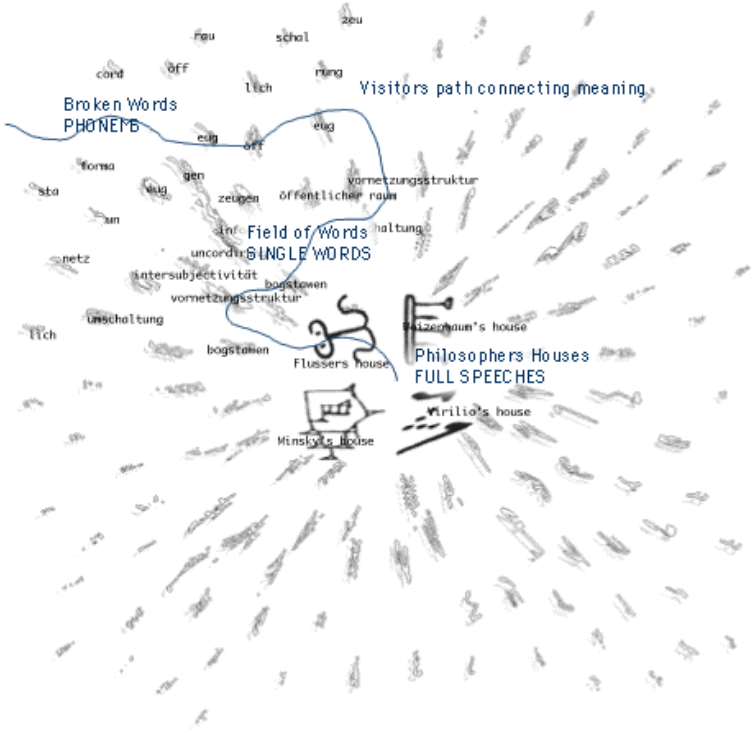


Fig. 5: Top-view from "Murmuring Fields"

World one: is the inner core of the space. The large signs, scaled as buildings, open up a field in which the full philosophical statements can be heard. The statements are looped and the visitor can choose to listen to either of the thinkers by navigating the space. In the centre the statements merge overlaying the information into a indecipherable cacophony. Here the space is dense - compact with meaning.

World 2: "Fields of Words". Here the statements are broken up into individual words. Each sound is represented by a sign of body-size scale. The sounds are triggered by proximity sensors setting up a precise relationship between the users movement and the production of meaning.

World 3: The peripheral area breaks up the words in to individual phonemes. In this outer field the sounds only vaguely associate to the original meaning of the statements through the voice and the intonation of the sounds. The signs, scaled as furniture, are rudiments of the original signs. The scarce density of the field bridges the vast blackness of void VRML space.

In Murmuring Fields space is concrete and abstract at the same time. The central field of World 1 is understood as an overview where the user can differentiate and decide which content to explore. From this blind spot the outer worlds are perceived as fictive landscapes inciting discovery. Here space inspires movement and action. By moving from World 1

towards the outer periphery the meaning of the words is deconstructed into phonemes. Conversely moving towards the centre the phonemes merge into words which then in turn merge into sentences. Movement causes the coding and decoding, arranging and re-arranging of content. The arranging and rearranging produces learning and memory. In this space meaning lies between the density of the cacophony of noise and degenerated silence.

Fig. 6: Views from "Murmuring Fields"

Murmuring Fields concentrates on the relationships between the visitor and exploration of space. In real space we relate to our environment through our bodily scale. In Murmuring Fields the signs, as placeholders for the sounds, relate to the visitor through setting up the same scale relationships. As one moves around in Murmuring fields one is confronted with a world abstracted from real world experiences. Here the flux in density of the world relates the notion of being inside or outside the world.

Murmuring Fields attempts to comprehend the spatial consequences of VRML space. VRML space is void and endless in any direction, free of context it relates a scaleless and timeless set-up. By inhabiting the void we seek to make sense of this artificial space. HoB set up a clear definition between the in- and outside of the model. Visitors were limited to the interior by a boundary box thereby clearly held with in the scene and its action. By doing so HoB dismisses the reality of VRML space as context. In Murmuring Fields the spatial understanding seeks not to construct a defined absolute form with in the space but to produce a density within the void. This density is not as much form as content. The sound space being prior to the visual space. By relating the interaction of the visitor to spatial production - as the space only "happens" when the visitor creates connections between the sounds - we imbed the time of this interaction into the space. The world is a dynamic space of transformations and changes held in time.

As a visionary aspect we are concerned with the spatial organisation as a trigger of a production of meaning through movement. In "Poetics of Space" Gaston Bachelard describes how space can be used to structure virtual worlds as memory spaces, meaning that one could organise data like one organises a building or furnishes a house. We are interested in the notion of memory traces in which the memory of past experiences are stored. The traces here becoming a recevoir of the past which later can be triggered so as to re-member or re-collect the past. Spatial elements in the world could reveal underlying hypertext information, as when one opens a drawer to reveal its content. The opening of the memory happening not through "pointing and clicking" but through "virtual touch" analogous to association. Objects in the world could be equipped with sensors as proximity, touch or time sensors triggering text, audio, video or spatial information.

# 4. The problem of user representation

## 4.1 The notion of an avatar

The avatar is the representative of the participant in a virtual world. At present one can distinguish two basic notions of avatar:

- avatar as a virtual constructed self existing as a projection of participants mental space in the virtual world (1st person perspective)
- avatar as an externalised body of communication detached from user's sense of his real body (3rd person perspective).

In the first approach, the self is fully immersed in the virtual world, identifying itself with its virtual form of being while in the second approach the self is looking at the world from outside, manipulating its representative as a puppet.

The most prominent point about the first approach to avatars is that they serve as *masks*. The individual speaks, hears, sees and acts through the mask. This can be seen as a parallel to theatre where the actor as an individual person assumes a specific role.

The second approach recognises the physical reality of body (and consequently the senses) being outside of the virtual world and thus limiting user's immersion. The third person perspective puts a mental framework for the participant saying: it is not you who is in there, but a separate body that replaces your presence and serves you to communicate with the others. It is the first step towards the notion of an agent.

Our approach to avatars is signified by the notion of the "extended avatar" which breaks with the heritage of immersion as implied by the first concept of a virtual self while at the same time recognising the unjustness of the second concept of a completely detached virtual body of communication.

We introduce two points of departure:

- the notion of user enactment (to replace the notion of user representation)
- the notion of avatar as an extended body of communication (to overcome the conflict of immersion vs. detachment).

We consider the avatar as an extended body of communication. Communicating both with ourselves and with other avatars. The avatar is a medium, an interface towards other avatars and the world. In developing this concept, we research the avatar in a twofold manner:

- as play figures - puppets steered by human interaction as in a game,
- as an embodiment of bodily gestures - their virtual extension.

## 4.2 Guidelines for avatars as user enactment

The notion of user enactment reflects the recognition that user presence in a multi-user virtual environment is not the question of "representation" but the question of providing mechanisms of interaction and communication with other participants. In order to accent the need of considering these issues as guiding ones, the notion of "representation" is replaced by the notion of "enactment". It is through looking for new shapes and new modes of interaction and communication that we explore different ways of producing avatars as enactment.

To accentuate this approach we have formulated following guidelines for avatar concepts:

- abstract the visual form,
- connect production of the avatar form to real bodily movement,
- provide for existence in time, not only space - the metaphor of "trace".

Switching to the notion of enactment it becomes clear that the visual representation in itself is not the deciding way of what is usually referred to as "individualised user embodiments". Furthermore, we remind that the kinaesthesia of real world/space perception, which works as a bundle of a dozen of different senses, is fragmented in virtual environments.

The majority of current approaches tries to resolve this discrepancy in sensual perception between real and virtual worlds, sticking to the visual as the dominant sense of perception. The other problem we realise is that these approaches tend to result in the focus on developing visual forms of representation mimicking real world visual appearances as close as possible. The resulting communication and interaction possibilities that these avatars offer, try to mimic real world physical interaction (such as movement of extremities accompanying avatar movement) - once again relying on the visual as the dominant mode of perception.

We feel that the inadequate treatment of the problem of "sensory fragmentation" in virtual environments is the major shortcoming of such approaches. It strongly limits possibilities of perception of space and interaction between participants and consequently the potentials of this medium.

Consequently, in our approach we break with the tradition of visual form of representation as the critical one (for individual user embodiments) and, as a first step in looking for new solutions, deliberately drive the visual to both extreme abstraction, and minimalist scarceness. Eventually, we focus on movement and gesture as two basic channels of presence and communication. Movement requests that the dynamic visual form provide minimal information needed for localisation in space and time. Gesture requests that it be dynamically connected to the participants real body through senses other than the visual.

The next sections describe the evolution of the "extended avatar" concept based on these guidelines. We start with the concept of avatars as electronic abstract masks and evolve to the notion of avatars as gestural bodies. Finally, we present a solution in the form of TRACE-avatars that we see as a suitable basis and a good pointer for further work on representations of body and movement for user enactment in electronic arenas.

## 4.3 Developed prototype avatar concepts

In developing avatar concepts based on presented guidelines, we have considered following aspects:

- visual appearance and relations of avatar and space,

- multisensory perception,
- procedural interaction & creation - channels of communication,
- the "extended avatar" - existence in time, not only space; the metaphor of "trace".

The two concepts presented below illustrate the overcoming of the first person perspective - third person perspective exclusive approaches to user presence in virtual environments. The concept of avatars as electronic abstract mask departs from the first person perspective and uses abstraction of visual form as a way of abandoning the exclusiveness of first person perspective and the illusion of purely visual immersion. The concept of avatars as gestural bodies starts with the third person perspective and heads away from it by connecting the avatar to real bodily gesture and movement. The meeting place of the two concepts is the proposed solution of TRACE-avatars in the demonstrator extended VRML based gallery Murmuring Fields.

### 4.3.1 Avatars as electronic abstract masks

The development of avatar forms based on the concept of the mask has to do with the feeling of security provided by anonymity and the possibility of reconstructing the self as one's tele-present. "Avataring" is today mostly about inventing a new person with a new behaviour. Avatar is a construction of the self as it wants to be seen by others.

This possibility however is based on a silent understanding with others, because of the overriding knowledge that in tele-presence everybody is an "atrappe". The first person perspective is also misleading because the third person aspect comes into play through the distance between self/avatar/other. Both the self and the others are looking at the avatar avoiding questions like "Who am I ?" because playing and comparing is the method to discover these standpoints. Knowing that the self is just an invention, it becomes the basic reference point in the model of our world's construction. Thus avatars should be understood as just one more model, additional to the existing system of models of self-constitution.

In this context, today even an e-mail address can be understood as an avatar because it effectively represents one's existence in electronic space. In the world of multi user games there exists a wide range of concepts of visual user representations - avatars - as figures or characters. Usually they are prefabricated figures which can be chosen from a gallery. Most of the existing visual representations for avatars adhere to the previously described concept of a mask. They are largely figurative and anthropomorphic visual representations. Such heavily visual concepts, often aimed at mimicking reality, forget that the whole concept of avatars as masks is only possible because of silent agreement of the participants to accept the fact that "everybody is an atrappe". Thus there is no need for elaborate visuals to provide this illusion.

The following avatar concept is based on the idea of an electronic abstract mask like in Greek theatre. Historically the avatar is the materialisation of consciousness. In our concept the avatar is therefore visualised not as a body but as mind (consciousness). The underlying form is abstracted and only essential elements of anthropomorphic presence are retained. Depending on the concrete application quite different implementations of this concept of avatars could be used. It is a literal construction method of avatar constitution that we describe.

Fig. 7: Mask of antique theatre

The first step in getting away from anthropomorphic forms is abstracting the visual appearance. At the same time however, one has to consider the problem of minimal information an avatar should provide. The visual appearance has to ensure it is differing from the polygons which makeup the geometry of the scene. Beyond the requirements of localisation the avatar should also indicate some communicational capabilities. Furthermore it needs to make perceivable the human being behind the mask.

As a minimal communicational capability and perception of the participant behind the avatar, we see the appearance and movement of lips and eyes. Interfacing the avatar via real-time video streaming could display movement of eyes and mouth as living parts of an abstract static representation.

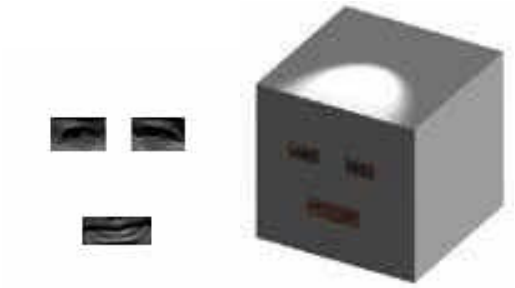

Fig. 8: Avatar video mask, projection on the Avatar plane

### 4.3.2 Avatars as gestural bodies

The notion of gestural body in the context of avatar concepts we refer to the body whose essence is not representation but pure presence. It is similar to the notion of body in Decroux's corporeal mime as described in [6]. It is the body liberated from the human shape and from body language as a scheme of producing meanings; a body disolved to a set of forms and possibilities.

It is the first step towards the "extended avatar" - the "extended body of communication". It is as in the Decroux's piece "Enveloppe" where the whole body is covered by cloth, and the movement of body and cloth becomes an interaction where it becomes impossible to say which moves which [6]. Here, the participant moves the avatar and the avatar moves the participant. The "extended body of communication" is participant's real body and the avatar, connecting and extending each other - like body and cloth in Decroux's piece.

#### *4.3.2.1 Introducing the notion of trace*

The first step in the direction of avatar as gestural body is describing avatar's movement in time and space. To this end we have developed different concepts of avatars leaving visible or

audio-visible traces behind. Avatars' movement in space creates spatial figures in time as time-based active embodiments of user in space.

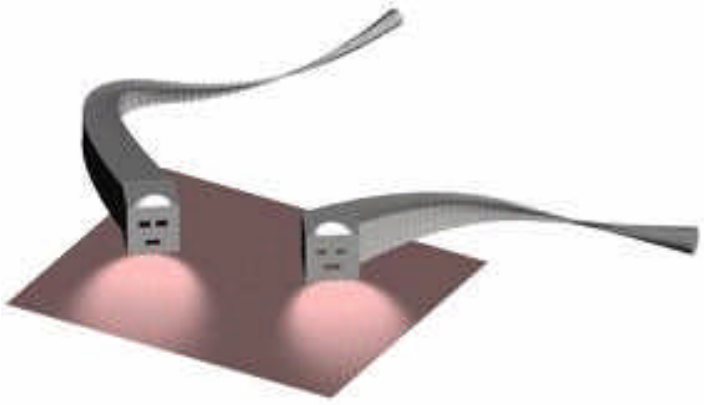

Fig. 9. Avatars leaving traces behind

The purpose of the trace is to provide:

- a mechanism for depicting participant's movement in the virtual space (dynamic localisation in space and time)
- a mechanism of interaction and communication between participants
- a mechanism for individual and world dependent user embodiment.

Movement and gesture as embodied through the trace provide individualised user embodiments and channels for interaction and expression. Again, the visual form as representation is in the background and it is the dynamics movement and gesture that creates visual patterns.

Because the notion of trace accentuates movement and gesture as modes of interaction and communication in the virtual world, and hence the mode of presence, it is a path towards involving other senses than the visual.
Movement and gesture are perceived foremost through bodily senses such as balance, muscle tension, force feedback, touch etc. and the visual sense is only one among these many. So the very notion of trace charts the way to a multisensory perception and connectedness with the environment. The next step towards involving our bodily senses and leading to the notion of gestural body is connecting the production of traces to real bodily movement as described in the section 4.3.2.2.

**Visionary aspects - memory traces**

On one hand, a trace is like a shadow, a sign of movement in time. But trace is also a memory, like Ariadne's thread, a path leading from past to present. In a metaphorical sense the users movement can be understood as a timeline of thought (Decroux connection) to be used as a choreographic notation describing space-time events. By navigating through the scene a space of memory is created which later can be explored. One can travel through virtual spaces as well as through as through the memory of travelling. One can follow oneself.

The aspect of memory traces can be approached in an abstract and metaphorical manner or in a more concrete way. The former is chosen in the avatar solution as part of the artistic concept for the extended VRML based gallery demonstrator Murmuring Fields (see Chapter 6).

The latter, more direct approach to traces as memory, would be to implement the trace as a history line - a timeline of events during the navigation in virtual space. In a first version the timeline could collect the touched parts of the world as URLs, like a visual bookmark line. In an advanced version the data on the timeline could result from a virtual microphone and a virtual camera.

The memory line would become an automatically recorded storybook of a users sojourn in a virtual world. This is to be understood as similar to sampling in music, where the sample exists as a molecule of the composition. Here the space-time samples are used to create clips caused by movement. This memory-clip is useful for many reasons. For instance the clip could be understood as a new approach to dance where sound spaces are used as a dance line. While traditionally the dancer follows the music, here a spatial choreography is produced as an interactive real-time process just through using the system. It is already dancing but at the same time like simultaneously tuning the instrument.

Moving in xHoB is a unconscious process of not knowing what to. It is a process of searching and detecting. Once this process is initialised it could be recorded and transformed by sampling methods as if it were a first draft to be worked on later. We call this method 4-D story boarding. In a future version the timeline events could also be manipulated and edited.

#### *4.3.2.2 Connecting avatar production to real bodily movement*

The next step was to connect the production of traces to real body movement. Here we present several possibilities that we have developed in our work.

**Light as sign-gesture**

This example builds on the notion of "bodies as a movement of boundaries" [quote who?]. We call this the "Light as Sign-gesture". The user wears a "body-mask" made out of optical fibre. At the spots where the optical fibres protrude to the outside a fine ray of light is emitted into the darkened installation space. The "body-mask" can be very simple, just a few bits of fibre as point-light sources or it can be more complex e.g. an artistic creation for an extended performance. A camera picks up the images of the user in real-time as a live video stream. The computer processes individual frames to produce different images and layers them upon each other before projecting a new video stream on the big screen. Because different images are calculated, only the movement of the user is extracted, and through the layering it produces a trace corresponding to user's movement, in real-time. The user's light-trace is an enactment of real bodily movement and the visual form is not merely a moving representation of a static shape but a fluid, dynamic creation of a new space-time. Figure 10 illustrates an interplay of two light-trace avatars (the timeline is bi-directional from left and right).

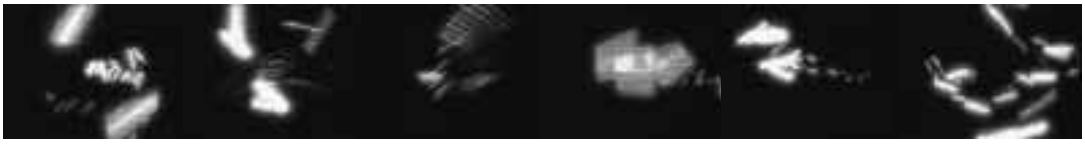

Fig. 10: Interplay of real-time produced body-coupled light-trace avatars

The visitor becomes a movement of abstract visual form produced interactively as light traces in space and time. This is the trace-avatar. Such an avatar has a timespace of its own. This solution is tightly coupled to the question of interaction procedures in a shared space and the implications are discussed in the next chapter.

Light-trace avatars are inserted into the virtual space, at present by real-time layering on the rendered scene (because CosmoPlayer does not yet support live video streams) while the Theremin could be used to track directional motion of the person so as to enable the avatar to move in full 3D space of xHoB. When live video streams become available in Cosmo, the

trace-light avatars could be inserted directly into the VRML scene before rendering, through an MPEG live video stream produced by the light-trace avatar software.

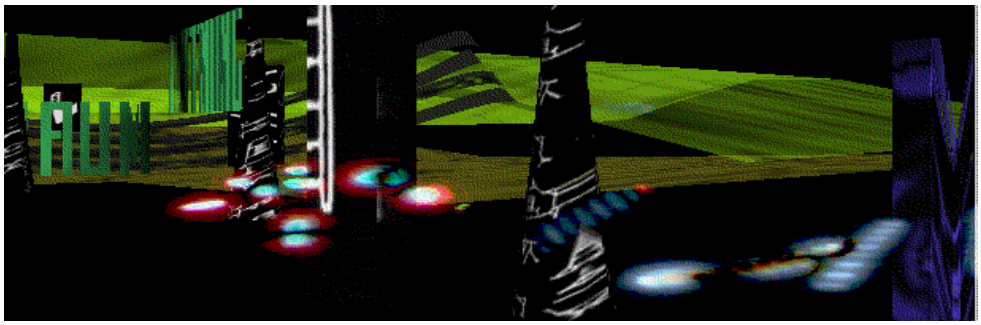

Fig. 11: Light-trace avatars in xHoB

## 4.4. Avatar solution in the demonstrator: TRACE-avatars

The avatar solution in the demonstrator is based on the notion of TRACE-avatar as described in previous chapters.
Each user is associated a trace in a different colour which serves as his avatar. Based on the real-time movement and gestures of the user in real-space a trace is created in the virtual space. Thus the trace conveys real-time individual user presence in the virtual space. The trace is the avatar - the avatar is the trace. This development is tightly coupled with the "SpaceDance" and "Instinctive SoundSpaces" interaction scenarios, which are also realised as part of the demonstrator.

- picture of TRACE-avatars here

The TRACE-avatar solution emphasises the focus on movement and gesture as two basic channels of presence and communication. The simple dynamic visual form provides necessary information needed for localisation in space and time. It is dynamically connected to the participants real body movement and gesture through senses other than the visual. It is a realisation of the "extended avatar" concept based on the described guidelines of avatars as user enactment through gestural bodies.

This TRACE-avatars are a somewhat simpler version/variation of the developed prototype concepts for avatars as gestural bodies discussed in the previous chapters. This choice is due foremost to following two reasons:

- allowing same kind of presence for visitors in the real space and visitors from the Internet (who have different interface channels)
- stressing the impact of connecting the avatar to real bodily movement even in relatively simple ways.

Present technical limitations in picking-up user gesture and unavailability of real-time video-streaming in VMRL have additionally influenced this choice as well.

Technically, this TRACE-avatar solution is realised using an optical tracking system and the Theremin employed as a gestural interface. The tracking system tracks the movement of users in real-space and delivers data for real-time creation of corresponding traces while the Theremin picks-up user gesture thus providing additional input for the form of the traces. This is discussed in more detail in Chapter 6.2, where also the difficulties and pointers for future

work are presented.

# 5. The problem of multi user interaction

## 5.1 Introductory considerations

"What to do ?" is basically a question of goal or purpose. In our approach the interaction is not guided or targeted towards a certain goal. The role of the environment is to provide an action oriented situation in space and time. It is unimportant in this regard whether the situation is based on a particular story, or whether the story is recognised. The only thing of importance is that the visitor finds a thread that stirs memories inside him. The area of conflict is the relationship that exists between man and his world of experience.

The esthetics of virtual space and forms of user enactment provide a framework for exploration and a context for actors' actions. Communication is understood in a much broader sense than conveying known meanings by means of a given system of expression. We focus on movement and gesture as two basic channels of interaction and communication. The esthetics which animates the visitors' movement transforms them secretely from accidental passerbys to instinctive travellers.

But what becomes of man in this staged world? How can he become part of it? What form of dialogue will he develop through interactive digital communication? How is the virtual space shaped by human intervention and what stories are told by people and space?

## 5.2. Developed Artistic Interaction Scenarios

### 5.2.1 SpaceDance - a virtual communication sculpture

In an extended gallery concept there is nothing to shoot or to choose like in a game. There is just space enticing movement which in turn produces content. Once a stimulating movement is done by one of the users, kaleidoscopic audio-visual frames of space will come to life. Movement causes the user to leave a visible trace as a sign of presence. Whether this is done by the users mouse movement, as in the on-line version, or by a tele-touch interface (theremin), in the installation version, the trace will be recognised as a counter production to the existing virtual world.

The esthetics which animates the users' movement by means of different forms of trace-avatars is the creation of new shapes in the spatial setting of the virtual world, with their interconnected body of "extended avatar". This movement - the space-dance - is a virtual communication sculpture. The final space-dance result is the one and only matter and reason of the interaction process. The space-dance is an invitation to exploration of the (extended) body and the experience of movement and gesture as channels of communication. As the interaction process is recorded through the space-dance as a virtual communication sculpture, new meanings emerge.

The virtual space is structured as a cluster of audio-visual objects. By moving through space events are triggered via proximity sensors and can be recorded as a set of samples. The trace is the organising timeline of passed objects and collects them like pearls on a string. One can look at the resulting space-dance sculpture from outside hearing a collage of voices or one can

enter the virtual sculpture, like an architecture, passing through several layers of time. It would be like walking in a video clip.

The final product of "Space-Dance" is a sculpture of interaction, an architecture of communication as an audio-visual block image in time-space. It should be displayed in a CAVE or in stereo mode on a monitor . When only displayed in 2D it will look like an elevation to be used in a floor projection like a top view. Displaying other views on vertical gaze walls would be interesting.

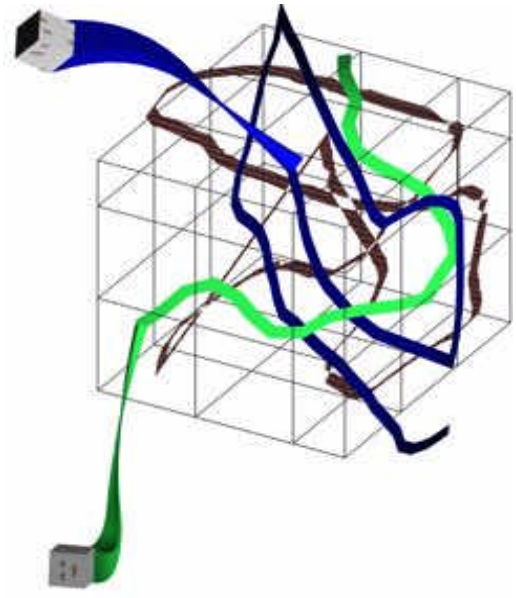

Fig. 12: Avatars performing "Space-Dance"

### 5.2.2 Play of Worldviews

In the '4 into1' configuration the environment is shared by four users who are situated in a real space installation with one projection screen on which the virtual scenery is projected. In difference to usual internet based multi-user environments, where every user has his own monitor space, in "4into1" there is one joint visual output device.

Each user has a different virtual environment interface with its own, distinctive, qualities and abilities. According to the idea of "Home of the Brain", four different interfaces represent the four different people. This configuration exemplifies the notion of people having different channels of expression but which still understand each other and are able to explore, discover and understand their distinctive differences.

The virtual space inhabited by the users' avatars is to be seen on a large screen through four different viewpoints being fused into one image. The individual players are spatially separated, the screen acting as a stage inhabited by the avatars. The interfaces enable visitors to move in the world and interact with each other by guiding their avatars. Individual viewpoints are coupled to users' avatars whose movement and interaction influences the composition of viewpoints on the screen. only if they cooperate completely will they produce a clear image.

Because of the different viewpoints (layered and obliterated) the image of virtual space will loose its clear boundaries falling in a state of fragmentation. This hyper-panoramic view might look similar to Marcel Duchamp's "Nude descending a staircase".

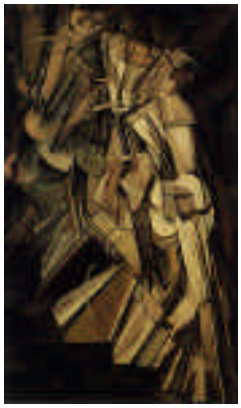

Fig. 13: M. Duchamp's "Nude descending a staircase"

Currently the layering of the different viewpoints is realised by real-time layering of rendered scenes and then projecting the resulting image on the large projection screen. This method is used because Cosmo Player does not yet support live video streams. Our work has been concerned with the aesthetics of such layering which is also related to the work of the Nottingham partner on boundaries between real and virtual space, where they have developed the technical solution for live video streams in their MASSIVE-2 system (see report on spatial structuring in Task 4.1.).

#### *5.2.2.1 Issues and implications addressed by "4into1"*

The concept of "4into1" explores the concept of a "shared environment" and its context in public space.

The 4into1 configuration poses the question of constructing a common/shared vision. The solutions will be explored by the visitors/participants. The layering of different viewpoints on a common screen exposes the hidden condition of distributed multi-user environments where everyone is given his own world view. The others are always there, even when we are not aware, there are "worlds we don't see". That is the basic difference between a shared environment and multi-user environment, between 4into1 xHoB and xHoB as an Internet based multi-user environment.

In 4into1 visitors engage into a play of "negotiation" - a dialogue of appreciation and understanding of the others' viewpoint - of that which is different. Players explore the "situation" and learn about the possibilities and limitations of seeing the world with different eyes, coming into dialogue and building a common vision.

The play is not about finding a "solution" because there is not one. It is the play which is the solution. Through their inter-play the visitors discover the "problem" - the situation - and the conflicts. The visitor is urged to experiment with ways of addressing this problem and finding its solutions. A clear view can be constructed when all players coincide in their views. But is it the interesting solution ?

In the process of play the views shift and change, visitors discover new views and new combinations of views - new worlds. There is no one world of xHoB to be discovered. It is not just different views but a construction of many different possible worlds. In "layered world views" there is no way of discerning the truth from fiction which urges us to not trust in what seems as given. It reminds us of our mediated condition in everyday life.

The play of world views, inspired by the aesthetics of space and interaction, is constructing new worlds, as shared visions. Alone I can be only in one world. I need/with the others to discover the many.

Construction of new worlds in xHoB is infinite. Because it is a result of two things:

- layering different user viewpoints where the number of combinations is theoretically finite but practically inexhaustible
- dynamics of interaction producing viewpoints and space-time bits of users' gestural bodies (traces).

In the case of layered viewpoints (see previous section) the memory chain would differ from the views experienced during the original passage. The memory is built up of impressions of the world from the original viewer only. When travelling through the memory tunnel one could only experience the individual memories of the shared experience. This shared memory is reconstructed by the visitor from the individually tunnel- memories. The reconstruction exposes the nature of collective memory in the real world. Being built from individual memories it is experienced as a whole only through experiencing those individual memories. The collage making up the collective memory is reconstructed differently by each individual "reader"-traveller.

#### *5.2.2.4 Visionary aspects - connected public spaces as mediated shared environments*

The existing technical solution for the 4into1 configuration relies on coupling the CosmoPlayer as VRML2.0 browser with our own MARS External Multi-User Interface Device Server. Further technical development of this platform could provide the possibility of connecting 4into1 configurations in different locations i.e. public spaces.

There could be several 4into1 configurations installed in different spatial locations. Movements and actions of users at every location would be transmitted to all other 4into1 configurations. This could be done extending the current MARS External Multi-User Interface Device Server to work as many-to-many scheme as opposed the to current many-to-one scheme.

In this way every installation would get information about the actions and movements of the users at all locations and this would then be locally rendered and displayed on the projection screen. Thus at each 4into1 location the screen would represent the same space as influenced by all the participants. However, there would be no mechanisms for synchronisation and time ordering of user actions. In this way the actions of users at different locations and events caused by them in space would appear differently at each 4into1 location, depending on their arrival sequence, which would often be different at different locations (due to different distances and uneven network transmission conditions).

As a metaphor this decomposition and fragmentation of the time line of events exposes how perception and interpretation of cause&effect relationships of events is determined by the mediation of the underlying medium, in this case the computer. It shows that the timespace of multi-user space is an artificially constructed timespace where causal ordering which governs the generation of time and space is created/constructed by the computer. The timespace from which the actions and events originated is not the same as the one that is perceived.

Through the mediation of the computer this time-space is first fragmented, decomposed and deconstructed and then reconstructed into a new time-space at the receiving end. It is important to note that the ways in which this time-space is constructed depends on the underlying criteria and models of synchronisation defining the functioning of the multi-user platform. And according to the realisation of particular platforms, there are different models of doing it.

This problem of causal ordering and time-space as a new artificial construction is another difference between multi-user and shared environments, which the concept of 4into1-connected exposes and brings into awareness.

The 4into1 configuration emphasises the bringing together of people in real spaces by exploring new forms/notions of public spaces as technologically mediated shared environments. The concept of 4into1-connected goes one step further emphasising connecting geographically distributed people by connecting public spaces in real space as opposed to connecting people behind their home screens.

### 5.2.3 Instinctive SoundSpace

In this concept, the virtual space is structured as an invisible soundspace composed of sentences, words and phonemes which get triggered by users' movement and gesture. The audio material is based on statements of the four philosophers from Home of the Brain. It is decomposed in pieces forming "interactive soundspace" to provide an stage to be explored by the actors.

The sound space is structured in areas where the actors trigger full sentences, words or just phonemes. In the central area full statements of the philosophers converge and contrast each other. This central area sets the overall context for the actors from which they can depart to outward areas where the decomposed soundspace offers more freedom for individual exploration and recomposition. Since several actors are involved the also hears sounds triggered by the others which in turn influences one navigation and movement in space. Because of that and due to the fact that the structure of the soundspace is open and the connections between decomposed sound patterns and original theme are very subtle, the actors engage in an exploration of the soundspace which brings them into mutual play.

The underlying idea is in a way similar to Decroux's notion of "movements of thinking" conveyed through bodily expression underlayed by a silent musical score [6]. At the same time however, it serves a completely different purpose. Through the interplay with the soundspace and accordingly with other actors, the visitor moves away from his inner world into the multisensorial reality of the environment. It is an unconscious gestural body of the visitor that is induced by the interplay of soundspace and actors' movement. Starting out as conscious observers the actors find themselves becoming instinctive travellers.

# 6. Demonstrator: VRML based extended gallery "Murmuring Fields"

The "Murmuring Fields" VRML based extended gallery demonstrator, illustrates the most important findings of our research. It is realised as a mixed-reality installation for multiple participants, combining real and virtual space but it can also function as a pure distributed multi-user virtual environment supporting large numbers of users across the Internet.

Here we focus on the mixed-reality installation version because we find this approach of connecting participants in real and virtual spaces through an installation situated in public space, much more interesting. At the same time, the most important building blocks of the distributed version are visible in the installation because the VRML space is its integral part. The only difference is in the software used to provide multi-user support, which is in the installation version limited to the notion of a shared environment, and in the fact that Internet users have to rely on standard interfaces to interact through their TRACE-avatars.

The "Murmuring Fields" demonstrator presents a realised artistic concept for a VRML based extended gallery that grew out of the "Home of the Brain" concept as a point of departure. The name of the installation has been changed to better reflect the new concept embodying the results of our work.

The demonstrator addresses following issues:

- abstracting the notion of a public forum,
- esthetics of virtual representation of space,
- virtual representation of participants,
- interaction in virtual environments.

All of this has already been described in detail in previous chapters so in the next sections we will refer only briefly to how they are visible in the demonstrator. For a thorough treatment please refer to corresponding chapters in this report.

In the following sections we describe the "Murmuring Fields" artistic concept for a VRML based extended gallery and the way it is realised.

## 6.1 Artistic concept

Context:

- Interactive mixed reality stage,
- Performing memories,
- Audience engagement,
- Instinctive travellers,
- Mapping relations in hybrid space,
- Exploring actor object connections,
- Tracing unconscious movement,
- Visualising the gestural body,
- Creating awareness of the senses.

Murmuring Fields is an interactive stage for casual/accidental passerbys in real space and in Internet. It is an extended performance. An action oriented situation brings visitors in real space and visitors in Internet together in the Murmuring Fields.

The first thing visitors notice when they enter the space is the murmuring soundspace. The sound reacts on the movement of their bodies. Visitors can also observe the traces of their paths that are following them like a shadow. Unconsciously, they change from being spectators to becoming actors. The medial environment depicts the gestural trace of the actors in real-time and displays individual perspectives on the spatially arranged screens. Position and viewpoint orientation of other actors are thus visible to all. Three to four actors are tracked in the real space via an optical tracking system and Theremin fields. Visitors from the Internet come together with persons in real space through their TRACE-avatars.

The environment consists of a spatial tracking system, surround audio system, and a networked multi-user VRML environment connected with semi-transparent projection surfaces (that partake in shaping the real space). The intertwining of virtual and real space is realised by connecting output of the virtual scenery to semi-transparent projection surfaces that actively

co-design the overall spatial setting, and by emitting the sounds triggered in the virtual space into the real space of the installation.

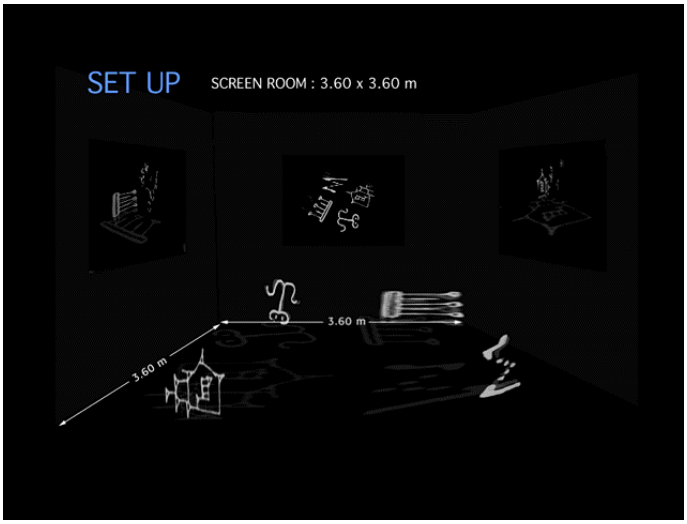


Fig. 14: "Murmuring Fields" installation set-up

We use the term "extended performance" to designate the quality of the interactive and digital space. More than just the extension of space through Internet, we are referring to overcoming the split between acting and observing: the externalisation of inner processes of the actor and the merging with other actors.

Kleist's famous essay "On the marionettes theatre" is the inspiration for the comparison of the marionette's state & movement of "unconscious grace" with the relation between human attitude and action. It is in the process of finding one's own centre of equilibrium through his TRACE-avatar that this comparison to the actor in Murmuring Fields functions. The human actor takes over the role of Kleist's marionette. The unconscious gesture creates traces in the virtual space and makes connections visible. The trace of the movement&gesture is the virtual representation of the actor - the TRACE-Avatar.

The actors' movement and gesture determines the shape and behaviour of the light-traces - the TRACE-avatars. The virtual traces form a memory space that reflects actors' individual movement. They also produce the negative-imprint of real elements in the virtual space. By following their traces on the surrounding projection screens the actors can observe the mapping of relationships through their interaction.

Both the virtual and the real space are equipped with signs as soundobjects that emit sentences, words or phonemes, when approached by the actors. The actual composition of the phonemes is left to actors' choice according to their free movement.

The movement of the actor in space creates a new audio-visual time-space, through the traces in the virtual space and the soundspace triggered and composed by actor's movement and gestures. Thus the interaction space of Murmuring Field combines elements of all three interaction concepts developed in our work: the SpaceDance of TRACE-avatars, the Instinctive SoundSpace, and the Play of Worldviews.

The virtual space is simultaneously present in Internet and can be entered by telepresent actors who thus actively partake in shaping the hybrid space. Thus, the shared communication space of the actors in Internet and actors in real space is the networked VRML stage, where all the TRACE-avatars meet.

## 6.2 Technical realisation

As stated in the Task 1.1 eRENA project proposal, the technical concept of the extended gallery demonstrator extends the original "Home of the Brain" environment towards a decentralised network architecture, supporting multiple users and allowing use of different network connections for individual parts of a shared environment. To this end we have developed two technical platforms addressing the different needs of the two concepts:

- a mixed-reality shared environment
- a pure multi-user distributed virtual environment.

The pure distributed virtual environment is implemented by further developing GMD's own interactive multi-user platform smallView, making it scalable to support a large number of users across the Internet. SmallView is a fully fledged VRML97 based multi-user virtual environment server and browser. The particular development for this task encompassed implementing support for IP Multicasting besides the original TCP/IP solution. A large amount of work was made towards ensuring the stability of the platform and keeping it updated with new requirements of the VRML97 standard. SmallView also incorporates Avatar nodes as an extension of the VRML standard to allow flexible user representation. Using smallView as the underlying platform the demonstrator can be run as a pure virtual environment accessible by large numbers of users across the Internet.

For the mixed-reality installation version of the demonstrator, which has been the main focus of our work, we have developed our own solutions as following extensions for existing VRML based browsers:

- support for multiple users in the concept of a hybrid-space shared environment,
    - MARS Simple Shared Environment Driver,
- support for multiple, networked, non-standard user interfaces (replacing the mouse and the keyboard),
    - MARS External User Interface Device Driver.

Platform and browser independence of these solutions is ensured by using Java as the language of implementation and using the External Authoring Interface (EAI) specification for communicating with the VRML browser and accessing internal structures of the VRML scene.

The newly developed concepts of avatars as user enactment and connected to real bodily movement, are implemented by following modules that we developed:

- optical tracking system based on mTRACK libraries from Michael Hoch of the KHM in Cologne
    - MARS Optical Tracking System
- support for using Theremins as simple gestural input devices
    - MARS Simple Gesture Interface Driver

The optical tracking system is used to track movement of participants in real space, while the Theremins are used to provide a simple way of involving user gestures. The data provided by these two systems determine in real-time the creation and form of the TRACE-avatars corresponding to individual participants.

The developed technical environment provides a platform which provides independent levels of control and implementation for:

- rendering and displaying of the virtual world
- multiple user support
  - for several users in a shared mixed-reality environment (no synchronisation support needed)
  - for large numbers of users in a pure, Internet based, virtual environment (full synchronisation support)
- non-standard user input devices (external and networked)

Figure 15 depicts overall architecture through the way these modules have been used for the realisation of the demonstrator; the general architecture of the resulting technical platform can also be understood from this sketch.

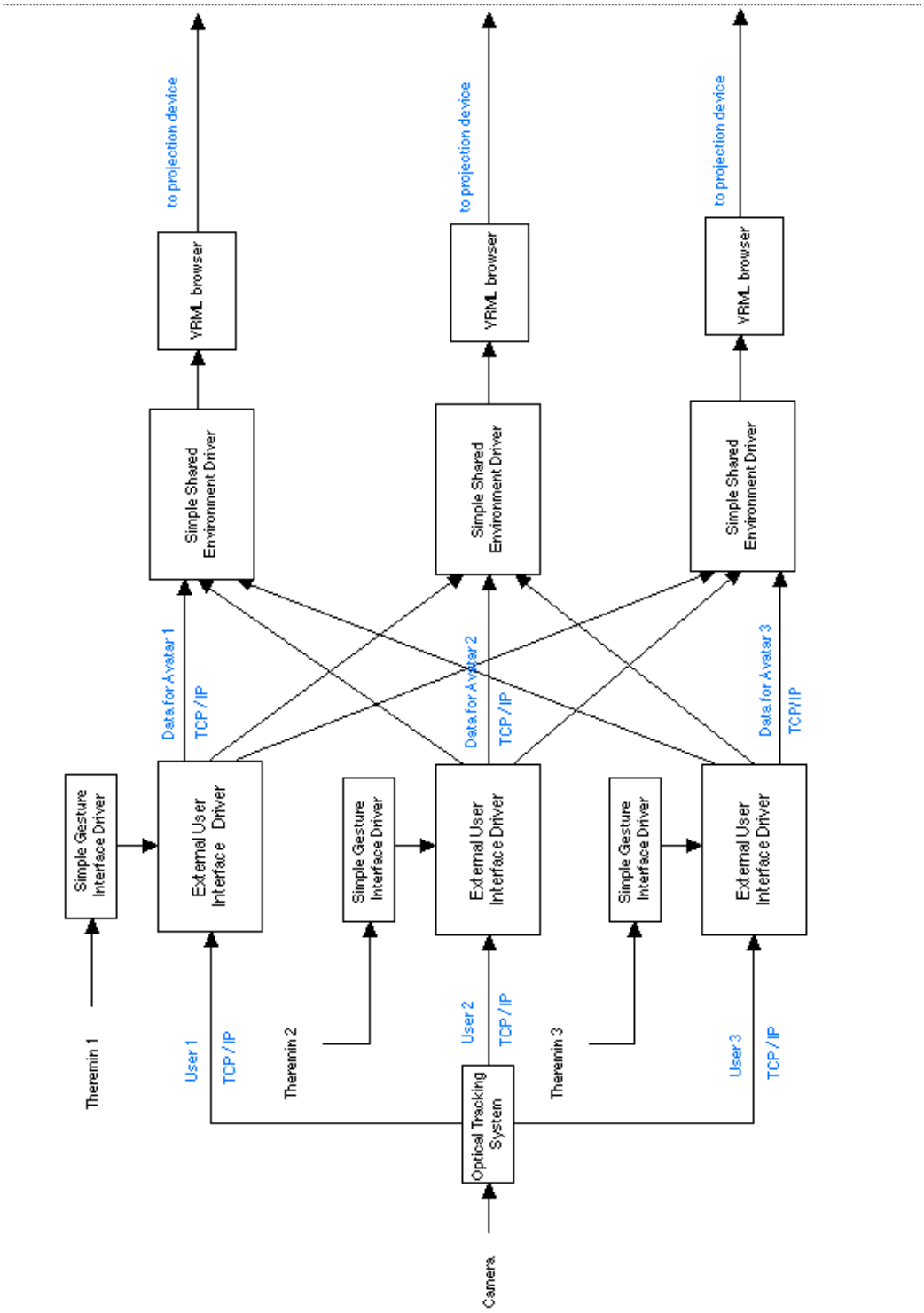


Fig. 15: Overall technical architecture for demonstrator realisation

Individual modules are described in the following sections, except for the tracking system and simple gesture interface driver which are described in the report for Task 6.1 dealing with new navigation devices.

The complete structure of the demonstrator as it would function as an installation is presented in the video accompanying the report (Video eRENA-GMD-D1.1) and additionally in the set

of sketches in the Appendix A. Virtual space structure and implementation has been described in Chapter 3.

### 6.2.1. MARS Simple Shared Environment Driver

This module consists of a set of Java classes invoked by an Java applet referenced as part of a HTML page in which the VRML file describing the virtual world is embedded. It basically receives avatar movement data over TCP/IP connections from the MARS External User Interface Driver module and causes movement of the corresponding avatar-objects in the VRML scene. (External Authoring Interfaces is used to access the internal VRML scene structure in the browser.)

Since the applet influences only the scene in the browser in which the applet was invoked, it is very simple to have a desired configuration of visual outputs of the scene in which the movement of all users is depicted. All one needs to do is start the applet with appropriate parameters for socket connections to the module that serves user movement data (external user interface driver) at the desired machines, or the desired number of times on the same machine. In this way one can easily have several outputs of the scene from different viewpoints, on one or on several different machines.

### 6.2.2. MARS External User Interface Driver

This module is responsible for getting data that are to control avatars' movement in the world, interpreting this data according to a certain format and transforming it into VRML co-ordinates.

The input data can come from any given input device (such as output from mouse, spacemouse, Theremin or optical tracking system) whose device driver must be outputting data to standard out. The module reads this data from standard out, transforms and maps them into appropriate VRML co-ordinates and sends out through a socket on a desired port.

For each avatar one instance of the module needs to be started with a different port for data delivery (to which the simple shared environment driver listens). In this way, individual avatars can be controlled remotely from different machines with multiple avatar controls per machine possible (depending only on the available number of input devices attached to the machine).

Because this module is independent of a particular interface (as it expects numerical input in a certain form that the interface device driver has to provide) it makes it possible to use any desired input device for controlling movement of avatars and navigation in the VRML scene.

Due to being independent from the module controlling the VRML scene, by communicating the avatar control data over socket connections, it allows extreme flexibility in designing different configurations of the shared environment (such as the number and distribution of output devices, types of interfaces, selection of viewpoints to be simultaneously displayed and controlled by different input devices).

# 7. Critical reflections

The "Murmuring Fields" demonstrator and the developed technical platform supporting its realisation provide a flexible experimental playground for further exploration of issues related to the concept of extended galleries and mixed-reality shared environments.

The biggest problem in our work on this task was trying out the concepts developed and getting a real feedback on how it would feel in the complete installation set-up envisioned. On one hand there is a big difference between experience of VRML based spaces in a monitor&mouse situation compared to a real space installation with VRML spaces on active projection surfaces. This applies to the experience of the soundspace and trace-avatars as user embodiments as well. The few occasions we had to simulate the actual set-up of the installation using the Virtual Studio provided extremely valuable feedback on the ideas and concepts developed.

Because all the components of the installation took time to develop but we were able to set-up these simulations only very recently before delivering the demonstrator for the review. Since the review that is taking place two months earlier than planned we basically lost the two months needed for the final tryout-evaluation-redesign cycle. Another critical thing in designing such environments is that the financial requirements of the complete set-up make it often, as in this case, impossible to try out the full installation set-up in the course of the work.

The most important conclusion from the simulation tryouts we did is that there is a lot more work to be done on mapping the output of tracking system describing positions of participants in real space to virtual space. One cause of the problem of mapping of participant's position is the large difference in scale between the virtual space and the real space available for our tryouts (100:1). The other is the fact that the tracking system at this point functioned with only one camera which, due to spatial constraints of the blue room, had to be positioned in one of the corners instead of vertically on the ceiling. The resulting perspective further deformed the mapping surface. Also, one camera tracking gives 2D positions only, so in this version the Theremins were used to add the third dimension (height).

The limited number of Theremins we had available, the rather limited reach of the individual pieces and their mutual interference, restrained us to having the height of the traces influenced by the actors only at few spots in real space. This is clearly visible in the video in parts where the traces remain at the height of the floor. These two points, the optical tracking systems and the Theremins as gestural interfaces are two most critical issues for further work. Details on these aspects can be found in the report for Task6.1 which deals with navigation devices in particular.

Organising the embedding of virtual space into the real space of the installation is also something where much more experimentation with the real set-up would have been needed. Especially the problem of choosing right projection surfaces i.e. the monitor based displays as active luminescent surfaces vs. Big projections screens is still to be resolved. This is important because of the aesthetic impact of the visual, as one of the enticing elements which, tends to get very much crippled by pixelisation on big projection screens.

Designing the soundspace was another difficult issue because what would have been needed throughout the design process instead of the VRML space only, is the real experience of triggering by body movement in real space, which was unavailable until the complete technical platform including camera tracking system was realised.

As in every interactive installation the real development process regarding interaction scenarios is still ahead because it needs the input from experiences with real "users". This especially regards feedback on developed interaction scenarios and the concept of trace-avatars as real body connected user presence and interaction mechanism.

We are working on setting up the complete installation for the Cyberstar award ceremony and performance on June 14 where it could be experienced by a wide audience. Our previous experiences teach us that such observation opportunities are extremely helpful for realising the real issues and problems and setting pointers for further work, especially concerning the guidelines and strategies for eRENA work in year two.

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