PPR-2, Part A

Executive Summary

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1. Introduction

The ESPRIT, LTR, i3-ESE project EP 29335, PUPPET, "The Educational Puppet Theatre of Virtual Worlds", has the objective to develop and investigate the value of a new virtual environment for use in early learning. Based on a theoretical framework of "learning through externalisation", PUPPET aims at extending the current forms of early learning through play, by exploiting the potential of virtual 3-D worlds, autonomous agents, and real time interaction in terms of Virtual Puppet Theatres (VPT), - using the theatre metaphor.

The results of the project will be to: i) promote new forms of creativity made possible by new IT-tools, ii) enable new forms of self expression not possible with conventional plays, iii) encourage learning to learn, and iv) allow for a new form of computer-literacy.

The 3 year project plan was revised after first year on the basis of experience gained and on the recommendation of the reviewers. The new plan has two major milestones in terms of implemented VPTs and their tests in schools. The work package A (mainly 2nd year) develops the *"VPT-A for Improvisational Plays"* as this is the particular aspect of what the technology of "the new tools" can offer. To allow for more direct story-telling/construction the work package B of mainly the 3rd year extends VPT-A to become "VPT-B with Authoring Tools and Narrative support".

The project consortium comprises 4 partners:

1. LIA, Aalborg University, Laboratory of Image Analysis (old name maintained here)
(New name: CVMT, Laboratory of Computer Vision and Media Technology)

Team Leader	Erik Granum (*PUPPET Project Co-ordinator*)
Deputy	Claus B. Madsen

2. COGS, University of Sussex, School of Cognitive and Computing Science

Team Leader	Mike Scaife
Deputy	Yvonne Rogers, (Patricia George)

3. IDAU, Århus University, Institute of Dramaturgy

Team Leader	Janek Szatkowski
Deputy	Torunn Kjølner

4. DFKI, Deutsches Forschungszentrum für Künstliche Intelligenz, Saarbrücken, Intelligent User Interfaces

Team Leader	Dr. Elizabeth Andre
Deputy	Dr. Thomas Rist

This reporting on the progress of the second year of the project is divided into 3 parts:

Part A: Executive Summary

Reviewing the technical, administrative, and collaborative aspects of the project's second year, as well as dissemination efforts.

Part B: Work Part Reports

Reporting on work done for each work-part at the level of tasks.

Part C: Deliverables of Year Two

External deliverables supplemented with internal reports and reprints of publications

2. Significant Achievements and Problems

The Puppet project concerns development of new tools to support early learning. However, the first year clearly indicated that the project partners also had a considerabl e learning phase to get through in order to make the necessary interdisciplinary efforts successful.

One important projection of this problem was formulated by the reviewers as the need for a shared vision. We have worked on that, and the revised Project P rogramme outlines a shared vision and its components of individual partner visions, from which it was derived. The vision was formulated as follows:

"Our shared vision is that the project will be able to explore how a real time interactive virtual 3D world (VPT) inhabited with life -like autonomous agents can be exploited by children through a dramaturgical framework of improvisational play to externalize their ideas and fulfill their imagination and creative capacity."

We like this formulation, which expresses where we want to go and indicates why. However, it does not tell how to get there and what the premises are.

The approach was originally and for good reasons very child centred on the basis of EL theories and empirical experience. Concepts and a frame work around the story -telling child-user were developed by COGS and carefully specified last year. These specs did not quite match what the technical partners envisaged as the novel contribution of new tools, but an overoptimistic view tried to accept thes e goals by assuming they could be achieved also as add-on facilities to the essential contribution of the new technology.

On the basis of our experience and the recommendation of the reviewers, we realized that the above approach was not feasible. The new Project Programme describes a new strategy with a starting point in the particular and interesting possibilities of improvising autonomous puppets which the new technology provides, and then finding ways of exploiting these optimally for the sake of early learning support.

The dramaturges have taken a lead as suggested and they have successfully met the challenge of developing a dramaturgical framework, which may bridge the gap between the storytelling child and the real time interactive puppet theatre with autonomous actors. Their framework labeled "The Black Sheep" is developed and refined through consultations with all partners, and it is fully acknowledged by all as the vehicle tying it all together.

While this very creative IDAU driven development took place regarding the inside of the puppet theatre and while COGS investigated aspects from the child's view from outside and around the theatre, the engineers struggled to make the platform dream come true.

The price for the ambitions of having

perceiving and reasoning autonomous agents

interacting in the real time

in a 3D world

was coming more and more clear to system designers and implementers. High level agents could not cope with the fast stream of perceptual information provided, communication channels were too slow, multiple agent and simultaneous actions needed special attention, etc.

All in all further delay of the VPT-A prototype for testing occurred with major frustrations for all parties. Psychologists were losing faith and found it very hard to im agine what all this autonomy eventually would be like, and engineers started worrying that the potential they knew was there would be all too hard to "bring to life" in a convincing manner.

The consortium has been through a period of great stress for these reasons, but the last couple of months have been dominated by a convergence where also psychologists are coming into the virtual world to help the birth of the living VPT-A from "inside-out".

The problem of shaping the technology to become the expected to ol is now a responsibility shared by all, and hence the necessary mutual understanding and appreciation has entered a very constructive and promising phase.

In the very days of the preparations for the review major advances were made on the basis of close collaboration on the system and an intense test and refinement effort involving all partners will take place right after the i3AC.

It is clear though, that making autonomous and interacting agents/puppets appear lively and appealing is no simple matter. It involves also a special art, that it may take time to learn and master. There are no text books describing how to make it work properly, and many iterative series of interactive experiments and program adjustments will be required to meet our goals.

The performance which we can present at the review has taken us over the critical threshold, so that we have faith and enthusiasm that we will come on top of the technology and be able shape it to serve our purposes.

By the end of year 2 (October 15) we should have a VPT-A ready for a meaningful school test confronting the children with our virtual farm and its inhabitants.

Future Plans

As indicated above the first of the coming milestones will be maturing the current VPT -A for school tests (October 15), with capabilities at least as levels I and II in the outline of the dramaturges. This will give important input to specifications of VPT-B.

Next milestone will be the proper VPT -A implementing the "Black Sheep". This requires in particular advances in agent be haviour capabilities. A school test will probably take place early 2001.

Final milestone is the VPT -B with some authoring tools including recording and playback. The timing of external deliverables and tests on this part is expected according to plans outlined in the revised Project Programme. However, the ambition of a multi -user configuration is considered unrealistic.

3. Contacts with Other Projects and Parties

During the second year contacts with other parties have been on the level of individual partners.

LIA

LIA plays a leading role in the larger interdisciplinary Danish research project "The Staging of Inhabited, Virtual 3D Spaces" with a technical task similar to its task in PUPPET. This "Staging" project is concerned with investigating the concept of a virtual theatre, and wants to explore the virtual worlds using the theatre metaphor. The "Staging" project, which is more of a basic research character, actually inspired the creation of the PUPPET project. Co-ordination of the two projects' resources is aimed at. LIA also has other projects with activities related to PUPPET interests, in particular on visually guided interfaces.

International contacts of the past year in fields relevant to PUPPET have more been in virtual reality and visualisation in connection with our new VR-Centre. LIA has not served on any i3 committees in passed year, nor has there been time to take initiatives for the theatrical and storytelling projects of i3-ESE.

COGS

COGS has had discussions at various meetings with POGO and with Kidstory.

COGS has also been talking to researchers outside ESE about the aims and methods we have been employing on PUPPET. Mike Scaife has visited psychologists/HCI researchers in Brisbane & Melbourne, Australia; Milan, Italy; Padova, Italy. Yvonne Rogers has visited Xerox Parc, California, Queensland Technical University, Australia and both have given talks on the project (see below).

DFKI

Members of the DFKI team have had various discussions with members of i3 Persona and i3 ese Nimis project which resulted into the successful acquisition of two new European projects: SAFIRA (Supporting Affective Interactions for Real-time Applications) and MagiCster (Advanced Training with an Embodied Believable Agent). Furthermore, Elisabeth André (Puppet project) and Ana Paiva (Nimis project) are editing a Special Issue entitled: "*User Modeling and Intelligent Agents"* for the UMUAI Journal (User Modeling and User-Adapted Interaction).

Furthermore, the DFKI team has been in close contact with researchers outside i3, in particular with Prof. Norman Badler from the University of Pennsylvania, Prof. James Lester from North Carolina State University, Dr. Jeff Rickel and Prof. Lewis Johnson from ISI and Prof. Justine Cassell from MIT Media Lab. The contact with Prof. Dr. Norman Badler

resulted into the successful acquisition of the EU -funded International MagiCster project (see above).

Finally, members of the DFKI team established links to the International Scientific Forum *"Towards an Information Society for All"* (ISF) which resulted into the following activities:

- Organization of joint i3 Spring Days Workshop on "Interactive Learning Environments for Children"
- Successful submission of an EU working group proposal entitled IS4ALL ("Information Society for All")
- Preparation of a new journal entitled *"Universal Access to the Information Society: An international interdisciplinary journal"* edited by Springer

IDAU

All the members of the IDAU team have been involved in the Danish National Research Programme "Staging of virtual inhabited 3D spaces". In relation with this we have met with researchers and artists working in 3D virtual spaces and/or using net -based experiments with interactivity (f.i. Douglas Davies, USA, May). IDAU have reserved the allocated travel money for the internal travels.

4. Dissemination and Take-up of Results

(*) indicates that the publication is submitted as part of PPR-2, Part C, Deliverables.

LIA / AAU

Publications Related to PUPPET (also re interfaces)

- Contributions to the monograph "Virtual Interaction: Interaction in Virtual Inhabited 3D Worlds", L Qvortrup (ed), Springer. To appear October 2000:
  - Erik Granum (Section Editor): "*Introduction*" (Section 2, pp 97-101)
  - (*)Claus B. Madsen and Erik Granum: "*Aspects of Interactive Autonomy and Perception*", (Chapter 9, pp 183-210)
  - (*)Peter Bøgh Andersen, Claus B. Madsen and Erik Granum: "*Discussion*", (Chapter 10, pp 210-217)
  - Thomas B. Moeslund: "*Interacting with a Virtual World through Motion Capture*", (Chapter 11, pp 221-235)

2. Thomas B. Moeslund and Erik Granum: *"Visual Motion Capture as a means of Control and Telepresence"* The 9th Danish conference on pattern recognition and image analysis, Aalborg, Denmark, August 2000 (pp 29-36)
3. Thomas B. Moeslund, Moritz Störring, and Erik Granum: " *Vision-Based User Interface for Interacting with a Virtual Environment* The 9th Danish conference on pattern recognition and image analysis, Aalborg, Denmark, August 2000 (pp 20-28)
4. Moritz Störring, Hans J. Andersen, and Erik Granum: *"Estimation of the Illumin ant Colour from Human Skin Colour"*. 4th International Conference on Automatic Face and Gesture Recognition, pages 64-69, Grenoble, France, March 2000
5. Moritz Störring, Hans J. Andersen, and Erik Granum: *"Estimation of the Illuminant Colour using Highlights from Human Skin"* . Accepted for oral presentation at 1st International Conference on Colour in Graphics and Image Processing, Saint -Etienne, France, October 2000
6. Karin Husballe Munk, Technical report: *Data Glove Driver and Gesture Server* . Techn. Report, CVMT, Aalborg University, January 13, 2000

Talks and Contacts Related to PUPPET

Meeting with AM-Production, Aalborg, May 2000

DANKOMB, National Conference, August 2000

7. Bo Cordes Petersen: *"Design and Implementation of a Virtual Environment for Virtual Theatre"*
8. Claus B. Madsen: *"Perception and Spatial Awareness of Reactive Agents"*
9. Rasmus Agerholm: *"Roleplaying Interactive Autonomous Agents in the Virtual World"*

COGS

The members of the group have been active in promoting the work of the project throu gh talks and paper submissions.

Publications Related to PUPPET

- Gabrielli S., Rogers Y. & Scaife M. (1999). Visual Perspective Taking and Young Children,s Development of Functional Spatial Representations in Virtual Environments. Proc. of the European Con ference on Cognitive Science (ECCS99), Sienna (I), October 1999, 411-416.

(*) George, P. and McIllhagga, M. (2000) The Communication of Meaningful Emotional Information for Children Interacting with Virtual Actors. To appear in: Affect and Interaction. Springer (in press).

10. McIllhagga, M. and George, P. (1999). Communicating meaningful emotional information in a virtual world. A. Paiva (ed) Affect in Interaction.

- Scaife, M. & Rogers, Y. (2000) Informing the design of a virtual environments: The PUPPET project. For International Journal of Human -Computer Studies, special issue on: User-centred design and implementation of virtual environments. (in press)

Talks Related to PUPPET

- Gabrielli, S., Scaife, M. & Rogers, Y. (1999) Children,s learning in Vir tual Environments. European Cognitive Science Society, Siena, October.
- Rogers, Y. (2000) Interaction design for children. Queensland University, June 2000.
- Rogers, Y. (2000) Interaction design. Sydney Technical University, July 2000.
- Scaife, M. (2000) Œ PUPPET,: designing a virtual theatre for young children, Monash University, July.
- Scaife, M. (2000) Interactive Virtual Design. Melbourne University, July
- Scaife, M. (2000) External Cognition and Effective Interactive Learning. Symposium on Cognition, Educ ation and Communication Technology. Swedish Cognitive Science Society, Stockholm, April

DFKI

The members of the group have been active in promoting the work of the project through system demonstrations to industries, publications, talks and workshops.

System demonstrations to industries and political organizations:

- Wirtschaftsmininisterium Saar, Saarbrücken, April 2000

- Representatives of the Provincia di Trento, Italy, February 2000
- Net-Linx AG, Dresden, Germany, February 2000
- Siemens AG, Munich, Germany March 2000
- MITRE Inc., Washington, USA, July 2000
- IBM T.J. Watson Research Center, New York, July 2000

Publications Related to PUPPET

- Elisabeth André, Special Issue on “Behavior Planning for Life -Like Characters and Avatars” based on an i3 Spri ng Days '99 Workshop, Journal of Artificial Intelligence Communications (AICOM), Sept. 2000.
- Elisabeth André, Martin Klesen Puppet - Ein virtuelles Puppentheater. In: KI - Zeitschrift Künstliche Intelligenz, Heft 2/00, Seiten 32 -33, ISSN 0933 -1875, arenDTa P Verlag, Bremen, 2000.

(*) Martin Klesen, Janek Szatkowski, and Niels Lehmann. The Black Sheep - Interactive Improvisation in a 3D Virtual World. In: Proceedings of the i3 Annual Conference 2000, Jönköping, Schweden, 13 - 15 September 2000.

- Elisabeth Andr é, Martin Klesen, Patrick Gebhard, Steve Allen, and Thomas Rist. Integrating Models of Personality and Emotions into Lifelike Characters. In: Affect in Interaction. Berlin, Heidelberg: Springer, 2000. to appear.
- Elisabeth André, Martin Klesen, Patrick Gebh ard, Steve Allen, and Thomas Rist. Exploiting Models of Personality and Emotions to Control the Behavior of Animated Interface Agents. In: Jeff Rickel (eds.), Proceedings of the workshop on "Achieving Human-Like Behavior in Interactive Animated Agents" in conjunction with the Fourth International Conference on Autonomous Agents, pp. 3 -7, Barcelona, Catalonia, Spain, June 2000.
- Elisabeth André, Thomas Rist, Susanne van Mulken, Martin Klesen and Stephan Baldes. The Automated Design of Believable Dialogue for Animated Presentation Teams. In: Justine Cassell, Scott Prevost, Joseph Sullivan, and Elizabeth Churchill (eds.), Embodied Conversational Agents. The MIT Press, pp. 220-255, 2000.
- Elisabeth André and Thomas Rist. Presenting through Performing: On the Use of Multiple Life-Like Characters in Knowledge -Based Presentation Systems. In: Proceedings of the 1998 International Conference on Intelligent User Interfaces, pp. 1 -8, New Orleans, Louisiana, 2000. Best Paper Award.

Talks Related to PUPPET

- Elisabeth André. Adding Animated Agents to the Interface, IBM T.J. Watson Research Center, New York, July 2000.
- Elisabeth André. Adding Animated Agents to the Interface, MITRE Inc., Washington, July 2000.
- Elisabeth André. Exploiting Models of Personality and Emotions to Control the Behavior of Animated Interface Agents. Agents 2000 Workshop on "Achieving Human -Like Behavior in Interactive Animated Agents", Barcelona, June 2000.
- Elisabeth André, Thomas Rist: Presenting through Performing: On the use of multiple lifelikecharacters in knowledge -based presentation systems, IUI '2000, New Orleans, 2000.

Organizational Activities

- Thomas Rist. Co-Organizer of i3 Spring Days 2000, Athens.
- Thomas Rist. PC member of i3 Annual Conference, Jönköping, Sweden.
- Thomas Rist. Member of I3 Co-ordination Group.
- Elisabeth André. Programme Co-Chair of Autonomous Agents 2001.
- Elisabeth André. PC Member of the i3 Spring Days Workshop on Interactive Learning Environments for Children, 2000.
- Elisabeth André. PC member of AAAI Fall 2000 Symposium on Socially Intelligent Agents - The Human in the Loop
- Elisabeth André. PC member of Agents 2000 Workshop on Achieving Human -Like Behavior in Interactive Animated Agents
- Elisabeth André. PC member of International Conference on Intelligent User Interfaces IUI' in 2000 and 2001.

IDAU

Publications Related to PUPPET

- Torunn Kjølner and Niels Lehmann : "Using Theatre as Model. Brenda Laurel's Aristotelian Perspective - and beyond". In: L Qvortrup (ed), "Virtual Interaction: Interaction in Virtual Inhabited 3D Worlds". To appear October 2000, Springer. (pp 76 - 97).

Talks related to PUPPET

- Janek Szatkowski: Digital Theatre and Multimedia Design. March 2000, University of Odense.
- Lehmann & Szatkowski : Dramaturgical Concepts for Virtual Puppet Theat re. Conference May 2000, Middelfart, Denmark.
- Kjølner, Lehmann & Szatkowski: Hyperopticon. A future theatre project. Aalborg, April 2000.

5. Project Co-ordination and Management

Co-ordinator

Resource allocation & usage

The Puppet project is well in pr ogress although behind schedule. Resources have been used best possible, and spending is largely on target. A serious problem has occurred for our British partner due to the drastic change in exchange rate between the Euro and the Pound Sterling. This prob lem will be addressed in connection with a review and update of the plans for the project at a forthcoming managerial board meeting. Among other things it is important to maintain efficient travel budget.

Consortium effort and annual overview

The meeting pattern of year two has been dominated by bilateral meetings between partners. This has enforced collaboration and supported the gradual development of the new conceptual framework proposed by IDAU. All partners have been very focused on their particular t ask and the framework and effort of IDAU have facilitated a much appreciated convergence of otherwise diverging philosophies. Technical difficulties have caused further delays of the project schedule propagating frustrations for the task of experimental ev aluation. But the consortium is now nicely united in the responsibility for contributing to the refinement of the "new tool" such that the potential for "liveliness" and engaging interaction in and with the autonomous agents/puppets can be brought to bear. A task much harder than anticipated. A good basis for developing more advanced behaviours etc. has now been established, so that three different versions of the VPT can be made available for school tests during the last year.

LIA Administrative/Managerial report

Site Leader: Erik Granum

Resource allocation & usage

Personnel: The spending of man months is on target with a cost slightly lower than budgeted.

Other categories: Resources have been sufficient. Budget to be reserved for external services regarding design of characters.

Team effort and annual overview

With the design framework established in the first year, the development of the VE -platform with visualisation, control, agent perception and communication, and low level agents has kept LIA busy all second year.

Close interaction with DFKI on autonomous agents for integration and refinement of the high level agents. Frequent interaction with IDAU to get design input and feed back on the VE

appearance and functionality. Increasing interaction with COGS on how the improvisational activities coming available can be exploited for children's play in the school tests.

There has been an extensive communication with e-mails and internal documents with all partners during the year. LIA has arranged bi- or multilateral coordinating meetings as follows:

Jan 12-14:	Meeting, Aalborg (DFKI, LIA)
Jan 20:	Meeting, Aalborg (IDAU, LIA)
Apr 7:	Meeting, Aalborg (IDAU, LIA)
Apr 12-14	Meeting, Aalborg (DFKI, IDAU, LIA)
Jun 8:	Meeting, Sussex (COGS, LIA)
Jul 04-05:	Meeting, Aalborg (COGS, LIA)
Aug 11:	Meeting, Aalborg (IDAU, LIA)
Aug 23-25:	Meeting, Aalborg (IDAU, COGS, DFKI, LIA)

COGS Administrative/Managerial report

Site Leader: Mike Scaife

Resource allocation & usage

Personnel: The allocation of man-months for the project has been appropriate for the tasks that we have undertaken. The spend on RFs is on target.

All other categories: The resources for all other categories has been greatly strained by the drop in the Euro against the pound sterling. It appears from the project officer that nothing can be done about this from Brussels and we just have to live with the consequences. These include a zero travel budget.

Team effort and annual overview

The research efforts of the members of the COGS team have again been very focussed and there has been strong collaboration with partners. We are generally happy with the direction of PUPPET although the unavoidable delays in prototype delivery have thrown aspects of the work behind.

The distribution of time, for the researchers, has largely matched that set out in the project plan work packages and no serious deviations occurred. Collaboration between partners has been facilitated by group meetings, email and phone contacts. In particular we have benefited greatly from the close working relationship with Århus, especially at the beginning of the year, and with Aalborg more recently as development work has involved us closely. Now that we have a good dramaturgical-early learning model developing we feel much happier with the obvious benefits of collaboration.

DFKI Administrative/Managerial report

Site Leader: Elisabeth André

Resource allocation & usage

Personnel: The initial estimate was 7 months for task A-3. Due to the required extensions to the Jam Agent Architecture an extra month was spent on this task at the end of August 2000 in order to provide the deliverables on time.

All other categories: Budgets have been adequate and spending roughly to target.

Team effort and annual overview

In the second year, DFKI GmbH has been focusing on the specification of the agent's behavior and on the integration of its High-Level Behavior Planning Module with LIA's Visual Environment. Furthermore, DFKI implemented the default and greeting behavior as specified in the internal document IDAU-000414. Finally, DFKI integrated concepts from drama into the High-Level Behavior Planning Module and started with the operationalization of the new framework for improvisational play proposed by IDAU.

There was a close cooperation between DFKI GmbH and other groups of the Puppet consortium, which was strengthened by various meetings:

- Jan 11-14 2000: Technical Meeting in Aalborg (LIA, DFKI)
  During this meeting, DFKI and LIA designed a new percept handling mechanism.
- Jan 25-26 2000: Bilateral Meeting in Saarbrücken (IDAU, DFKI)
  During this meeting, IDAU presented a new conceptual framework for VPT-A and a first scenario for improvisational play "The black sheep". DFKI and IDAU discussed first step towards an operationalization of the new concepts within the existing agent-based architecture.
- Apr 11-14 2000: Technical Meeting in Aalborg (LIA, DFKI, IDAU)
  During this meeting, the High-Level Behavior Planning Module (DFKI) was connected with the Visual Environment (LIA).
- August 23-25 2000: Technical Meeting in Aalborg (LIA, DFKI, IDAU, COGS)
  HLA module further refined according to responses from IDAU and COGS.

IDAU Administrative/Managerial report

Site Leader: Janek Szatkowski

Resource allocation & usage

Personnel: The research team has consisted of Associate Professors Torunn Kjølner, Niels Lehmann and Janek Szatkowski. Scientific Assistant Lone Kofoed Hansen has been employed for a period in 2000. We have used a little less than the allocated labour costs in order to cover the increased expenses on travel budget.

Other Categories: IDAU tries to keep track of new programmes and experiments with child users. IDAU has travelled a bit more than planned in order to create and enforce bilateral work sessions. This has been important for the project.

All in all expenditure is kept within the allocated resources.

Team effort and annual overview

IDAU has focussed its work on the task of developing dramaturgical concepts that could be operational for the other partners. Building of a virtual theatre, developing strategies for, and adjustments to, agent behaviours etc. are done, partly by establishing a formal platform for such work lead by a notion of what the final result might be like, and partly in front of the computer when the results start to show on the screen.

Work done in multilateral sessions creates huge leaps forward. IDAU have been participating in discussions on the lay out of both VPT-A and VPT-B. We have not yet produced internal deliverables presenting sketches of VPT-B. We have used quite precise results of the potentials of the agents produced to VPT-A to maintain futile to evoke some elaborated descriptions of scenarios with extended narrative structures and new interfaces. We trust that the stable development of the VPT-A platform has highest priority, and that any further development will come out of the experiences in the next coming months in the project. Instead IDAU has tried to deepen their understanding of the agent architecture problems.

IDAU has visited all partners to develop appropriate framework for VPT-concepts. The geography has allow relatively frequent visits to LIA

6. Bottom Line

The Puppet Partners are learning. The second year of the project is characterised by hard and focused work by all partners. The engineers are being taught the lesson that the “magic” of their autonomous agents acting in real time does not come for free. Psychologists are realising that their contribution is essential to help bringing this “magic” about and that this is a major part of the projects potential for early learning. The dramaturges are also learning, they say, but to other partners this appear as teaching others how the project’s combination of ambitions within new technology and early learning can be structured to form an exiting ballpark for experiments and new advances.

These were the good news. The bad news is that we are still behind schedule, because this (necessary) learning takes time.

However, we are getting there, and the ultimate goal of the project is still valid and achievable.

PPR-2, Part B
Work Part Reports

Table of Contents

Work Package A

VPT-A for Improvisational Plays

WP-leader: LIA, Erik Granum

Objectives

To finalize the conceptual framework, the technical design and implementation, and the final evaluation of the project's first Virtual Puppet Theatre, the VPT-A for Improvisational Plays.

Summary of Work

The efforts dedicated to WP-A are as planned close to all of the project's efforts of year 2. All partners have worked very hard and yet results have not met the deadline set up in the revised Project Programme. This has mainly been due to technical difficulties, and these problems have been accentuated by consequences of the different research cultures necessarily combined in the interdisciplinary project. Section 2 of the Executive Summary, Part A of this PPR-2, attempts to describe the context around this situation, while these paragraphs introduce the Work Part Reports with a brief summary.

The goal of the WP-A has been pursued along two paths in parallel supplemented by an effort to achieve convergence of the two.

COGS has made important contributions by studying narrative and story construction from EL and child's point of view, and has been much concerned about how the VPT would present itself to the children through its interfaces. In the last part of the year they have also contributed with evaluations of the developed prototypes, gradually gaining an interests and an appreciation of the particular affordances of the technology being developed.

LIA and DFKI, the technology providers, have been much concerned about making the VPT SW platform present the very point of the new technology: autonomous agents interacting in real time in a 3D world. Technical difficulties arose with regard to meeting real time requirements for communication channels and agent activities, but even when these were basically overcome it was realised that obtaining a convincing user experience of a living and interesting virtual world is not a simple matter.

IDAU has constructively and successfully challenged the essential problem of creating a framework bringing the goals of early learning together with the new tools. From an intuitive understanding of the special potential of the technology, a mapping of this potential into the realm of improvisational plays was developed as an *Actant Model* named "The Black Sheep". This model also provides a source of inspiration to approach the problem of combining the advantages of autonomy of the puppets with the goal of facilitating play construction, a basic problem of contradicting concepts. In particular the model invites to experimenting with the balance between direct and indirect scripting in the coming design for VPT-B. With indirect scripting we mean controlling the play by specifying agent behaviours and attitudes and

controlling initial as well as “runtime” conditions for the scenari o in which the play takes place.

Regrettably the VPT-A is not yet in place, but we are close. An intensive and combined effort by all partners is required and planned to shape the prototype and its “liveliness” into a matured “version 0.2” for school tes ts by the end of year two. By January 2001 facilities and agent behaviours for the “Black Sheep” should be ready for school tests.

The status to be presented at the review is a farm scenario with six characters, a farmer, a dog, a sheep, a pig, and two cow s. The user can explore this world with and without inhabitants, observe the characters idle and interactive behaviours, and assume any character as avatar. A “greeting scenario” is available, where appropriate behaviours for this purpose have been developed and encoded.

Reporting

The proposed structure for internal reports has not been followed, but a rich flow of emails and reports has maintained the exchange of information within the consortium. External deliverables are provided for tasks 1 to 3 supple mented with selected internal reports and publications. For task 4 three documents describe the evaluation of prototypes at various stages of development.

Task A-1: Functional Specification and Development of VPT-A

Task leader: IDAU, Janek Szatkowski
Contributors: IDAU, COGS
Participants: DFKI, LIA

Objectives

- To investigate how the available technology in terms of the implementation of the VPT prototypes can be best exploited for EL and drama purposes.
- To define possible EL and drama goals for VPT-A insofar as the system allows
- To develop a structure and agent behaviours that facilitates children's use of the VPT -A design for improvisational play.

Work Done

The work under this Task has consisted of two strands that have been gradually coming together. These are:

A-1.1 The development of a dramaturgically -based conceptual framework for VPT -A by IDAU, and

A-1.2 Contributions to refinement of an EL -based conceptual model for the VPT -A and to interface functions by COGS.

A-1.1 IDAU Contribution

A-1.1.1 Summary of Conceptual Considerations (Extract from Deliverable A1)

Trying to establish a dramaturgical platform for agent -architecture, we noticed that existing platforms seems to be based on two very different paradigms - philosophically speaking. One platform is driven by a philosophy of consciousness (Kantian) and the other by a more behaviouristic approach where desires, beliefs and actions is contained in a will (Schopenhaurian).

- MODEL OF CONSCIOUSNESS

- MODEL OF BEHAVIOUR

Our main research-question is: Is it possible to construct a third position using an inspiration from a:

- MODEL OF THEATRICALITY

in which our main interest is getting agents to perform to optimise a field of potential interest for the avatar/user. In other words using the theatrical fiction as point of departure more than human nature in reality.

We suggest that this might be done through:

IMPROVISATIONAL THEATRE.

We will argue that improvisation make it possible to maintain a high degree of interaction and a possibility for the user to invent stories during the process of improvising (acting). We will outline some basic elements of an improvisational theatre and investigate the possibilities of a classical dramaturgy of conflict, as the latter seems better suited to our actual scenario and early learning goals. We will readjust some of our dramaturgical tools in order to create an improvisation that is:

SITUATIONAL

i.e. where the user can investigate a situation with as little narrative stress as possible. The improvisation aims at giving an experience of a dramatic conflict in a specific universe and find out how the user wants to position him or herself in this field of conflict. So we developed a:

DRAMATIC ACTANT MODEL

which could describe the functionality of different types of agents. The concrete suggestion is described in a scenario called:

THE BLACK SHEEP

where the Farmer (a the protagonist) wants to create order: to feed the animals and keep them inside their stables and fences, but where an antagonist wants to spoil this order. The Farmer has a dog as his helper, the user/avatar is cast as the Black Sheep, but can of course opt for another position i.e. help the farmer. In which case the Grey Sheep (helper of the Black Sheep) would take over and create disorder. To implement this we suggest:

AN ACHIEVEMENT MACHINE

which could measure the Farmer's level of success. If he succeeds he might go in to

SUCCESS MODE

and if he does not he changes in to

FAILURE MODE.

So we also sketched an idea of combining the achievement machine with a

STATUS MACHINE

that should help morphing the physical expressions.

In order to get something like this implemented, we needed to start one step ahead and hence investigate the actual programming and the development of both high and low level agents. So we designed a version of VPTA called version 0. Here we tried to work with the possibilities of our virtual 3D environment with a limited amount of physical movements, animation and sounds, thus working on the level of the smallest units of meaningful

ACTIONS AND REACTIONS.

We investigated how the agents might become expressive and hence communicate intentions. This *design* was called

A GREETING SCENARIO

and considered as a preparation for our Black Sheep Scenario. We are still worki ng on further refinement of this scenario.

EARLY LEARNING

We are working on a programme that should provide possibilities for early learning. As pointed at in the COGS report it is obvious that the speed with which it has been possible to devise prototyp es with a satisfactory level of sophistication, has created some frustrations. However, there has been a constant positive will to find productive targets and goals in the work. Looking at the VPT from a dramaturgical perspective, there were elements that would have gained from controlled feed back from which it might have been possible to identify more specific elements for early learning. We think of:

- how children learn navigational skills,

- how their identification with the avatar could functionin an improvisational scenario,

- what abilities children have to decenter when they are given the option to inhabit different agents as avatars

We also suggested some elements of interest in relation to the black sheep scenario. Here it might be interest ing to se how the children would deal with the concept and mental models inherent in the metaphor of the black sheep.

A-1.1.2 Work Done (IDAU) (Extract from Deliverable A1)

We have worked from different dramaturgical set ups and possibilities since Novem ber/ December 1999. We have chosen to present our thoughts to our partners in concrete bilateral meetings: In Aalborg on January 20th, and April 7th and 14th, DFKI, Saarbrücken on January 24th-26th, COGS, Sussex March 1st. -3rd. We introduced a series of g eneral ideas and theories as well as a concrete scenario which lead to very fruitful discussions. Our understanding of both the technological possibilities of the developing platform and agent architecture as well as the early learning requirements and ide as were enriched. The discussions lead to continuous negotiations and readjustments of several elements in our basic ideas.

We still believe that our project have to be considered an ongoing process where developments of ideas and practical implementation s followed by tests with children inform every new step and negotiations for further development. It seems clear to us that the task it is to actually develop a concept for a virtual puppet theatre and the basic programming and architecture needed to put i t into practice has to take time, more time than anybody could be able to foresee. The project is based on close interrelations and links of four very different institutions to be realised. If one chain in such a linking system need more time than calculated, the others will have to make a halt. As dramaturgs we depend on being able to see the agents at work in order to suggest further developments. We are forced to keep in mind

that our project does not work from acknowledged and supported platforms or te chnologies, and that it strives to integrate dramaturgical craft and thinking in unknown ways.

The "Travelling Puppet Theatre"

At our first meeting in Aalborg (000120) we presented a rough outline of a scenario and its supporting dramaturgical concepts. Th rough questioning promotion of basic ideas and a strong marcation of the directions we found most interesting, we were able to adjust some of our wilder ideas. Further work reduced them to a rather profiled scenario that we presented at DFKI in Saarbrücken (000124). Our reasoning behind choosing improvisational theatre as our point of departure had started us of on the track leading to a presentation of the concrete scenario. Martin Klesen and Elisabeth André presented the basic elements in the JAM agents very convincingly and promoted their idea of what could provide us with the High Level Architecture for the agents. A crucial knowledge for all partners is to understand how the paradigm of this architecture is conceived of. our way to share the ideas was i ntroduced as *"Dramaturgical Concepts for Agent Architecture and Early Learning in Improvisational Puppet Theatre",* a power point slideshow. This slideshow is in part incorporated into the Deliverable A1, and in extension (to cover play theory and early lea rning considerations presented at COGS) it is enclosed as appendix 2 to the deliverable. The slideshow could be considered as one of our major internal deliverables.

The outcome and inspirational input from the meeting with DFKI made us adjust our thinking. We promised to provide a detailed scenario scripted with the kind of physical activities the system by then could provide in mind.

On March the 1st we visited COGS, Sussex, to introduce them to our scenario and the concepts behind it. We also provided el ements of play theories that had inspired us and could conclude that that our dramaturgical perspective could offer some input to the discussion of early learning potentials. This again gave us the opportunity to exchange vital information and input as to thinking possible horizons of early learning. COGS gave interesting feed back to some of our basic assumptions. Due to the changes in time plans COGS clearly had had to rethink some of their contributions to the project, and did so in a very productive manner.

One Step Back

After the travels in March we produced a short travel -report to the consortium after which we visited Aalborg twice and in order to get details to script more in a more concrete and minute way. The first meeting (00.04.07) where both Aalborg and DFKI were present, clarified the need to retreat from the Black Sheep Scenario and simplify it even more, still as a preparation for the Black Sheep, though. We issued a preliminary document (00.04.08.) that described this VPTA version 0. Part of this document is also included in this the deliverable A1.

This trilateral meeting should be noted as a highlighted moment in our work progression. For the first time it was possible to sit around a computer screen together. Both High and Low level expertise became matters of common reference and details i.e. layout of scenography and possible actions were discussed and sanctioned. Such meetings are indeed of vital importance in exchanges in a crossover research like ours. The meeting in Aalborg the following week made it clear that we needed an even more detailed specification (document dated 00.04.14. and enclosed as Appendix 1 to deliverable A1), so we designed a framework for a very naive and simple greeting, formed as a scenario. To actually implem ent this has,

however, taken great efforts on behalf of the HLA construction: it was necessary to speed it up, to design reasoning in appropriate ways etc.

Just before the completion of this report we have been able to see the first version of this scenario (August 2000). We appreciate that there still are problems to be dealt with before we can start a full evaluation of the dramaturgical structures of this scenario. We hope, of course, that this will happen in the nearest future so that we can make the l ast adjustments. Devising in this way certainly take time and effort, things can not be solved metaphysically or through well known laws. The material that is produced must be treated as the only concrete building brick we have to further the development o f our scenario. A first short report on this is issued dated 00.08.14.

A-1.1.3 Conclusions (IDAU)

We would like to conclude, that the decision to build a platform and an agent architecture particular to our research has had a very positive consequence. A s dramaturgs we have had the possibility to follow the process in all its initial steps, gradually grasping the complexity of construction and thus being able to influence the process by making suggestions and forwarding wishes. This produces a research pr ocess that is rewarding and inspiring. It has its price, of course. The price is that each part seems so interconnected, that a delay for one part necessarily also means a delay somewhere else - and so on. Delays seem unavoidable as long as we do not have the possibility to re-allocate manpower within the hour or work together in the same space.

We still hope that our Deliverable Report A1 (IDAU -000808) will show why it might make sense to include dramaturgical concepts in the development of early learning programs based on real time, 3D graphics with autonomous agents.

A-1.1.4 Reporting (IDAU)

Various proposals and travel reports have been circulated as emails and internal reports have either been incorporated into the external deliverable A1 (IDAU -000808) of this task or they have been submitted as appendices to this deliverable.

A-1.1.5 Resources and Task Structure (IDAU)

The initial estimate has been appropriate. IDAU has kept within allocated resources.

We are strongly in favour of a pragmatic rese arch strategy under each task structure that will enable the project to remain flexible and responsive to new developments and problems. We would rather progress slowly in smaller steps, than attempting any lighthearted major jumps ahead. There is no doubt that the development of platform technologies from almost scratch is an enormously complex task. But at the same time it gives us important research knowledge not otherwise obtainable.

A-1.2 COGS Contribution

Following on from the conceptual model outlined in COGS-990512 (year 1), we have been engaged in a dialogue with partners as to the theoretical basis for further developments of the prototypes. The conceptual model was originally seen as being one base in incremental learning for the younger of our likely age-group users, the 4-5 year-olds. As such it entailed a series of modules that were aimed at giving the user a different experience with aspects of the system. These learning gains would be consolidated and used creatively in the final module.

As technical development has proceeded we have been made aware that not all of these modules could, in fact, be built in the time available. This has meant that we need to think through the consequences of not having a complete series. At first this seemed to be a problem but, following the useful comments from the reviewers at the last i3 review, we have now seen how the modules that look likely to be built will be employed for creative play. This is thanks to the development of the Århus team's scenario, the *'black sheep'*, which should allow the children to become absorbed in the system by providing a relatively simple structure.

While development has been proceeding we have been engaged in a number of vital contributory tasks, helping to define the value of the prototypes for testing. These are:

- Reviewing the play literature with a view to seeing how the key concepts of 'narrative' and the child's construction of stories, in the psychological literature, might be relevant to PUPPET. These efforts are documented in PPR-2 Part C: COGS-000401 "Issues of Play from a developmental Perspective", and COGS-991210 "Some thoughts on Narrative" with an extensive appendix with figures and tables.
- Extracting from this literature a range of possible indices of play and learning that we are hoping to apply to the prototype testing, appropriate to the complexity of the prototypes as they arrive.
- Development of a 2D GUI for the system that was the product of much research and development (see below).
- Investigation of children's communication of emotions by designing and testing some intermediate scenarios for children's perceptions of animated agents that we are using to determine their preferences for realism, story construction and interpretation (see below).

The consortium is aiming to implement the black sheep scenario as the culminating module for VPT-A. The rationale therefore, is now a pleasing mix of the original cognitive, learning one – focusing on the child's ability to improvise a story using the potential of the new technology – and the dramaturgical model, outlined by Århus. COGS has taken from Århus and from DFKI the centrality of the concepts of 'actor' and 'agent' and, as indicated above, we are applying them to our field study evaluations. We have been in constant touch with partners over this.

A-1.2.1 The development of a 2D Graphical User Interface, 2D-GUI (COGS)

This was motivated by one of the most difficult issues to resolve when designing a virtual environment (VE) for children, which is how they can act on, interact with and within that environment. This is particularly relevant when the interface is geared to pre-literate children,

as is the case with VPT. As systems designers, navigation, manipulation of objects, control of avatar, avatar appearance, dialogue and interaction with others, virtual (agents) or real (other avatars), are all aspects of the environment that we provide mechanisms for the user to effect. If the user is experienced and the interface is poor, then the user can adapt. However, what will happen if the user is a five-year-old child? How do we map their understanding of the world, their naïve physics, to the interface that we provide to a VE? What sort of design process is appropriate for this situation? We have proposed answers to these questions in the design process of a 2D pictorial interface to the 3D VE for 4-8 year old children.

Based upon empirical work and the functional requirements of our proposed system and interface specifications of the first year, a 2D Graphical User Interface (2D GUI) was designed and build at COGS. An empirical evaluation of the main features of the 2D GUI was carried out with 16 children aged between 5 years 11 months and 7 years 2 months (mean of 6 years 6 months). The main aim of the study was to make an evaluation of the stacking window system in terms of the journey metaphor, the pictures used and basic navigation. The results suggest that the stacking window system is easy for children to understand - indeed the metaphor of a journey was clear to the majority of children. The descriptions of the icons were mostly consistent with our intended meaning (to represent different palettes, emotions and/or actions).

Main findings:

All children (except one) found it very easy to navigate between cards (in the 2D GUI these will be windows in a stack). The children found the majority of icons to be self-explanatory. However, there were some exceptions, which we will need to think about further (where there were obvious problems the children provided drawings as suggestions). The results from the emotion icons were very interesting and raise a number of important empirical questions that we can introduce within the context of further empirical work. However, the types of emotions that the icons displayed were based upon research. Two sets were used - the majority of the children preferred one set over another (those based on cartoon type faces) but interestingly some of the children suggested that younger children would prefer the second set (which were derived from caricatures of posed photographs a young child's face). These results are presented in summary form in the document COGS-000518 *"Summary of empirical work relating to the design and evaluation of the 2D GUI"* included in the PPR-2 Part C.

Conclusions:

- Stacking window system was easy for children to understand
- The metaphor of a journey was understood by a large number of children
- The children's descriptions of the majority of icons were consistent with our intentions, indeed a large number of children were able to determine function from these static images
- Some icons have been changed

Overall, these conclusions suggest that young children will be able to understand, interact and navigate within the VPT using the 2D GUI with a reduced period of learning and/or support.

A-1.2.2 Communication of Emotion (COGS)

Previous empirical and theoretical work has suggested that emotional information has a central role in storytelling. In a virtual world where the user can interact with agents, the way in which that agent displays its emotional state and what the user infers from this display is central to effective affective communication. Given the reliance on visual expression of emotion in current VR Systems, any differences between children and adu lts in the way such information is utilized and perceived raises interesting design issues in relation to the experience and age of the user. We have investigated the special meaning that young children place on facial expression when gathering informati on about emotion. Initial exploratory empirical work into young children's abilities to select to and respond to particular forms of facial expression was carried out.

Main findings:

Previous research has suggested that young children (under 8 years of age) tend to be biased by visual cues, especially facial expressions. Specific emotion icons were designed that were derived from caricatured versions of a young child posing facial expressions of a happy, sad, angry, frightened, calm and neutral emotion. For the large majority of the children, the results suggest that the emotion conveyed in the happy, sad, angry and frightened faces was consistent with our intended display (e.g. the children perceived the angry face as "cross" or "angry"). The more ambiguous emotions (e.g. calm and neutral) were not perceived in such a consistent way. Some children reported that these faces displayed a positive emotional state, while others reported a negative emotional state. A number of children suggested that these faces displayed a 'mixed emotion'.

Given that an emotional interface needs to serve the contradictory function of allowing children to both recognize clear emotional categories, while at the same time giving them enough flexibility for creative and imaginat ive expression, these results can be seen in a positive light. Perhaps the most important point was that the children enjoyed being able to change the characters facial expression within the context of storytelling. A similar pattern was adopted with all c hildren: they first selected a facial expression for a particular character, and second, they focussed on the intentions, motivation, goals and actions of that character. Overall, changing the facial expression of the character facilitates storytelling.

Conclusions:

- By focussing on facial expressions we have an effective means of conveying emotional information within our system. This is important given the role of emotion in narrative and storytelling.
- Children are able to discriminate between cartoon -like faces in a similar fashion to that described in previous research that used human faces. This provides us with a more abstract means of portraying emotions. This is important in the context of VPT given that the portrayal of emotions needs to be abstr act enough to be applicable to more than one character, yet recognizable as an emotion.
- The range of emotion icons seems to be sufficient, indeed the flexibility with which some emotion icons can be used (that are more ambiguous, e.g. calm and neutral) is advantageous for story-telling.

- Children are able to build up character actions, emotions and action modifiers.
- Children use facial expressions creatively; facial expression can be used to elaborate the protagonists intentions, goals and actions.

This empirical work has been written up in a paper, COGS -000622, "*The Communication of Meaningful Emotional Information for Children Interacting with Virtual Actors* ," enclosed in PPR-2 Part C.

Reporting

COGS has contributed to the deliverables of Task A -1 with i nternal documents and a publication, all included in the PPR-2 Part C:

COGS-000401 *"Issues of Play from a developmental Perspective"*,

COGS-991210 *"Some thoughts on Narrative" with an extensive appendix with figures and tables"*.

COGS-000518 *"Summary of empirical work relating to the design and evaluation of the 2D GUI"*

COGS-000622 *"The Communication of Meaningful Emotional Information for Children Interacting with Virtual Actors"*

Task A-2: Technical Design and Implementation of VPT-A

Task-leader: LIA, Claus B. Madsen
Contributor: LIA
Participants: DFKI, COGS, IDAU

Objectives

To complete the development of the technical platform VPT-A, designed for improvisational plays, in line with existing specifications, so as to support the required functionalities concerning

- autonomous agents,
- the avatar function,
- their interactions in the virtual environment, and
- the user interface.

Work done

This task is charged with developing the Virtual Puppet Theatre as a software system with three main functional requirements:

- it must manage a virtual environment containing landscape, fixed structures, props, and animated characters (autonomous agents),
- it must provide mechanisms allowing agents to perceive the virtual world and act on it,
- it must present the virtual world to the user using 3D computer graphics and sound rendering.

The current state of the VPT-A platform and functionality of each of its modules is described in detail in deliverable A-2-2. In the reporting period the task has primarily focused on the following elements:

1) Virtual Environment Server,
2) Low Level Agent, and
3) Artwork

Virtual Environment Server (VE Server)

In the period following the delivery of PPR-1 it became clear that having the Visualization module and the VE Server as two separate programs was not viable due to the communication overhead involved. This concerned communicating primarily object positions and orientations back and forth fast enough to allow for smooth rendering of object movements. In view of this a decision was made to integrate the two modules into a single software package, with the added benefit of allowing shared data structures. This has proven to make functional extensions to both modules much easier. For example a generalization of the way the viewpoint is controlled so that the "camera" can be attached to any object in the virtual world, or can be controlled directly by the user, or by the Visualiser itself when commanded to move

the viewpoint from one position to another. The latter has been implemented as a spline interpolation between control points.

As a response to various testing by IDAU and COGS throughout the reporting period technical support has been provided for letting the autonomous agents perform animations, for example animations for greeting another agen t. Similarly, technical support for letting agents change facial expressions has been designed and in all essence implemented, though it is not yet an available functionality to the agents.

Also in response to testing and evaluation within the consortium f acilities have been added allowing the user to perform avatar actions in a simple fashion. For example by pressing a keyboard key the agent currently used as avatar will utter a specific sound, allowing the user to communicate himself to the other agents using this modality.

Low Level Agent (LLA)

From the beginning of the project a decision was made to divide the autonomous agents into two levels: High Level Agent (HLA) and Low Level Agent (LLA). Detailed descriptions of both can be found in deliverables A-3-2 and A-2-2 respectively. Following the PPR-1, and the subsequent revised Project Programme the development of the LLA became a part of this task.

In the reporting period extensive developments have been made on the LLA. Through close collaboration with DFKI a design has gradually evolved where much more functionality than was originally intended has been put into the LLA, freeing the JAM -based HLA module to focus on goal-based reasoning, and leaving purely spatial reasoning to the LLA.

A main achievement with the LLA concern the design and implementation of a potential field path planner allowing the agents to move around in the world to specific places/objects without running into obstacles. The path planner is capable of solving navigation problems of any complexity, including mazes, provided there exist a path wide enough for the agent.

Additionally, it turned out that an actual reactive obstacle avoidance capability was necessary in order for the agents to successfully maneuver in tight spaces when t here are other agents nearby. This kind of problem cannot be solved by the actual path planner, because the sense -plan-act loop is too slow. Therefore a sense -react approach has been designed and implemented, which is based on each LLA continuously computi ng a "repulsion vector", allowing the agent to steer clear of moving nearby objects.

During the last half of the reporting period it has through tests become clear that the JAM architecture used for the HLA cannot handle the amount of sensory information p rovided to each agent by the VE server. On the other hand this high amount of information is necessary to allow agents to react immediately and maneuver smoothly. Thus in close collaboration with DFKI a protocol has been designed through which the HLA can utilize and gain up-to-date access to a spatial memory within the LLA. This way the HLA can have a valid status of the virtual world, but it does not have to integrate all the information itself in order to maintain an internal world model.

Artwork

In order to support the scenarios gradually being designed within the consortium, primarily with input from IDAU and COGS, large amounts of "art work" is needed. Art work covers 3D models of landscapes, buildings, props, and characters. For the characters it also covers animations. To support the initial levels of the VPT-A version 0.2 (and 1) described in deliverable A1 (IDAU-000808) "On the Dramaturgy of the Improvisational Virtual Puppet Theatre" 3D models and a number of animations have been produced for 6 characters.

In addition sound files have been accumulated for each character. In all there are presently animations and sound files for positive and negative responses for all 6 characters in a greeting scenario described in internal document (IDAU-000408) and also in part in deliverable A1. The sound files have been produced by IDAU, and the models and the animations have been created by LIA.

At various stages of its development the VPT-A platform has been distributed to partners over the reporting period. Additionally several multiple day events have been held, where representatives of either IDAU or COGS have been visiting LIA in order to interact on the development of the platform. This has resulted in many fruitful interactions and insight into the possibilities of the platform, and has instigated numerous changes ranging from minor technical issues to more extensive functional changes.

Reporting

Distribution of several VPT-A platform prototypes and corresponding descriptions were anticipated during spring. This happened although with an irregular frequency reflecting the actual progress in the development. LIA and DFKI frequently exchanged SW-versions of the VE and agent implementations, respectively, as part the collaborative development. COGS had a version with limited agent capabilities installed in April. Later tests by COGS have taken place in Aalborg (June/July and August) to benefit from direct feed-back and face-to-face discussions.

Descriptions of the emerging prototypes were given in January in Puppet Note LIA-000117, "VPT 1 v.0 - provided functionality and user interaction".

The general design considerations and philosopy were described in a paper "Aspects of Interactive Autonomy and Perception" (included in PPR-2 Part C), which contributes to a book on “Virtual Interaction”.

The major and external deliverable of this task, Deliverable A-2-2, “Description of the VPT-A Virtual Environment Platform” is also included in PPR-2 Part C. The scheduled Deliverable A-2-3 "Yet another VE-Platform, - and Why!” will be submitted at review.

Task A-3: High-Level Behaviour Module for VPT-A

Task Leader: DFKI, Elisabeth Andrè
Contributor: DFKI, IDAU
Participants: LIA, COGS

Objectives

Design and implementation of a high -level behaviour module and a basic repertoire of behaviours that allow for improvisational play.

Work Done

DFKI has been focusing on the specification of the agent's high -level behaviour and on the integration of its High -Level Behaviour Module with LIA's Visual Environment. Furthermore, DF KI implemented the default and greeting behaviour as specified in the internal document IDAU -000414. Finally, DFKI integrated concepts from drama into the High-Level Behaviour Module and started with the operationalization of the new framework for improvis ational play proposed by IDAU. The software including documentation developed within task A-3 can be downloaded from the internal DFKI homepage for Puppet.

As the basis for our High -Level Behaviour Module we use the Jam Agent Architecture (JAM Version 0.61 +0.79i) developed by Marcus J. Huber at Intelligent Reasoning Systems (http://members.home.net/marcush/IRS/). However, an extra amount of time had to be spent to adapt this architecture to the specific needs of the project. As outlined below there were three major technical problems that had to be solved in order to effectively control the behaviour of multiple interactive characters in a 3D virtual world.

Extending the Jam Agent Architecture to a multi-agent scenario

JAM was primarily designed for single a gent purposes, i.e. to read and execute a Jam script specifying the initial goals, plans and facts of a single agent. Within the Puppet scenario (a virtual farmyard) however, we must be able to control and observe the behaviour of multiple agents (sheep, p ig, dog, etc.) running simultaneously. We therefore added mechanisms to safely stop, suspend and resume a Jam agent. This makes it possible to temporarily halt an agent in the middle of plan execution, e.g. for debugging and testing purposes. We also implemented an easy way to redirect the standard output stream for each Jam agent, e.g. to enable redirecting the output to a text window instead of writing it into the same shell as all other processes. This is particularly important when multiple agents are r unning simultaneously because otherwise the common output of all agents becomes unintelligible.

Improving the performance of the Jam agents for real time use

When carrying out preliminary tests with the first version of the VPT -A system, we detected that t he Jam agents' "sense -plan-act cycle" was not fast enough for real time use. The main problem was the way information (e.g. actions and percepts) was exchanged with the 3D virtual world. Consequently, in order to improve the overall performance of the High -Level Behaviour Module, a new communication mechanism based on "pipe streams" was implemented. This new mechanism allows the JAM agents to efficiently exchange messages with an external source (e.g. the 3D environment) and led to a significantly better ru ntime

behaviour of the agents. We could demonstrate that the average performance of a single agent was 4 to 10 times better (depending on the number of agents running simultaneously) compared to the build-in features of the standard JAM version that we used before.

Handling of continuous and simultaneous/parallel actions

Our virtual puppets are capable of executing continuous actions (e.g. maintain a certain distance to another agent) and they can execute certain actions simultaneously (e.g. move to another location, while making a sound and playing an animation). Therefore, the High-Level Behaviour Module controlling the virtual puppets must be able to initiate and monitor these kind of activities. To solve this problem, we improved and subsequently deployed JAM's "PARALLEL action" that can be used to execute branches within a plan simultaneously (using multiple threads). The High-Level Behaviour Module can now send an action command to the 3D environment (e.g. approach another agent or object) *and at the same time* monitor the goal achievement and apply strategies that deal with subgoal failure (e.g. if the path to the target is blocked), and start playing an animation and/or a sound file. Even more important, the High-Level Behaviour Module can now terminate the ongoing behaviour voluntarily, either after a certain amount of time has elapsed or when some context condition is fulfilled (e.g. the avatar is within my field of view).

Although these extensions have been made for use within the Puppet project, they are general purpose in the sense that they can be used by anyone who wants to deploy JAM for multi-agent applications with real time constraints. At least some of the extensions will therefore be included in future releases of the platform.

A detailed description of how we used the new JAM platform to implement a basic repertoire of high-level behaviours for all agents can be found in our deliverable A3.2. The greeting scenario described therein which is based on a (symmetrical) pattern of relationships between the agents (e.g. farmer and dog like each other but farmer and sheep don't like each other) is an example of how we implemented an improvisational set-up as suggested by IDAU. The next step is now to implement the more complicated and demanding improvisational scenario we describe in our joint paper "The Black Sheep – Interactive Improvisation in a 3D Virtual World" (to appear in: Proceedings of the i3 Annual Conference 2000). It involves a farmer, his dog, a black sheep, a gray sheep, cows and pigs. The task of the farmer as the protagonist is to create order whereas the black sheep as the antagonist (supposed to be played by the child) wants to create chaos. This clash of wills will be the top-level driving force in this scenario and the central focus for all characters.

Reporting

The work corresponding to this task has been described in the deliverable A3.2, which together with the joint DFKI-IDAU paper is enclosed in the PPR-2 Part C. Further information can be found under:

http://www.dfki.de/imedia/puppet/
publications, software etc.
http://www.dfki.de/~klesen/puppet/ (restricted access)
software, documentation, internal reports, etc.
Login with username '**puppeteers**' and password '**avatar**'.

Task A-4: Experimental Evaluation of VPT-A

Task-leader: COGS, Mike Scaife
Contributors: COGS
Participants: IDAU, LIA, DFKI

Objectives

The aims of this Task are:

- To carry out empirical and observational studies to investigate the value of VPT-A in supporting new forms of play in virtual environments.
- To analyse children's interactions with constructive and expressive tools and to assess their contribution to the development of symbolic activity in the use of objects, roles and collaborative activity (cognitive goals) and in developing early drama skills (drama goals). These aims to be tailored to the degree of functionality available in VPT-A.
- To assess the capability of young children to navigate in, interact with and understand virtual environments.
- To feedback data from early prototypes to the development team in order to improve and refine the final product.

Work done

Unfortunately no VPT-A ready for school tests has yet been available, so the efforts of this task has concentrated on evaluating high-tech prototypes and feeding-back results. Mid-tech prototype tests are reported under Task A-1.

The group has made three intensive usability evaluations of the prototypes in this research year and the related documents are enclosed in this PPR-2 Part C. They have been circulated to partners and there has been a vigorous discussion of the implications of the usability trials inside the project.

A first version of VPT was presented at the last review (Sienna, October 1999). Much work was put into the development and an improved version was installed at COGS in April, 2000. An evaluation of this prototype was completed and described in document COGS-000404. The document commented on the state of the system at that time and the features and changes needed to bring the system to a point where it can be used in an experimental situation, i.e. 4-8 year old children can be sat in front of it. We have been in constant touch with partners and joint meetings have been of crucial importance. The next test was conducted in Aalborg in the first days of July 2000, and reported in a "Discussion Document", COGS-000718.

When the high-level modules had been incorporated into the system, a joint meeting was set up at Aalborg where an evaluation of the latest version of the system was carried out and reported in document COGS-000829.

The current system represents a vast amount of effort on the part of the partners, and we were all very excited by the prospect of presenting the completed system in our local schools.

Reporting

Internal reports on prototypes (COGS-000404/000718/00829) are included in PPR-2 Part C.

Work Package B

VPT-B with Authoring Tools and Narrative Support

WP-leader: LIA, Erik Granum

Objectives

To develop the conceptual framework, the technical design and implementation, and the final evaluation of the project's second Virtual Puppet Theatre, the VPT-B with Narrative Support.

Summary of Work

Efforts related to WP-B was planned to start already in March 2000 (Task B-1) with Functional Specification and Development and in June 2000 with technical efforts (Tasks B-2 and B-3). Generally these efforts have been delayed, as they are awaiting results and experience from VPT-A.

However, COGS has been able to start relevant investigations of storytelling children, and their interactivity with virtual worlds. Adding results of these investigations to the emerging VPT-A experience a solid basis for important design decisions regarding VPT-B will be available shortly.

Reporting

Only internal report deliverables of Task B-1 were scheduled in year 2. They are on halt and their content and numbers will be adapted to what the coming developments call upon. External deliverables of WP-B are still target dates as they are designed to allow for the final tests and analysis.

Task B-1: Functional Specification and Development of VPT-B

Task-leader: IDAU, Janek Szatkowski
Contributors: (IDAU), COGS
Participants: LIA, DFKI

Objectives

To develop an over-arching model for improvisational play in the virtual environment, that derives its concepts and logics from theories of early learning, dramaturgy and development of systems of virtual environment and autonomous agents. This includes a conceptual framework for the consistent combination of autonomy and authoring via scripting.

Work Done at COGS

COGS has continued to rev iew the research findings on play and creativity in children as a backdrop to designing VPT -B. While this work is still in its early stages we have begun the following:

1. To develop the basis for derivation of scenarios and typical plots for VPT -B by seeing what kinds of plot structures older children can/will use in everyday play. We have carried out some empirical work, which will allow us to think creatively about combinations of improvisation, scripting, and editing for storytelling.

2. To develop of tools for storytelling: Several 2D prototypes has been developed using Director to evaluate combinations of tools that explore improvisation, scripting and editing for storytelling. Twenty children [aged between 5 years 11 months and 7 years 6 months] wer e seen individually, with the majority seen on two occasions. This data is currently being collated but our initial results seem to be very interesting and will hopefully provide some insights into how best to develop tools for storytelling and develop dr amatic skills. The results will be made available to all partners as soon as possible in paper form, and will be presented for discussion purposes at our next joint meeting.

3. To experiment with the use of an off -the-shelf virtual environment, the DIVE environment developed under EU auspices at SICS. The rationale for this is to get useful initial data, relevant to VPT -B, on children's interactivity with virtual worlds – how do they manage? Whereas for the first point we have been largely using Director as a tool for simple initial prototypes, here we are trying to extend the application to something that has more of a 3D character to it.

4. The development of a 3D tool to explore some aspects of young children's interactivity with virtual worlds

COGS is in the process of developing various programs to obtain some initial data that will be relevant to VPT -B. The specific environment that we are currently using is written in C and DIVE/Tcl. We have been exploring the use of different input devices for cont rolling a Spaceball (a 6DOF mouse) and also a pair of 5DT datagloves within DIVE version 3.3X. Some VRML objects and other objects created with AC3D (a 3D modeler) have been imported into DIVE to test this feature. A series of avatars (they come as demos w ith its source code in DIVE) and their properties have been analyzed. The properties are among others: walk, jump, glance, nod, etc. It is possible to use collision detection and proximity within DIVE. The objects mentioned above have events triggered wi th proximity sensors. Also, spatial audio in DIVE has been tested. It is possible to attach a sound to an object and play it by triggering an event, such as proximity, or by clicking on the object.

We are currently moving towards a stage of development w here it is possible to design specific empirical studies that explore young children's interactivity in the context of a 3D environment.

Reporting

No external deliverables are due in year 2.