

Appendix A

Glossary

It is important to define each of the major terms that relate to this work, so that the problem is well understood when talking about collaborative interaction in Virtual Environments. In addition, this list is used by the non-VE expert evaluators as most of the terms appear in the questionnaires (Appendices C-G).

- **display systems** \Rightarrow Monitors denote display systems for example. There exist even more advanced displays systems, like a room displaying images on each of its four or five walls. This room is called **CAVE**.
- **stereo glasses, shutter glasses** \Rightarrow A special type of glasses that enable viewing of artificial stereo images in a Virtual Environment.
- **Virtual Environment, VE** \Rightarrow VEs are synthetic, computer generated environments which immerse the user and generate the illusion to be at another place.
- **Collaborative Virtual Environment, CVE** \Rightarrow CVEs are multi-party VEs which allow a number of users to share a common virtual space, where they may interact with each other and the environment itself.
- **being present** \Rightarrow Denotes the feeling of being in another world or of someone else being in your world.
- **lighting uniformity** \Rightarrow Lighting uniformity denotes the overall result of all light sources in your environment. They determine the brightness and contrast of most of the things there. The uniformity will determine whether there are parts really bright while others are dark.
- **transfer rate** \Rightarrow The transfer rate denotes the rate with which your environment imports and exports data from and to other environments.

The higher this transfer rate the more smooth movements of things in your environment appear to you.

- **cabling** \Rightarrow As most of the technical equipment needs electricity they are connected to energy sources using cables. Additionally cables are used for transferring data from external devices to the computer and vice versa.
- **physical input device** \Rightarrow Pen like devices or computer game joysticks are electronic input tools for interacting with the virtual world. These physical input devices enable the user to interact with the computer and are often denoted as man-machine-interfaces.
- **tool** \Rightarrow Tools are representing different operations, actions and functionality. A tool could be a virtual pair of pliers or a hammer or a scalpel for example. They are often presented on special toolbars and menus.
- **virtual tool representation** \Rightarrow They represent the selected tools which are then attached to the physical input device. This could be a small three-dimensional hammer model following the movements of the user's hand.

Appendix B

Stereo Video Scheme Code

```

;; instantiate and register the DivoService
;; -----
(define divo-service (make-instance-by-name "fpDivoService"))
(-> divo-service 'register-service "DivoService")

;; instantiate and register the movie service
;; -----
(define movie-service (make-instance-by-name "fpMovieService"))
(-> movie-service 'register-service "MovieService")

;; instantiate a movie texture ;;
-----
(define movie (make-instance-by-name "fpMovieTex"))

;; instantiate the fpDrawEyes node and
;; configure them for the left and right eye
;; -----
(define left-eye (make-instance-by-name "fpDrawEyes"))
(define right-eye (make-instance-by-name "fpDrawEyes"))

;; set both fpDrawEyes nodes active but assign
;; the start to the right eye
;; -----
(-> (-> left-eye 'Enable) 'set-value 1)
(-> (-> right-eye 'Enable) 'set-value 1)
(-> (-> right-eye 'WhichEye) 1)

;; instantiate fpFile nodes and
;; load the screen geometry to play the movies on

```

```

;; -----
(define screen-eye-left (make-instance-by-name "fpFile"))
(define screen-eye-right (make-instance-by-name "fpFile"))

(-> (-> screen-eye-left 'Filename) 'set-value "./data/video-screenLeft.iv")
(-> (-> screen-eye-right 'Filename) 'set-value "./data/video-screenRight.iv")

;; instantiate a fpDCS for grouping everything
;; and plug the tree together
;; -----
(define screen-dcs (make-instance-by-name "fpDCS"))

(-> (-> left-eye 'Children) 'add-1value EyeLeft)
(-> (-> right-eye 'Children) 'add-1value EyeRight)
(-> (-> screen-dcs 'Children) 'set-value (list right-eye left-eye))
(-> (-> scene-root 'Children) 'set-value (list movie screen-dcs))

;; create a material, set it blank, it is later used
;; for overriding the screen geometry
;; -----
(define material (make-instance-by-name "fpMaterial"))
(-> (-> material 'Diffuse) 'set-value (make-vec3 0 0 0))
(-> (-> material 'Alpha) 'set-value 0.5)
(-> (-> material 'FrontColorMode) 'set-value 0)

;; assign the material to the fpDrawEyes nodes
;; it is used for overriding the material of the screen geometry
;; in the pre- and post-draw-call-backs
;; -----
(-> (-> left-eye 'Material) 'set-value material)
(-> (-> right-eye 'Material) 'set-value material)

;; determine where the texture comes from and
;; onto which geometry the texture has to be mapped
;; -----
(-> (-> movie 'URL) 'set-value "Div01")
(-> (-> movie 'NodeList) 'add-1value screen-eye-left)
(-> (-> movie 'NodeList) 'add-1value screen-eye-right)

;; finally play the video ->
;; that means set the download of video texture active
;; -----
(-> (-> movie 'Playing) 'set-value 1)

```

Appendix C

Introduction questionnaire

- Ihr Alter
Your age
- Welchen Beruf üben Sie aus ?
What is your profession ?
- Sind Sie
Are you
 - Rechtshänder / right-hander
 - Linkshänder / left-hander
 - beidhändig / both-handed
- Wieviele Stunden in der Woche benutzen Sie einen Computer ?
How often do you use a computer per week ?
 - weniger als eine Stunde / less than one hour
 - 1-5 Stunden / 1-5 hours
 - 5-10 Stunden / 5-10 hours
 - 10-30 Stunden / 10-30 hours
 - mehr als 30 Stunden / more than 30 hours
- Mit welchen Eingabegeräten haben Sie Erfahrungen ?
Which of the following input devices have you used already ?
 - Mouse
 - Joystick
 - Touch Screen

APPENDIX C. INTRODUCTION QUESTIONNAIRE

- 3D Eingabegeräte / 3D input devices
 - Andere / others :
- Haben Sie jemals Virtuelle Umgebungen benutzt ?
Have you ever used virtual environments ?
 - häufig / often
 - manchmal / sometimes
 - niemals / never
- Wofür benutzen Sie Ihren Computer ? (Mehrfachnennung möglich)
What do you use your computer for ? (more than one tick possible)
 - Textverarbeitung / Text editing
 - Spiele / Games
 - Internet surfing
 - 3D Modellierung / 3D Modelling
- Welche der Displays haben Sie schon benutzt ?
Which of these display systems have you used already ?
 - Monitor (mit/with Mouse und/and Joystick)
 - stereoskopisch/stereoscopic Monitor
 - Stereoskopische Projektionswand / stereoscopic projection Wall
 - Responsive Workbench (TM)
 - CAVE(TM)
 - Head-Mounted Displays

Appendix D

Usability questionnaire

- A1. Hatten Sie das Gefühl, daß ihr VE auf Ihre Eingaben reagiert hat ?
Did you feel the VE was responding to your actions ?
 - 6 oft/often
 - 5
 - 4
 - 3 manchmal/sometimes
 - 2
 - 1
 - 0 niemals/never

- A2. War das Arbeiten mit den Eingabegeräten komfortabel ?
Did you feel comfortable working with the input devices ?
 - 6 gut/good
 - 5
 - 4
 - 3 akzeptabel/acceptable
 - 2
 - 1
 - 0 schlecht/bad

- A3. War das Arbeiten mit der Stereobrille komfortabel ?
Did you feel comfortable working with the stereo glasses ?

- 6 gut/good
 - 5
 - 4
 - 3 akzeptabel/acceptable
 - 2
 - 1
 - 0 schlecht/bad
- A4. War das arbeiten mit der Verkabelung komfortabel ?
Did you feel comfortable working with the cabling ?
 - 6 gut/good
 - 5
 - 4
 - 3 akzeptabel/acceptable
 - 2
 - 1
 - 0 schlecht/bad
- A5. Wie beurteilen Sie die Darstellung von Schrift innerhalb des VE ?
How do you rate the appearance of text in the VE ?
 - 6 gut/good
 - 5
 - 4
 - 3 akzeptabel/acceptable
 - 2
 - 1
 - 0 schlecht/bad
- A6. Fanden Sie die virtuellen Werkzeugrepräsentationen intuitiv ?
Did you find the virtual tool representations intuitive ?
 - 6 ja, gut/yes, good
 - 5

- 4
 - 3 akzeptabel/acceptable
 - 2
 - 1
 - 0 nein. schlecht/no, bad
- Wie fanden Sie die Anordnung der
How do you rate the alignment of the

A7. Werkzeuge ? / tools ?

- 6 gut/good
- 5
- 4
- 3 akzeptabel/acceptable
- 2
- 1
- 0 schlecht/bad

A8. Menüs ? / menus ?

- 6 gut/good
- 5
- 4
- 3 akzeptabel/acceptable
- 2
- 1
- 0 schlecht/bad

APPENDIX D. USABILITY QUESTIONNAIRE

Appendix E

Co-presence questionnaire

- B1. Hatten Sie das Gefühl, Ihr Partner stehe auf der anderen Seite des Tisches ?
Did you have the impression your partner was standing on the other side of the table ?
 - 6 ja/yes
 - 5
 - 4
 - 3 manchmal/sometimes
 - 2
 - 1
 - 0 nein/no

- B2. Hatten Sie das Gefühl, daß Ihre Stereobrille und die Ihres Partners ihre Kommunikation behindert ?
Did yours and your partner's stereo glasses hinder your communication ?
 - 6 überhaupt nicht/not at all
 - 5
 - 4
 - 3 manchmal/sometimes
 - 2
 - 1
 - 0 sehr/very

APPENDIX E. CO-PRESENCE QUESTIONNAIRE

- B3. Hatten Sie den Eindruck, dass Ihr Partner Sie anschaute ?
Did you have the impression your partner was looking at you ?
 - 6 ja/yes
 - 5
 - 4
 - 3 manchmal/sometimes
 - 2
 - 1
 - 0 nein/no

- B4. Hatten Sie das Gefühl mit einer Person oder mit einer Maschine zu kommunizieren ?
Did you have the impression to communicate with a person or with a machine ?
 - 6 Person
 - 5
 - 4
 - 3 künstliche Person / artificial person
 - 2
 - 1
 - 0 Maschine

- B5. Hatten Sie wegen der Zeitverzögerung in der Videoübertragung das Gefühl, daß Ihr Partner weniger präsent wäre ?
Did you have the impression due to the delay in video transmission that your partner was less present ?
 - 6 nein/no
 - 5
 - 4
 - 3 manchmal/sometimes
 - 2
 - 1
 - 0 ja/yes

- B6. Hatten Sie wegen der Zeitverzögerung in der Audioübertragung das Gefühl, daß Ihr Partner weniger präsent wäre ?
Did you have the impression due to the delay in audio transmission that your partner was less present ?
 - 6 nein/no
 - 5
 - 4
 - 3 manchmal/sometimes
 - 2
 - 1
 - 0 ja/yes

- B7. Sind Sie der Meinung, daß das Videobild Ihres Partner wirklich notwendig ist ?
Do you think that the video image of your partner is really necessary ?
 - 6 ja/yes
 - 5
 - 4
 - 3 manchmal/sometimes
 - 2
 - 1
 - 0 nein/no

- B8. Sind Sie der Meinung, daß Sie Ihre Aufgaben ebenfalls ohne das Videobild Ihres Partner vollenden könnten ?
Do you think you could complete your task even without the video image of your partner ?
 - 6 ja/yes
 - 5
 - 4
 - 3 vielleicht/maybe
 - 2
 - 1

APPENDIX E. CO-PRESENCE QUESTIONNAIRE

- 0 nein/no
- B' Welchen Hintergrund hinter Ihrem Partner haben Sie bevorzugt ?
Which background behind your partner did you prefer ?
 - Kamerahintergrund / camera background
 - künstlicher Hintergrund (z. B. Operationsraum) / artificial background (e.g. operating room)
 - uniformer Hintergrund (z. B. blauer, schwarzer Vorhang) / uniform background (e.g. blue, black curtain)
- Welche der folgenden Faktoren, würden die Präsenz Ihres Partners für Sie erhöhen ?
Which of the following factors can increase the co-presence of your partner ?

B9. Ausleuchtung / lighting uniformity

- 6 sehr/very
- 5
- 4
- 3 vielleicht/maybe
- 2
- 1
- 0 ueberhaupt nicht/not at all

B10. Übertragungsgeschwindigkeit / transfer rate

- 6 sehr/very
- 5
- 4
- 3 vielleicht/maybe
- 2
- 1
- 0 ueberhaupt nicht/not at all

B11. Position und Größe des Partners / partners position and size

- 6 sehr/very
- 5
- 4
- 3 vielleicht/maybe
- 2
- 1
- 0 überhaupt nicht/not at all

APPENDIX E. CO-PRESENCE QUESTIONNAIRE

Appendix F

Co-work questionnaire

- C1. Hatten Sie das Gefühl mit einer Person oder mit einer Maschine zu kommunizieren ?
Did you have the impression to communicate with a person or a machine ?
 - 6 Person
 - 5
 - 4
 - 3 künstliche Person / artificial person
 - 2
 - 1
 - 0 Maschine

- C2. Würden Sie nochmal mit demselben Partner zusammenarbeiten ?
Would you collaborate with the same partner again ?
 - 6 ja/yes
 - 5
 - 4
 - 3 vielleicht/maybe
 - 2
 - 1
 - 0 nein/no

- C3. Wußten Sie immer, was Ihr Partner gerade tut ?
Did you always know what your partner was doing ?

APPENDIX F. CO-WORK QUESTIONNAIRE

- 6 ja, immer/yes, always
 - 5
 - 4
 - 3 manchmal/sometimes
 - 2
 - 1
 - 0 nein, nie/no, never
- C4. Wußten Sie immer, wo Ihr Partner gerade steht ?
Did you always know where your partner was standing ?
 - 6 ja, immer/yes, always
 - 5
 - 4
 - 3 manchmal/sometimes
 - 2
 - 1
 - 0 nein, nie/no, never
- C5. Wie oft haben Sie Ihren Partner angeschaut ?
How often did you look at your partner ?
 - 6 häufig/often
 - 5
 - 4
 - 3 manchmal/sometimes
 - 2
 - 1
 - 0 nie/never
- C6. Wie oft haben Sie zu Ihrem Partner gesprochen ?
How often did you speak to your partner ?
 - 6 häufig/often
 - 5

- 4
 - 3 manchmal/sometimes
 - 2
 - 1
 - 0 nie/never

- C7. Hatten Sie das Gefühl während der Ausführung Ihrer Aufgabe gleichberechtigt zu sein ?
Did you have the impression you had an equal part while working together ?
 - 6 ja/yes
 - 5
 - 4
 - 3 mehr oder weniger/more or less
 - 2
 - 1
 - 0 nein/no

- C8. Sahen Sie Ihren Partner als gleichberechtigt an ?
Did you see your partner as equal ?
 - 6 ja/yes
 - 5
 - 4
 - 3 mehr oder weniger/more or less
 - 2
 - 1
 - 0 nein/no

- C9. Haben die Hand und Körpergesten Ihres Partners die Zusammenarbeit unterstützt ?
Did hand and body gestures of your partner support your collaboration ?
 - 6 ja/yes

APPENDIX F. CO-WORK QUESTIONNAIRE

- 5
 - 4
 - 3 mehr oder weniger / more or less
 - 2
 - 1
 - 0 nein/no
- C10. Sind Sie der Meinung, daß das Videobild Ihres Partner wirklich notwendig ist ?
Do you think that the video image of your partner is really necessary ?
 - 6 ja/yes
 - 5
 - 4
 - 3 manchmal/sometimes
 - 2
 - 1
 - 0 nein/no
 - C11. Sind Sie der Meinung, daß Sie Ihre Aufgaben ebenfalls ohne das Videobild Ihres Partner vollenden könnten ?
Do you think you could complete your task even without the video image of your partner ?
 - 6 ja/yes
 - 5
 - 4
 - 3 vielleicht/maybe
 - 2
 - 1
 - 0 nein/no
 - C12. War die gesamte Zusammenarbeit befriedigend ?
Was the overall collaboration satisfying ?
 - 6 ja/yes

- 5
- 4
- 3 mehr oder weniger / more or less
- 2
- 1
- 0 nein/no

Appendix G

Observer questionnaire

- D1. Wie lange mußte der Benutzer überlegen, um eine Tätigkeit auszuführen ?

How long did the user have to think before performing an action ?

- 6 kurz/shortly
- 5
- 4
- 3
- 2
- 1
- 0 lange/long

- D2. Mußten sich die Benutzer lange besprechen eine Tätigkeit auszuführen ?

Did the users have to debate a lot before performing an action ?

- 6 ja/yes
- 5
- 4
- 3 mehr oder weniger / more or less
- 2
- 1
- 0 nein/no

APPENDIX G. OBSERVER QUESTIONNAIRE

- D3. Hatte der Benutzer Probleme Werkzeuge mit seiner/ihrer rechten oder linken hand auszuwählen ?
Did the user have problems to select tools with his/her right or left hand ?
 - 6 ja/yes
 - 5
 - 4
 - 3 mehr oder weniger / more or less
 - 2
 - 1
 - 0 nein/no

- D4. Hatte der Benutzer Probleme mit seiner/ihrer Orientierung ?
Did the user have problems with orientation ?
 - 6 ja/yes
 - 5
 - 4
 - 3 mehr oder weniger / more or less
 - 2
 - 1
 - 0 nein/no

- D5. War es offensichtlich, daß der Benutzer während der Session an Konzentration verlor ?
Did the user obviously loose concentration during a session ?
 - 6 ja/yes
 - 5
 - 4
 - 3 nicht signifikant / not significant
 - 2
 - 1
 - 0 nein/no

- D6. Wie schnell konnte der Benutzer Fehler korrigieren und die Arbeit fortsetzen ?
How quickly could the user correct mistakes and continue the work ?
 - 6 sehr schnell/very quickly
 - 5
 - 4
 - 3
 - 2
 - 1
 - 0 sehr langsam/very slowly

- D7. Hatte der Benutzer Spaß während der Session ?
Did the user have fun during the session ?
 - Ja / Yes
 - Nein /No

- Informal observations of the user:

APPENDIX G. OBSERVER QUESTIONNAIRE

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