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REPORT ON

AtGentive WP1 Workshop on

Advanced support for attention in collaborative learning settings

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THE AMERICAN UNIVERSITY OF PARIS

knowledge, perspective, understanding

AUP, Paris January 23rd and 24th 2006

The following people have participated to the workshop and contributed to this report:

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OBU Mary Zajicek	**Ontdeknet** David Kingma Inge Molenaar Koen Molenaar Maurice Vereecken	**UTA** Harri Siirtola Toni Vanhala	

Abstract

This deliverable reports on the meeting of the Atgentive consortium on "Advanced support for attention in collaborative learning settings" which took place in Paris on January 23 and 24.
The reader can find here both a summary of the discussions that took place and the collection of papers and presentations offered by several partners during that meeting.

Monday, Jan 23, morning session

After the **welcome** and the **introduction** (and the coffee!) from **Claudia Roda (AUP)**, **Inge Molenaar (Ontdeknet)** gave a presentation and a demonstration of the **Ontdeknet learning platform** (see appendix 1 – Presentation: Meeting WP1, and appendix 2 – Memo: OntDeknet technology presentation). "Ontdeknet is an e-learning environment involving and challenging everybody". Basically, Ontdeknet platform acts as a *mediator* of the interactions among students, teachers, and external experts. A user can log in to the environment as a student, a teacher or an expert. Everybody can introduce themselves (About Me) can personalize the environment (My Settings) and can engage in *learning sequences*. A typical learning sequence includes:

1. Introduction (student and experts fill *personal info* form; experts write intro story related to their expertise)
2. Goal setting (students write what would they want to learn; experts acknowledge)
3. Assigning to an expert (students choose experts; chosen expert notified)
4. The mind map (students describe topics they would like to address by filling out the *mind map*; experts look at the mind map to understand students better)
5. The assignment (students post questions and read; experts post answers; teachers give assignments and monitor)

The learning sequences are supported by various tools within the ODN learning environment (personal info sheet; writing/reading mind maps; reading/writing contributions; monitoring students and/or experts activities)

Teachers' role is mainly in providing assignments for the students and monitoring progress.

During the learning sequences, a software agent (Onty) may intervene. Onty's actions are contingent upon students' advances with respect to the current learning sequence and student's actions.

In the discussion, several possible challenging scenarios as well as ways to improve the ODN were mentioned. It was observed that the learning sequence is rather rigid which makes the agent behavior rather predictable. Inge Molenaar (Ontdeknet) said that this was not a problem with younger users (primary school students) as they were easy to be interested by Onty and its behavior. Another feature of this population is that their questions can be anticipated in most cases. Using ODN with older children (secondary school) or with general adult audience may represent a challenge because of the above mentioned learning sequence rigidity, and the limited information used to guess user's attention state (mouse events).

In the continuation, **Pradeep Kumar Mital (INSEAD)** presented the ICDT (see appendix 3 – Presentation ICDT-model) platform. This platform supports on-line collaboration, virtual community building, as well as various tools for synchronous

(chat, IM, video conf) and asynchronous (email, forums, news, repository) communication. ICDT is built around the four essential concepts: *information*, *communication*, *distribution*, and *transaction*. Users who log in can read/post news, initiate discussions in forums, engage in chats, conferencing, broadcast video events, upload/download content. The system keeps track of all the events on the platform in a *log file*. The log file of all the events is available to all the users. In the discussion, it was suggested that the log files from ICDT platform, can be analyzed and scanned for “interesting” events.
Unlike within ODN where users are divided among 3 categories (students, teachers, experts) with clear roles, within ICDT all users are equal in the sense that everybody is allowed to perform actions enabled by the system. Another distinguishing feature of the ICDT is that the system has no representation (knowledge) of users’ goals or intentions. Again, within ODN, students’ goals are represented within the learning sequences.

In the second part of the morning session application specific scenarios were presented.

Inge Molenaar (ODN) and the colleagues from ODN have presented several challenging scenarios where AtGentive framework may be of use. (see appendix 1 – Presentation).

The first one involves secondary schools students using Ontdeknet and is based on interviews with teachers. It is about ODN environment supporting the work on a realistic project where students are supposed to save a local festival which is at risk because of insufficient sponsorships. The project has 5 steps: collaboration contract (groups members agree on the principles of collaboration); awareness stage (looking for other examples of free festivals); research (asking the expert what is sponsorship?); product stage (writing the overview of the organization of the festival and a sponsor proposal for, say, local bank); presentation stage (students present their proposal to the expert and send it to the bank).

Based on the project outline, following learning sequence is generated:

- ☑ Introduce yourself
- ☑ Assignment 1
- ☑ Assignment 2
- ☑ Sign up with your expert
- ☑ Assignment 3
- ☑ Assignment 4
- ☑ Assignment 5

Possible evolutions of this scenario were presented:
1) after submitting assignment 1 to the teacher, and after it has been assessed, students continue to work on it. Onty, the agent, believes that they should work on Assignment 2 and issues appropriate message.

In order to make the learning more effective,

a) Onty can instead ask the students what they do and then decide if it would be OK to leave them or advice to move on. Or,
b) Onty can directly explain his message by telling the students that having finished Assignment 1 they should move to Assignment 2.

In the discussion that followed, it was pointed out that b) is quite realistic but in option a) Onty would have difficult time interpreting the open text response from the students.

The second scenario involves primary schools students who work in groups of 3 and are supposed to write a paper in which they will describe the profession of the expert they work with.

The learning sequence looks like this:

- ☑ Introduce yourself to the expert
- ☑ Describe your goal
- ☑ Meet your expert
- ☑ Write a concept map
- ☑ work on your paper
  - ☑ read the information of the expert
  - ☑ ask questions
  - ☑ write a summary of the information of the expert in our paper
  - ☑ read the answers
  - ☑ write a summary of the answers in your paper
  - ☑ choose pictures for your paper

Four possible evolution cases were presented:

1) In the Introduction step, after a while students stop adding more text. Here usually teacher intervenes by asking students additional motivational questions (what are your hobbies? age?). In the AtGentive the system may notice low activity of the students and based on the contextual information (where are the students in the learning sequence) it can issue appropriate messages/actions.
2) In the second case, at least two students do something simultaneously: one is trying to input some text and the other plays with Onty, using the mouse. Teacher usually intervenes by explaining to the children that one cannot enter the text while the other is playing with the mouse. With respect to the AtGentive system, it will be expected to detect this unusual pattern of activities, determine what are they supposed to do, and issue the appropriate message.
3) In this case, students try to find the expert following Onty. They are expected to go to the bottom of the current page where the expert link is. Teacher can intervene by showing the students how to navigate to the link. Onty, on the base of what student current goal is should determine what are the alternative foci and direct the students to the link.
4) In the last case, while filling in the mind map from, students stop after the first entry. Teacher's intervention consist of motivational question. On the other hand, the AtGentive system should detect the inactivity, try to guess why the

students stopped (cannot find the next text box? Do not know what to input?), and suggest possible solutions.

Thierry Nabeth (INSEAD) presented **scenarios** related to the use of AtGentive within the **ICDT** platform (see appendix 4- Presentation AtGentive – AtGentiNet Description & Scenarios for supporting Attention). First, he gave a description of what an "AtGentNet" should support. The AtGentNet should:

- Be a digital environment for supporting the knowledge exchange in learning networks
- Rely on the concept of Microworld (a set of spaces in which the users are engaged into knowledge exchange related activities)
- Support elements (spaces, items, users) that are accessible to the users, and records of the traces of the activities, and they can be processed
- Provide mechanisms to support the attentional process of people & organizations

Microworlds are "organised as a set of specialised spaces containing a variety of components (from information items to more active components), providing a metaphor and supporting a certain activity / context". Users can choose to engage in various interactions within these spaces. Examples of spaces include: **information spaces** (news space, orientation (provides guidance), community information…); **communication spaces** (forums, conversations, "meeting room", blogs, discussions); **distribution spaces** (cybrary, repository, wikis, team and personal shelves…); **transaction spaces** (marketplaces (knowledge-trading/consultance), forms, lectures, simulations…). Examples of objects include: **documents** (presentations, papers, videos…); **postings** (news item, discussion entry, blog entry…); **generated items** (log entry, activity indicator); **complex objects** (booking form, simulation session…); **miscellaneous** (user and group profiles) . During these activities different **events** are generated. Main categories of events include: visiting a space, reading an item, creating an item, etc.

Regarding the ***attention*** proper Thierry suggested that attention management can be done via a) guide users in the acquisition of attention management practices by providing support mechanisms about how to effectively manage their attention, and via b) development by entities (person, organization, group or community) of the attentional **self-reflective metacognitive capabilities**.

He proposed 4 mechanisms for attention support:
1) AtGentNet will create a unique space which will be specific for the activity at hand. The assumption is that a dedicated space will contain only the elements relevant for that activity and that this will reduce the probability for the user to be distracted.
2) "Magic lens" mechanism: this is a tool which enables particular perception of some common data. This perception will depend on users' current activity and goal (e.g. if I am looking at some forum I will be seeing entries from particular user either enhanced or with different color).
3) The next mechanism is in a form of a software agent which is *au courent* of the user's goal and activity and can pro-actively suggest change of user actions, point to

elements of interest, inform the user of some event which is relevant for the task he or she is performing etc.
4) The last mechanism that was mentioned were set of tools which would support the development of the user's meta-cognitive abilities. An example of such a tool may be a visualization of previous activities (where was the time spent? What is the most used action, etc.)

The discussion that followed stressed the fact that ODN and ICDT were quite complementary platforms as the one is environment for guided learning process for children, and the other is a platform which would support/enable/enhance interactions (possibly learning interactions) in an environment of peers.

Just before lunch **Benoit Morel** (**Cantoche**) presented the **Cantoche** approach to the issues of managing attention (see appendix 5 – Presentation: Embodied Agents: Management of the user attention; and appendix 6 – Paper presenting the Living Actors Technology). Basic assumption of their approach is taken from Picard "The way people interact with technology is the way they interact with each other". In the case of Cantoche, user attention is attracted by an animated anthropomorphic agent. Such an agent can be used to guide the user through a manual for a new device, explain the functioning of a new program, or simply entertain the user. Benoit explained various characteristics of the agent that can be used in the manipulation of user's attention: physical aspect of the agent (realistic vs cartoonish style; use of different types of clothes; use of accessories), the behavior of the agent, as well as other elements such as voice vs no voice (text balloons), position on the screen, relative size, etc. His presentation ended with a classic animated movie by Chuck Jones, 1953, with Duck Amuck starring, and where virtually every aspect of the presentation was illustrated in a funny manner.

Monday, Jan 23, afternoon session

The afternoon session started with **Mary Zajicek's** (OBU) presentation on **Interaction level scenarios** (see appendix 7 – Presentation: Interactional Level Scenarios). Under the assumption that the "screen can be assigned a document object model identifying individual discrete areas of interaction arranged in a hierarchy" she presented two generic interaction level scenarios. In both scenarios, the "helping agent" is supposed to detect the user state from a) the time the user spends on certain (portion of the) screen, and b) the place on the screen that user clicks on. Depending on these two variables, the agent will offer several options/explanations to the user. Afterwards questionnaires (as subjective measures) as well as action log analysis (objective measures) can be used for evaluation purposes.

The next presenter, **Barbora Parakova** from **CELN** explained the role of the Czech partner (see appendix 8- Presentation: Czech Efficient Learning Node). In tight collaboration with Ontdeknet, CELN is supposed to provide a test-bed for doing experiment with the AtGentive platform/agent. CELN partner suggest that English language be the content which will be taught with and without AtGentive agent, to students from a Czech primary school. Barbora raised many questions regarding:

- the age group (9, 10, 11… years?),

- the learning subject: is English language appropriate?,
- the low to intermediate level of ICT skills among teacher and student body in the Czech republic,
- the schools that are under equipped with ICT technology .
- the need to clarify if there would be any extra equipment (e.g. eye tracking) and whether this would be plausible.

In the discussion that followed, the consensus was that English language is a plausible subject matter. Regarding the equipment, everybody agreed that only standard apparatus would be required of the pilot schools .

In the continuation, **Toni Vanhala** from **UTA** presented two possible scenarios for experiments where plausible psycho-physiological measures can be performed (see appendix 9 – Presentation: Psycho-physiological experiments in AtGentive; and appendix 10 – Paper: Psycho-physiological measures for estimating attention). In the first experiment a student is performing an independent study (e.g. web surfing) while another user posts new info that might be relevant. Based on the first student task (goal) and on the contents of the info (keywords?) the AtGentive system should choose an appropriate method of interrupting and notifying the first user. Given this set-up several experiments can be envisaged:

a) Estimating the effectiveness (and, e.g., pleasantness) of different methods of directing attention
b) Investigating the effect of repeated interruptions on the attentional and emotional response

Several psycho-physiological, verbal, and behavioral measurements can be performed in order to 1) Identify the general effects of interruptions, 2) Investigate how responses evolve when interruptions are repeated, 3) Suggest appropriate methods and minimum relevancies for interruptions

The second scenario is very similar to the first one except that it is not specified where the new posting is coming from. **Harri Siirtola (UTA)** expressed various concerns of the UTA team regarding the possibility to generalize the findings. He pointed out several parameters that may influence the measurements: students' prior knowledge, learning style preferences, motivation, etc.

In the last part of the "scenario sessions" **Claudia Roda** (AUP) gave a presentation about the **conceptual framework** and the AtGentive **application scenarios** (see appendix 11 – Presentation: Initial analysis of Atgentive's conceptual framework and application scenarios). The main hypothesis behind the AtGentive approach is that agents (which come between the users and the application) can affect user's attention and manage it in effective way. An AtGentive agent can support the users in their attentional choices (help in recollecting essential information when resuming an interrupted task; help in impasse situations…) or agents may guide users' attention to alternative (better) foci (notification of important events; reminder of deadlines…). After presenting the main components of the conceptual model (user, application (ODN, ICDT), and the AtGentive agent) and their interactions Claudia presented an event-based conceptual framework (EBCF). Behind the EBCF there is the hypothesis that indeed the behavior of all the system can be analyzed in terms of the events produced by the three main components: the user, the application, and the agent. These three define therefore the three categories of events. In the rest of her presentation, Claudia proposed several scenarios illustrating the behavior of the AtGentive agent as well as different types of events.

The first scenario illustrates a situation where the user switches between 2 activities (e.g. filling the mind-map and filling a questionnaire in ODN) and the agent proposes to restore the context of the resumed activity.

In the second scenario, we have a case where the user starts an activity that requires a lot of time. The agent recognizes that there is not much time left and suggests to the user to continue previously interrupted (presumably shorter) activity. The point is that the agent optimizes the use of time.

Scenario three describes a case where while performing some task, an email for the user arrives. Based on the information about the sender, the importance of the message, and its relevance for the task at hand, the agent decides when to notify the user.

The fourth scenario proposes a learning situation where the user visits some knowledge areas (ICDT). The agents may report the applications' suggestion that other area of interest (alternative foci) may be visited.

In scenario five, the user has explicitly asked to be notified if an email (possibly from specific sender and/or with specific keywords in the subject) has arrived. The agent then tries repeatedly to notify the user until he or she acknowledges.

Scenario six: If the agent proposes something and the user dismisses it, the agent will not re-propose it without additional motivation/explanation.

Scenario seven illustrates the point that the agent should be able to recognize when the user's attention has inappropriately drifted and, if necessary, intervene by re-attracting user’s attention to the task, or refocusing his or her attention to other relevant task.

The penultimate, eight scenario illustrates a rather difficult but quite possible situation, when the user engages with different (not ODN, or ICDT) application in the middle of his/her work. The agent has no way of knowing if what user does in the moment is more or less important and therefore probably the best possible thing is not to intervene.

The last scenario describes a situation where the user has initiated several tasks which, normally, would not be performed in a simultaneous manner. Again, based on the time limits, and the progress in particular tasks, the agent should decide when to propose resuming what remaining activity.

In the discussion that followed it was agreed that the event based conceptual framework represent an appropriate tool for describing and analyzing different scenarios involving the AtGentive agents. Similarities were recognized and pointed to between some of scenarios described by Claudia Roda (AUP) and Toni Vanhala (UTA), and by Claudia and Inge Molenaar (Onddeknet). It was also discussed that EBCF represents a good formalization that can be used for simulation of different scenarios with possibility to analyze the effects of various parameters (time limits, task urgency, user goals, effects of interruption…).

The long day ended in the nice restaurant near AUP. With some exceptions (hint Claudia) people had a really good dinner :)

Tuesday, Jan 24, morning session

Mary Zajicek (OBU) reported on the methodologies for evaluation as well as the time line and the milestones for the WP4 (see appendix 12 - AtGentive Formative Evaluation). She explained the three evaluation levels: Formative (identifying user's needs and define/validate usage scenarios); Summative (evaluating the work produced); Substantive (assessing the substantive value of the knowledge produced). She elaborated more on the formative evaluation and presented the methodologies of the so called Extreme Programming (XP) and the Agile Development.

Harri Siirtola (UTA) reported on state of the art of the possibilities to estimate user's attentional state via psycho-**physiological measurements** (see appendix 13 – Presentation: Psycho-physiological measurements in AtGentive) . Given the constraints within the AtGentive project (non-invasive measurements, classroom situation, complicated equipment will not be available *in situ*) UTA team has described several possibilities: EEG brain measurements (limited usability; electrodes should be placed on users' head); ECG heart measurement (possibility for wireless ECG); measuring muscles activity (requires skin preparation); posture measuring e.g. approach-withdrawal reaction (in-built (in the chair) devices available but expensive); eye measurements (a camera can track the movements of the eyes, the saccades, gaze direction, pupil size, and eye blinks). In summary, it was concluded that in principle it would be possible to come up with some inexpensive devices for the pilot experiments (e.g. webcams) with limited possibilities, and some more complicated devices could be used for the evaluation of the final system in laboratory settings.

Jaroslav Cech (CELN) presented some of the issues that will have to be resolved in the pilot experiment (see appendix 14 – Presentation: Dynamic agent ?!). Apart from the learning content (English for Czech students or something else) the team will have to decide on the age group, teaching scenario as well as "the art of usage": home and/or school. He also raised the issue of what will be actually measured and how: overall attention? knowledge growth? frequency and manners of interaction with the agent? difference between the groups with and without the agent? Jaroslav also proposed to consider automatic information collection for the Atgentive Agents.

Tuesday, Jan 24, afternoon session

David Kinkma (Ondeknet) presented a diagrammatic view of the Atgentive framework as related to the OntDeknet application. (see appendix 16 – Presentation: Diagramatic Framework)

Laurent Ach (Cantoche) presented a possible structure of interaction between the atgentive agents, the applications, and the Cantoche's agents (see appendix 15 - Attention & Embodied Agents: Attentional states and Living Actor states). He proposed that Cantoche agents could be augmented by an "attention related" language that would form the interface to the Atgentive system.

APPENDICES

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Appendix 1: **Presentation**

Title
Ontdeknet Presentation and Demonstration

Authors
Koen Molenaar, Inge Molenaar, Maurice Vereecken, David Kingma

Company

Ontdeknet

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Meeting WP1

Koen Molenaar - Inge Molenaar
Maurice Vereecken – David Kingma

22 January 2006

What is Ontdeknet?

An electronic learning environment:
Focused on collaboration between
students within schools
and
experts in society.

Mission of Ontdeknet

"Citizen involvement in education through the means of the Internet"

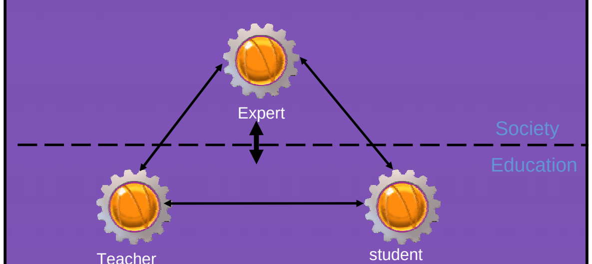
Goals
- ✓ To better integrate society and education
- ✓ To diversify and individualize education

For Whom?

Educational institutions:
- ☑ Primary education > 100 schools
- ☑ Secondary education, 5 pilot schools

The community
- ☑ Companies (multinationals → SME's)
- ☑ Sector related organizations
- ☑ Cultural institutions
- ☑ Private persons

The Model



Learning with Ontdeknet!

Demo

- ✓ Portal
  - ✓ Expert environment, Koen
  - ✓ School & teacher environment, Maurice
  - ✓ Student environment, Inge

Cases

Secondary education,

- ☑ based on a teacher interview

Primary education,

- ☑ based on protocol analysis of teacher interventions

Case Secondary education

Setting

- ☑ **Context:**
  - ☑ Learning sequences are used to support educational projects in realistic settings.
  - ☑ Every project starts with a realistic description of the problem at hand.
- ☑ **Case:**
  - ☑ “A local festival is at risk, they do not have enough sponsors. Can you help them pursued a bank to sponsor a new samba corner of the festival?”

Project Outline

Every project consists of 5 steps:

Collaboration contract

- ☑ *Write a contract with your group-members on how you will collaborate.*

Awareness stage

- ☑ *Visit the websites of 3 free festivals and make an overview of important issues for free festivals.*

Research stage

- ☑ *What is sponsoring? Consult your e-coach on sponsoring.*

Product stage

- ☑ *Write an overview of the organization of the new samba corner for the festival and consult your e-coach if this fits the profile of the bank.*
- ☑ *Write the plan for the samba corner as sponsor proposal for the bank.*

Presentation stage.

- ☑ *Make a persuading presentation for your e-coach and present this at the bank.*

Learning Sequence

The learning sequences of this project consists of the following steps;

- ☑ Introduce yourself
- ☑ Assignment 1
- ☑ Assignment 2
- ☑ Sign up with your expert
- ☑ Assignment 3
- ☑ Assignment 4
- ☑ Assignment 5

Problem

Problem:

- ☑ Students starts with assignment 1 sends it to the teacher for assessment and continues with assignment 2.
- ☑ Then assignment 1 is assets and students will continue on improving this assignment.
- ☑ Onty believes the students should be working on assignment 2 and gets really upset!

Solution:

- ☑ Interactive option: Atgentive asks students what he is doing and decides if that is okay.
- ☑ Guidance option: Atgentive provides the student with guidance; first assignment 1, then assignment 2 ect.

Problem

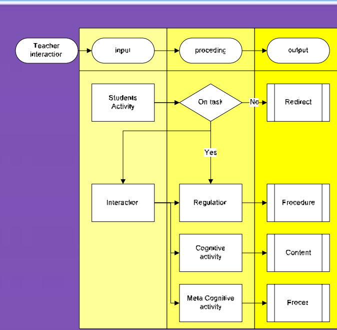
Problem

- ☑ Students work on assignment 3 and want to consult the expert.
- ☑ This can occur anywhere in the process of working on assignment 3 depending on the type of student, available knowledge on the topic etc.
- ☑ Now we demand from student that they assigns to the expert the beginning of the assignment.
- ☑ The positioning is not effective for all students.

Solution:

- ☑ Interactive option: Atgentive asks students if he/she wants to meet the expert
- ☑ Guidance option: Atgentive provides the student with guidance at a time he/she seems to be stuck in the assignment. He you can ask your expert for help?

Framework teacher intervention



Cases; primary education

Setting

- ☑**Context:** Students in primary education work together in a triad, with an expert to make a paper about the profession of the expert.
- ☑**Case:** Make a paper in which you describe the profession of the expert you are working with.

Learning sequence

The students work with the following learning line:

- ☑ Introduce yourself to the expert
- ☑ Describe your goal
- ☑ Meet your expert
- ☑ Write a concept map
- ☑ work on your paper
  - ☑ read the information of the expert
  - ☑ ask questions
  - ☑ write a summary of the information of the expert in our paper
  - ☑ read the answers
  - ☑ write a summary of the answers in your paper
  - ☑ choose pictures for your paper

Case 1

Attentional state:

- ☑ Task: Step 1. Introduction.
- ☑ Students: Studiegroepje (8 years old):
- ☑ Activity: Students follow Onty, they understand the explanation and start to introduce themselves. After a while they do not add anymore text.

Intervention teacher:

- ☑ Content: the teacher suggests writing their hobbies and age.

Case Atgentive:

- ☑ Atgentive monitors low activity → determines alternative foci.
- ☑ Content: Onty comes up with the question did you include the following topics and shows the students a checklist.
- ☑ Process: Please explain why you think you are done (evaluation).

Case 2

Attentional state:

- ☑ Task: Step 2 goal
- ☑ Students: DJT (8 years old):
- ☑ Activity: Students start to write a goal. Leanne is playing with Onty while Beng is trying to type.

Intervention teacher:

- ☑ Procedure, Lianne when you play with the mouse Beng can not type at the same time.

Case Atgentive:

- ☑ Atgentive monitors double activity → determines alternative foci
- ☑ Procedure: please do one activity at the same time!!

Case 3

Attentional state:

- ☑ Task: Step 3 Find an expert.
- ☑ Students: DJT (8 years old):
- ☑ Activity: Students follow Onty, but has a problem with going to the experts. The link to the expert is below the search graph.

Intervention teacher:

- ☑ Navigation: You have to scroll down and select an expert.

Case Atgentive:

- ☑ Atgentive monitors low activity, scroll up and down → determines alternative foci
- ☑ Procedure: Students have problem to find right link
- ☑ Content: Students have a problem find the right expert
- ☑ Process: Students do not know how to search

Case 4

Attentional state:

- ☑ Task: Step 4 Mind Mapping
- ☑ Students: DJT (8 years old):
- ☑ Activity: Students do not fill in any words after the first

Intervention teacher:

- ☑ Process: How can you think of more words to fill in?

Case Atgentive:

- ☑ Atgentive monitors low activity → determines alternative foci
- ☑ Procedure: Students have problem to find the next box
- ☑ Content: Students have think of more words
- ☑ Process: Students do not know how find more words

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Appendix 2: **Memo**

Title
Memo Description Ontdeknet

Author
Inge Molenaar

Company
Ontdeknet

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Memo Description Ontdeknet

From: **drs. Inge Molenaar**
To: **Atgentive team members**

15-01-2006

Introduction

Ontdeknet is an e-learning environment involving and challenging everybody (within our society) to share and explore knowledge.

Ontdeknet is developed in a joint effort of the organization Ontdeknet, the Dutch ministry of Education, the Dutch ministry of Economics and Ants (technical development). The idea for Ontdeknet was created in 2000 and awarded with the national education price in the same year. Since then the platform had technically evolved towards an ELO[1] and educational implementation have been further developed.

Ambition

Ontdeknet aims to make knowledge and skills from society accessible for educational institutions focused on the individual goals of the student. Virtual learning relationships between "experts" and “students” are established in a virtual learning environment.

The mission of Ontdeknet is:

1. To integrate society in education
2. To support individual talent development of students.

How do you create a framework, which makes the contribution of all citizens to education possible, viable and executable?
Ontdeknet is the Dutch answer to this question. The collaboration with the experts expands the student’s world of experience and has a positive effect on the learning behavior. The contribution of citizens is achieved through the Ontdeknet-environment. All together Ontdeknet is an electronic learning environment, in which students work together with experts. Ontdeknet differs from other electronic learning environments because it aims to create a relationship and collaboration between the expert and the student for a longer period of time. The environment supports this collaboration with a number of tools, which have been developed in collaboration with teachers, students and experts. Through this joint effort a unique framework has been developed to integrate the contributions of regular citizens in education.

The Ontdeknet environment provides guidance to support individuals to learn together based upon common interests. Hand in hand with technology, Onty (the learning agent) makes "the complex process of collaboration and knowledge exchange" simple for the users. The integration of citizens in the educational process makes the goals of individual education, and maximum talent development scalable and accessible for all.

Onty, in a chrismas suite

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[1] ELO = electronic learning enviroment

Experts; Question based learning
The student's questions and interests set the parameters and are central in the Ontdeknet approach, based on new learning theories. *The expert* provides the students with real life knowledge and experiences in dairies. Student's questions to an expert are answered in a forum that is visible for everybody.

The Ontdeknet project
Ontdeknet is operational for students aged between 7 and 15 years old in 150 schools in the Netherlands. It is used for career orientation, writing papers, and presentations and to support thematic education. The learning relationships between experts and students supports more individual education based on the experts' experiences and student's interests. Research has shown (Molenaar, 2002) that students are highly motivated to work with Ontdeknet and that it promotes transformative use of ICT in education.

The results
The **results** of the project are very practical and show that the creative use of technologies can enhance changes in our society:

- **Children** on Ontdeknet learn with their expert on the topics of their interest. This individual and interactive approach to learning has increased the motivation. It enlarged their worldview due to interactions with people beyond their own social circle. For children it is simple: *"I learn faster with Ontdeknet"*
- **Teachers** are hesitant to use ICT when it demands difficult procedures. Ontdeknet has been developed in collaboration with the teachers. They indicated to appreciate Ontdeknet as tool to implement ICT in education and to move towards "new learning". The guidance of an agent helps teachers to concentrate on the learning of the students in stead of the technological and procedural issues.
- **Experts** largely enjoy sharing their knowledge and expertise with children and claim to learn from the naïve questions posed by the children.
- **Business** use Ontdeknet to support educational institutions as part of their social responsibility policy. Cultural institutions enrich visits of students by preparing with interactive discussions.
- **A foundation of elderly citizens** actively provides experts for Ontdeknet. These seniors typical have low Internet skills. Ontdeknet provides them with means to actively use Internet and build up Internet skill in the process.

2001; Dutch minister of education, behind Ontdeknet

Pedagogical theory

Learning arrangements are continually innovated and adapted to changes in society. Current arrangements are enriched with technology to foster learning processes and learning outcomes that enable learners to act effectively in society (Simons, van de Linden & Duffy, 2000). Additionally, the importance of authentic learning and active involvement of the learner in the learning process is emphasized.

Constructivism is the driving theoretical foundation for many educational reforms. Three elements come to the fore in numerous descriptions of (and prescriptions for) constructivistic learning arrangements, 1) the constructional nature of the task, 2) the situatedness of the environment and 3) the collaborative character of the arrangement. These elements, however, are defined differently by different researchers and consensus about the interplay between these elements is far from reached.

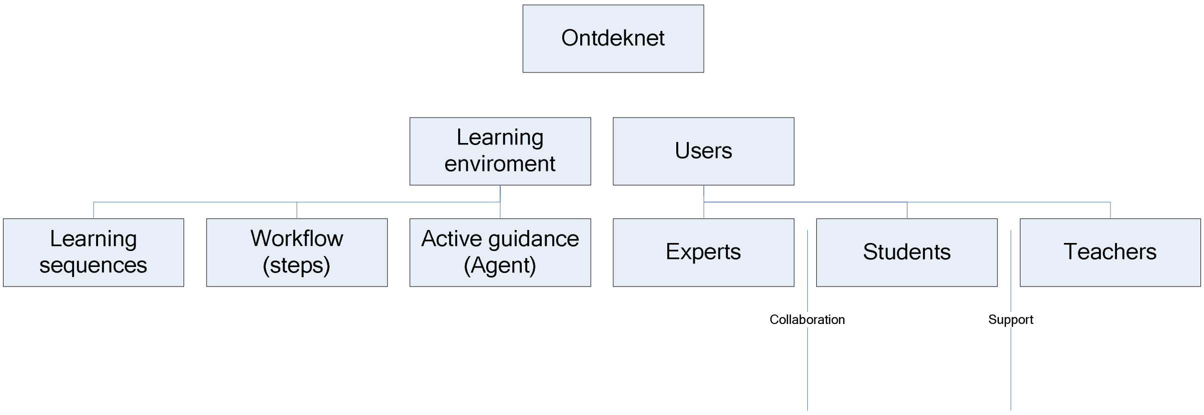
Ontdeknet concerns an innovative learning arrangement that aims to have an effect on the nature of the knowledge that students acquire. We expect it to be more integrated into the mental models of the students. The interplay between the three elements has an important roll. The three elements and their potential effects are conceptualised as follows:

The constructional nature of a task is related to features of the task, such as opportunities to choose ones own learning goals, self-responsibility for ones own learning procedures and opportunities for self-testing. A task with these features requires metacognitive activities from the students, such as orientation on prior knowledge, planning of the learning procedures and evaluation of their sources and progression (Simons, van der Linden & Duffy, 2000; Vosniadou, DeCorte, Glaser & Mandl, 1996).

Situatedness of the learning environment is determined by the socio-cultural environment in which learning takes place. We presume that a rich real-life socio-cultural environment offers learners opportunities to understand the usage and relevance of knowledge in practice, the nature and value of knowledge (Seely Brown, Collins & Daguid, 1989). This enhances the development of their personal epistemological insights, i.e. the beliefs that learners have about the 'certainty', 'simplicity', 'source' and 'justification' of knowledge (Bendixen & Rule, 2004, Hofer & Pintrich, 1997).

Collaborative character of the learning arrangement refers to arrangements in which cognitive resources are socially shared in order to extend individual cognitive resources or to enable learners to accomplish something that individual learners could not accomplish alone (Lehtinen, Hakkarainen, Lipponen, Rahikainen & Muukkonen, 2000). It fosters learners' awareness of their own conceptual models in comparison to the models of others and thus promotes construction of new models and reconstruction of inadequate conceptual models (van der Linden & Renshaw, 2004; Dekker & Elshout-Mohr, 2004).

Research has shown that students are motivated to work with Ontdeknet and that it promotes transformative use of ICT in education (Molenaar, 2002). Ontdeknet is mostly used to support students' vocational orientation, for example, a student consults a lawyer, a chemist, or a carpenter about their daily activities, schooling, schedules, payment and career path as well as technical issues such as instruments and procedures used during execution of the profession. Several hundreds of experts representing different professions are available for consultancy.



The arrangement has the following characteristics:

- *Constructional nature*: Students, working alone or in small groups, steer their own learning process. The constructional nature of the task comes to the fore in the self-initiating role the students play (see the elaboration in the next paragraph). The students are placed in central position between the expert, who provides information and the teacher, who supports the learning.
- *Situatedness*: The information given by the experts concerns their professional knowledge and experiences and has value and relevance for both experts and students. The vocabulary used by the experts is related to the socio-cultural environment of their profession and their examples, reasoning and explanations reflect their thinking as an expert (Ericsson, K.A. & Charness, 1994). Thus, the students acquire knowledge and get an idea of the nature and value of the information in the real-life situation, in which it is used by the experts. The task to collaborate with an expert has real-life value and relevance for the students themselves also, because it is embedded in their curriculum ('career orientation').
- *Collaborative character*: Students collaborate with an expert (in a virtual environment) and with each other (in triads in the classroom). Students engage in various activities to initiate and structure the collaboration. The Ontdeknet-learning agent facilitates the process (see the elaboration in the next paragraph).

The Platform: three users environments

Ontdeknet was designed for three different users: namely the students, the teachers and the experts. Each user group brought their own wishes and demands:

- **Students** wish for a motivating environment and enjoy self directed learning.
- **Teachers** demand a learning environment, which supports their vision on learning and that connects to the national curriculum.
- **Experts** demand an efficient and easy environment which supports them in fulfilling their experts duties within the agreed upon contribution of 1 hour per week.

Each group of users has a dedicated environment and each user has his/her personal environment. Table 1 provides an overview of the different environments and items of each the users' environment.

Users	**Students**	**Expert**	**Teacher**
News overview	My news My learning sequences My settings	My news My settings	My news My settings
Working corner	About me My assignments My portfolio Internal discussions	About me My dairies Concept map topics Forum Internal discussions Assignments	About me Assignments Learning sequences Internal discussions
Works with	My experts	My students	My students
Extra info	My school	My teachers	My students experts

Table 1. Overview of environments in Ontdeknet

Technologies involved

Ontdeknet is a web based modular platform (XML-based), which supports workflow engines and a real-time rendered 3D Agent. The architecture enables users to define their own process (workflow) by selecting different activities (from modules). In this way users create their own learning sequence. Based on the defined learning sequence the Agent guides the individual user. This guidance is based on the users place, movements and advancements within the platform.

This project is a collaboration between the France company **La Cantoche**, the Dutch companies **Ontdeknet** and **Ants**. The technology of Cantoche allows real-time rendering of the 3D agent. The dynamic learning sequence technology of Ants allows users to create their own process. The combination of the agent and the dynamic learning sequence module allows for individual guidance of the users.

Learning sequences
Lessons on Ontdeknet are always guided by the so-called learning sequences. The platform allows teachers and learners to the create sequences. A learning sequence is a number of activities the student has to perform on Ontdeknet to reach a certain learning goal. In a learning sequence two types of activities can be used: activities around assignments and activities around experts.

Ontdeknet supports the use of the following assignment types:
1. Written paper
2. Visual paper
3. Questionnaires with open and/or multiple choice questions

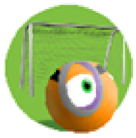
The activities that support the assignments are:
1. Goal selection
2. The mind map
3. The expert

The activities that a student can perform in relation to the experts are:
1. Introducing themselves
2. Assigning to an expert
3. Reading Dairies
4. Posing questions
5. Chatting with an experts
6. Exploring the experts information

All the above activities can be selected a used in a learning sequence.

A example of a learning sequence The five step
This example of a learning sequence consists of five steps, which are an analogy of the normal process of collaboration. The five process steps are:

1. *Introduction*
    a. The student introduces himself through filling out his personal information.
    b. The expert introduces himself through filling out his personal information and writing an introductory story.



2. *Goal setting*
    a. The student sets his goals for working with Ontdeknet.
    b. The experts takes notice of the goal

3. *Assigning to an expert*
    a. The student assigns him/herself to the expert who can support him to reach the goal.
    b. The expert receives a notification that a new student has arrived

4. *Making the mind map; mutual understanding*
    a. The student describes the topics he would like to address in the collaboration with the expert by entering these topics in a mind map. The student can use the introduction dairy and the personal information of the expert to obtain the necessary context for filling out his mind map.
    b. The expert receives the mind map to see what the student likes to learn from him.

5. *The assignment*
    a. The student reads the contributions of the expert and asks questions.
    b. The expert will write a contribution on each of the topics, typically one per week. He will answer questions, which provides the opportunity to further elaborate on certain issues.

The tools in the five step
Different tools in the environment support this process:

Step	**Tools**		
User	*Student*	*Expert*	*Teacher*
Introduction	Personal information sheet	Personal information sheet	Monitor
Goal setting	Goal sheet	Project information	Provide assignment
Assigning to an experts	Search expert by reading their personal information and introduction diary	Write introduction dairy	Monitor
Setting topics	Mind map	Overview Mind map items	Monitor
Work on paper	Read contributions Ask questions Write paper	Write contributions Answer question	Monitor

Table 2. Tools in the Ontdeknet environment to support the five step process.

Onty, the Agent
Currently, the reactions of the agent are connected to the advancements of the students in respect to his activated learning sequence and the student's position in the platform. Templates are created for this purpose. Around every activity on Ontdeknet a templates is built.

A template contains the following elements:
1. An introduction,
   what is this activity?
2. Navigation guidance's,
   where do you perform this activity?
3. Explanation, (activated upon arrival at the right screen)
   how do you perform this activity?
4. Finalising,
   this activity is finished

In the templates navigation guidance is included. When an user moves in the wrong direction he is redirected by the agent. Based on the mouse actions of the student different parts of the template are activated. The system registers the situation on the platform and the advancements of the students. The system decides on the basis of advancements of the user, if a template is started and it registers where the sequence will start depending on the situation on the platform of the user.

Adaptive adjustments to these templates are possible, but demand for interpreting activities of the teacher and are very work intense. The Atgentive approach would allow for a more efficient process of adaptive interaction with the agent, without necessary involvement of the teacher.

The evolution of Ontdeknet
Ontdeknet focuses on the enhancement educational innovations by webbased technology. To provide some inside in the development of Ontdeknet screens of the 3 platforms are shown.

Platform	**ODN v1**	**ODN v2**	**ODN v3**
Vision	Provide a platform which enables experts to share knowledge with students.	Personal environments for every user to guide students and experts in their collaboration. Teachers and Onty are the coaches of the learning process.	Improvement of learning environment based on a matrix between the new insides in educational research (constructivism) and broadband Internet possibilities.
Main goal	Knowledge sharing	Personal environments and online guides	Innovation

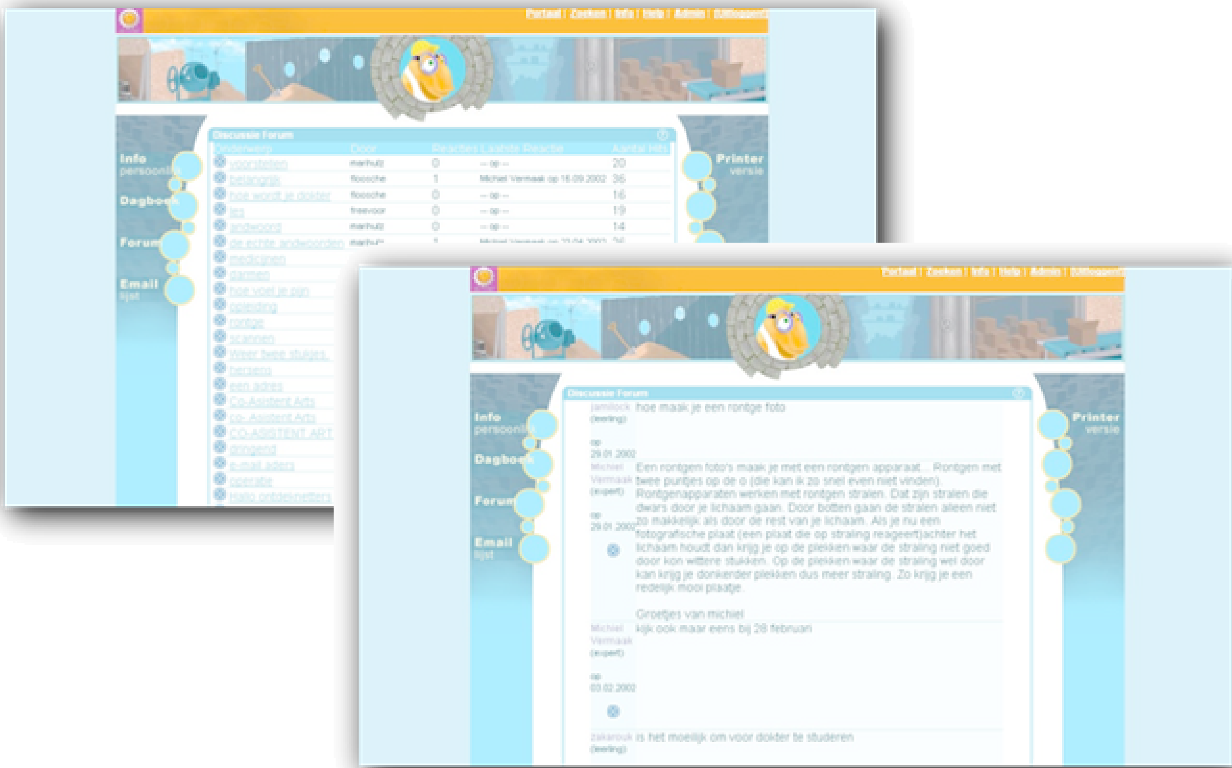
Table 3, ODN platforms

Portals of the first and third version:

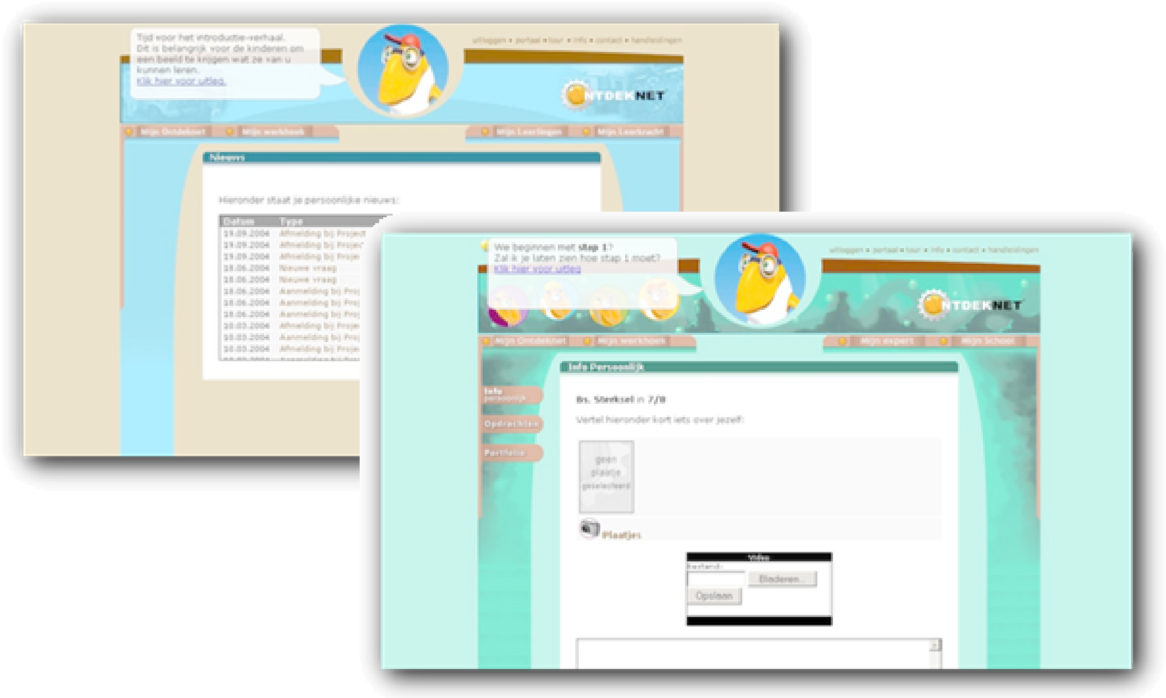
ODN v1 Focus on knowledge sharing
In 2000 Ontdeknet has been to be developed from the initial idea to an software application. This environment allowed the experts to create diaries and answer questions of the students in a forum. ODN v1 was developed as a best-practise and showcase to prove that knowledge could be shared beyond the boundairies of the school and technologies anno 2000 were advanced enough to support this.

The expert environment of the doctor:

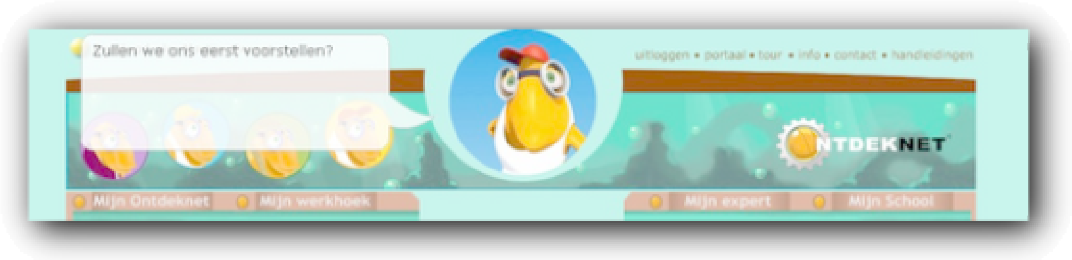
Ask and answer, a simple but effective forum:



ODN v2 user environments and coaching from agent Onty
To improve the collaboration between experts and students ODN v2 was focussed on identity (by user environments) and intelligent guidance by Onty. The guidance was done from the Muppet location in the centre of the header.



To explore the effect of agent and improve the visibility / usage of process we added emotions to Onty. Below a screenshot were he becomes said because the user is performing the wrong activity:



ODN v3 Ontdeknet broadband innovations
Improvement of learning environment based on a matrix between the new insides in educational research (constructivism) and broadband Internet possibilities.

Search within meta-structures

Movies in Ontdeknet; the motor expert

Explanation of volcano's:

3D Onty explains a game

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Appendix 3: **Presentation**

Title
ICDT-Model

Author
Albert A. Angehrn

Company
INSEAD

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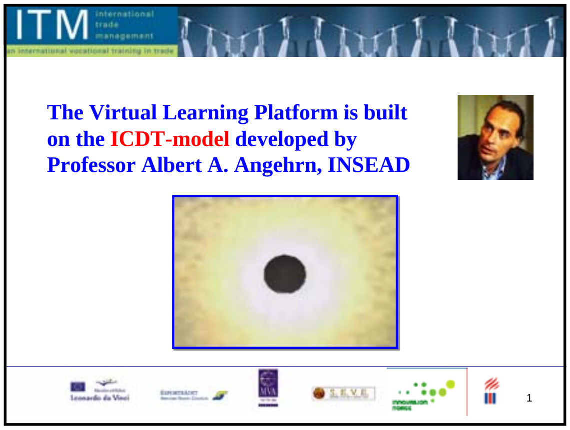
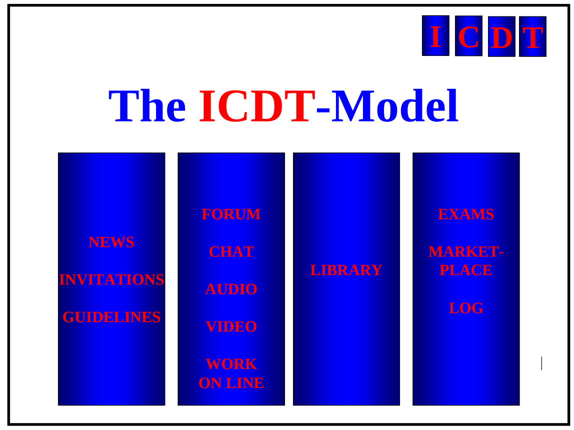
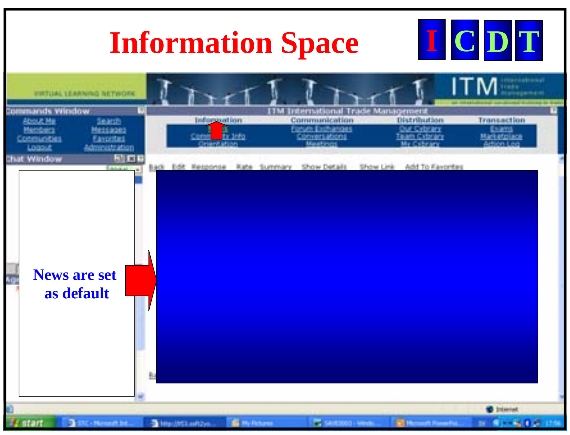
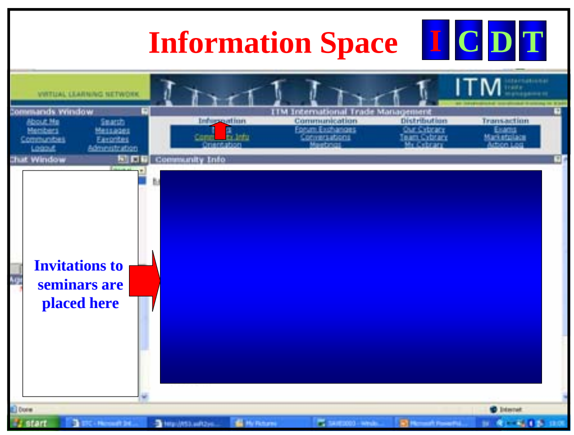

ITM international trade management
The Virtual Learning Platform is built on the ICDT-model developed by Professor Albert A. Angehrn, INSEAD
1

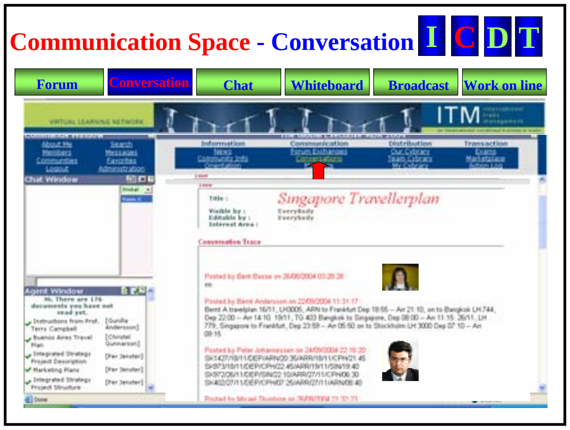

I C D T
The ICDT-Model
NEWS
INVITATIONS
GUIDELINES
FORUM
CHAT
AUDIO
VIDEO
WORK ON LINE
LIBRARY
EXAMS
MARKET-PLACE
LOG

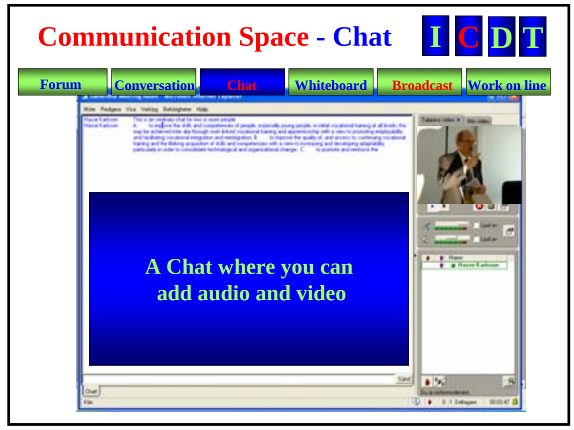

Information Space
I C D T
News are set as default


Information Space
I C D T
Invitations to seminars are placed here


Chat Window
Everybody logged in is automatically shown on the right side of the chat window
I C D T
Who is Edward Fox ?
Where does Mr Fox works ?
LAMMHULTS

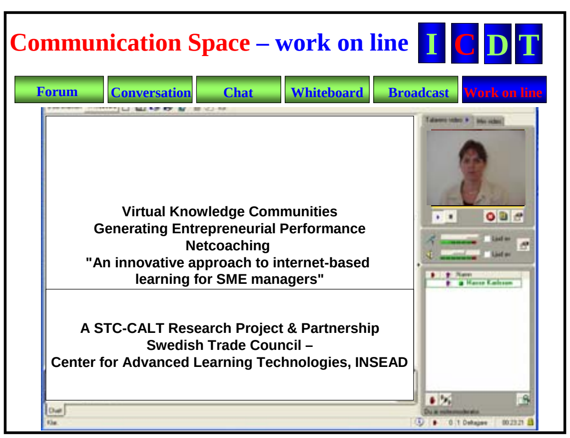

Communication Space - Forum
I C D T
Forum
Conversation
Chat
Whiteboard
Broadcast
Work on line
Forum Exchanges is where everybody can post new discussion topics, read and reply

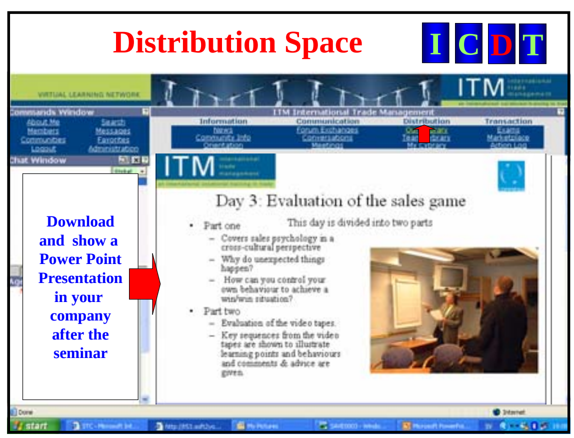

Communication Space - Conversation
I C D T
Forum
Conversation
Chat
Whiteboard
Broadcast
Work on line
ITM
Singapore Travellerplan


Communication Space - Chat
I C D T
Forum
Conversation
Chat
Whiteboard
Broadcast
Work on line
A Chat where you can
add audio and video


Communication Space - Whiteboard
I C D T
Forum
Conversation
Chat
Whiteboard
Broadcast
Work on line
Using Lotus Sametime
to brainstorm on line
using audio and video

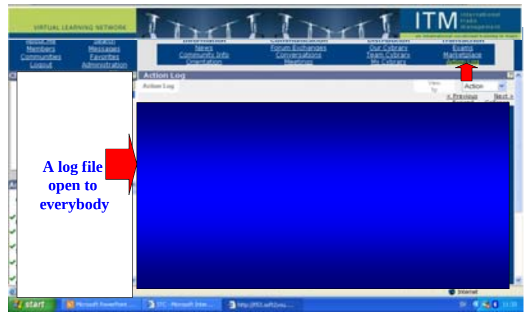

Communication Space – Broadcast
I C D T
Forum
Conversation
Chat
Whiteboard
Broadcast
Work on line
Change Management
&
Learning Networks
Prof. Albert A. Angehrn
INSEAD


Communication Space – work on line
I C D T
Forum
Conversation
Chat
Whiteboard
Broadcast
Work on line
Virtual Knowledge Communities
Generating Entrepreneurial Performance
Netcoaching
"An innovative approach to internet-based
learning for SME managers"
A STC-CALT Research Project & Partnership
Swedish Trade Council –
Center for Advanced Learning Technologies, INSEAD

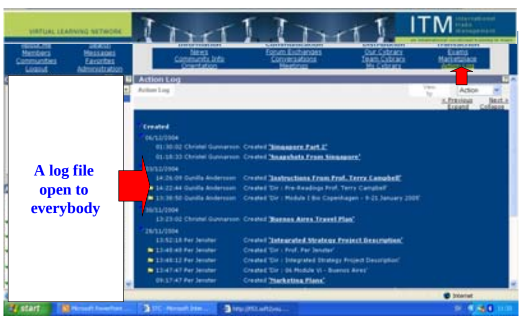

Distribution Space
I C D T
ITM
Download
and show a
Power Point
Presentation
in your
company
after the
seminar
Day 3: Evaluation of the sales game

Distribution Space I C D T

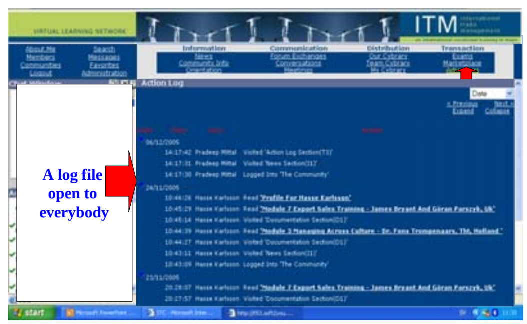
Transaction Space – Action Log I C D T



Transaction Space – Action Log I C D T

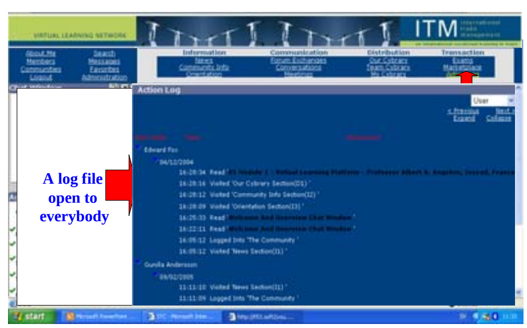


Transaction Space – Action Log I C D T



Transaction Space – Action Log I C D T

Transaction Space – Action Log I C D T



Virtual Learning Platform creates a unique base for

ITM international trade management
an international vocational training in trade

Thank You.

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Appendix 4: **Presentation**

Title
AtGentive – AtGentiNet Description & Scenarios for supporting Attention

Authors
Thierry Nabeth (& Albert A. Angehrn, & Pradeep Kumar Mittal)

Company
INSEAD

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AtGentive - AtGentiNet
Description & Scenarios for supporting Attention

AtGentive; WP1 Workshop;
23 January 2006, Paris, France

Thierry Nabeth (& Albert A. Angehrn, & Pradeep Kumar Mittal)
INSEAD CALT (Centre for Advanced Learning Technologies)
http://www.calt.insead.edu/

Table of content:

- Introduction
- AtGentNet
- Scenarios for supporting attention
- Next Steps

Introduction

- The new organisational context (the knowledge economy)
- The challenges of attention

The new Organizational context:

- The knowledge economy is characterised by:
  - globalization, exacerbated competition, acceleration of changes
  - information and technology flood (email, IM, blogs, forum, wiki, ...)
- New Success factors
  - For the organisations: ability to properly select, combine and transform resources.
  - For the knowledge worker: ability to select, develop and apply a unique set of (managerial or technical) expertise

The challenges of attention:

Perception. How to deal in an effective way with the massive amount of information and solicitations, sorting out the good from the useless

Reasoning & Decision. How to process in an effective way this information. How to make sense of this information. How to decide the next line of action.

Execution. How to deal with the execution of multitude of activities that users & organisations are now engaged in (without being overwhelmed, distracted, and reserve time for the creative work).

AtGentNet

- A digital environment for supporting the knowledge exchange in learning networks
- Rely on the concept of Microworld (a set of spaces in which the users are engaged into knowledge exchange related activities)
- Elements (spaces, items, users) are accessible, and the traces of the activities are recorded, and can be processed
- Mechanisms are available in AtGentNet to support the attentional process of people & organizations

Knowledge exchange in AtGentNet

- The users:
  - Managers geographically distributed
  - They work in SMEs and they feel isolated
- The activities
  - They share documents and cases
  - They share experiences via interaction in discussions (forum, chats, etc.)
  - They can also engage into some learning activities (lectures, simulations, etc.)

AtGentNet relies on the concept of microworlds

- Organised as a set of specialised spaces containing a variety of components (from information items to more active components), providing a metaphor and supporting a certain activity / context
- users (and agents) are engaged in a set of interactions in these spaces
- Artificial agents are assisting the activities of the users.
- The elements of a microworld are available, as well as the different traces for both human and non human processing

The different categories of spaces:

- Information spaces
  - News space (announces)
  - Orientation (provide guidelines)
  - Community information (social translucence)
  - Logs. **
- Communication spaces
  - Forum exchange
  - Conversations
  - Meeting room
  - Blogs*
  - Discussions (attached to an item)

Note: categorisation based on the ICDT model

The different categories of spaces: (2)

- Distribution spaces
  - Cybrary or community shelf (repository of documents)
  - Cyber Encyclopaedia (Wiki of terms)*
  - Team shelf
  - Personal shelf
    - Office space
    - Private space
- Transaction spaces
  - Marketplaces (for knowledge trading / consulting)
    - Shopping spaces
    - Reputation systems*
  - Forms
    - Polls area*
    - Assessment area*
    - Registration or booking areas
  - Learning spaces
    - Lecture space
    - Simulation

The different categories of elements:

- Document
  - Presentation (PowerPoint)
  - Article
  - Guideline (for instance orientation document)
  - Cases
  - Video
  - Etc.
- Posting
  - News item
  - Discussion entry
  - Conversation item
  - Blog entry*
  - Blog response*
  - Email
  - Wiki page*

The different categories of elements: (2)

- Generated item
  - Log entry
  - Activity indicator
- Complex object
  - Booking form
  - Exam
  - Simulation session
  - Questionnaire
  - Pool
- Miscellaneous
  - User profile
  - Group profile

The different categories of events:

All the different activities are recorded by the system, and are made available in the log file.

Main categories of events
- visit a space
- read an item
- create an item
- edit an item
- delete an item

Note: Obviously the refinement of the different categories of action is something that will be elaborated during the project.

Supporting attention

- Different modes of support
- Mechanisms
- Some scenarios

The management of attention can be done via:

- The acquisition of **attention management practices and support mechanisms** about how to effectively manage their attention
- The development by entities (person, organization, group or community) of the attentional **self-reflective metacognitive capabilities**

First mechanisms: space structuration & specialisation (metaphor)

- AtGentNet will be structured as a set of well identified and specialised spaces supporting a limited number of activities. The forms is which these spaces are presented to the users will be chosen to make it very clear the context and the nature of the activities taking place in a given space
- Assumption
  - The creation of dedicated spaces will reduce the likeliness of distraction of the user.
  - Besides, the form of the space will reinforce the perception of the context of the interaction

Second mechanisms: the ”Magic Lens”

Individual enhancing and filtering of shared representation

- The Magic Lens concept consist in providing a personalized enhanced perception of a common representation, taking into account the specificity of the users interacting with this representation. More concretely the different users wearing this magic leans (that can be activated in the browser) will get a slightly perception of the shared space (Cybrary, Forum, Chatroom, etc.) in which they interact.
- Example of user experiences: in a forum, the user will see magnified the posting of the other users that are important to him.

Third mechanisms: Agent interventions

Artificial agents may proactively intervene.

- The Agent, aware of the user's profile and of the context may proactively intervene.
- Example: an embodied character, only visible by the user, may intervene and indicate an item of particular importance
- an agent may suggest some new behaviour and practices. (your quote all your messages as very important. “Do you know the story of the boy who cried Wolf”. Or, I observe that you are using the email to communicate with the same group of people. Why not to create a blog? it may help you to make best use of your time)
- An agent may question the relevance of the behavioural profile with the stated agenda of the user (dissonance).

Fourth mechanisms: self-reflective tools

- AtGentNet will provide a set of mechanisms to develop his / her attentional meta-cognitive abilities
- Via:
  - The visualisation of it previous activity related to his / her dedicated attention (where did he spent his time, what are his actions). This information will be extracted from the observed activity.
  - A set of assessment of his current way of managing his / attention. The system may indicate an observed attentional profile.
  - The definition of an agenda (getting focussed), and the suggestion of an attentional profile matching this agenda.
  - A set of presentation & exercises to understand attentional concepts. (for instance stories presenting cases of bad practices; for instance on the good use of email; different categories of attention –captive / volontary- -front of mind / back of mind-, etc.)

Next steps

- Other mechanisms to integrate: visualizing organizational attention (social translucence, tagging, etc.)
- Defining some activities that can help people to develop attentional skills (for instance multi-tasking)
- Define roles? (human coaching?)
- ...

INSEAD CALT focus

- Behaviour and cognition in digital social environments.
- Education. Using (role playing) games to help people to acquire social skills.
- Virtual community engineering (and in particular their social engineering)
- Intelligent systems (cognitive agents) for digital social environments

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Appendix 5: **Presentation**

Title
Management of the user attention

Authors
Benoît Morel, Laurent Ach

Company
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Embodied Agents:
Management of the user attention

WP1 Worshop
January 23 2006

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Why an Agent to catch the user attention?

"[…] *The way people interact with technology is the way they interact with each other*" [Picard, 2004]

No less than 90% of the learners polled said that they prefer an interface with an interactive character over an interface without a character [Reeves, 2004]

When the attention is not really sustained, the physical elements can be memorized. This is not the case with semantic elements. [Montigneaux, 2002]

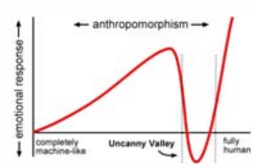
- An Agent can increase the attention of the user because they can have the same kind of behaviours that a human with standard interactions.
- Importance of the choice of the Agent

Summary

- **Physical aspect**
  - Style
  - Features
  - Accessories
- **Behaviors**
  - Gestures
  - Expressions
- **Rhythm**
  - Rhythm between each behaviors
  - Rhythm of each behaviour
- **Other**
  - Voice, position, Scale, Environement
- **Example**

Physical aspect

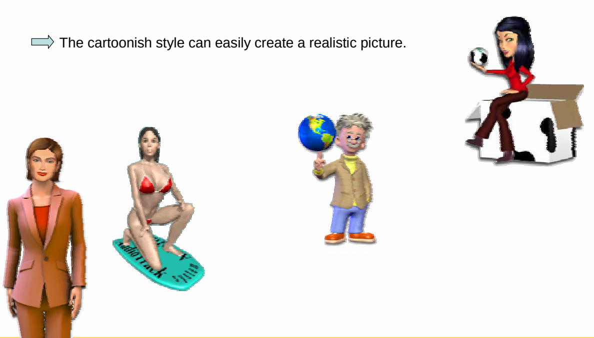
- *"Human-like characterization is one good form of autonomous agents, because people are accustomed to interact with other humans".* [Takeuchi & Naito, 95]. '
- The deception can be strong with a realistic Agent because he is never perfect (Mori, 1970 The uncanny valley theory :



"The completed reel can be identified as the completed fake" [Wells, 1998]

Physical aspect

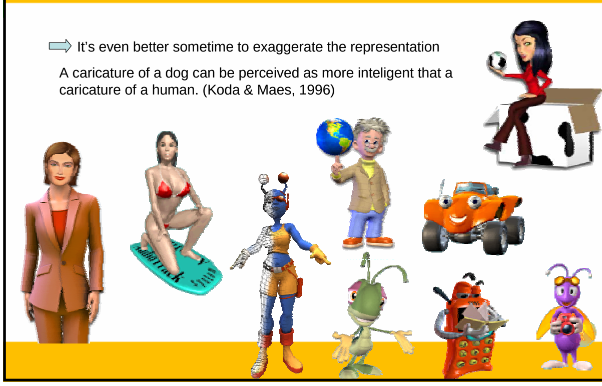
- The cartoonish style can easily create a realistic picture.



Physical aspect

- It's even better sometime to exaggerate the representation

A caricature of a dog can be perceived as more inteligent that a caricature of a human. (Koda & Maes, 1996)



Physical aspect

- Use of different clothes

- Mix of the different colors

The 3 primary colors (blue, red and yellow) are respectively in harmony with the 3 secondary colors (orange, green and purple) in order to balance the transferred information

Blue is the symbol of the calm

Physical aspect

- Use of accessories
  The consultants use often some pictures, figures, vidéos, ..

Behaviors

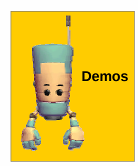
The Agents play an important role to motivate the learner. The fact they have behaviors like in the real life increase the impact of the motivation. [Lester & Stone, 1997]

Too much dialogues are boring. The non verbal communication is advantageaous to catch the attention. An action or a joke can easily replace the dialogue. [Eco, 86].

- Face
  - *Eyes*: researches by Hidegard (1950), Hogan (1996). There is a different message depending of the orientation, the degree of the gaze.
  - *Eyebrows*
  - *Mouth*
- Body
- Arms and legs

Behaviors

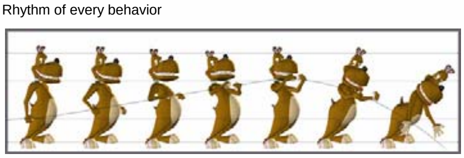
- Basic Expressions
  - *Basic*
  - *Smile*
  - *Happy*
  - *Sad*
  - *Angry*
  - *Surprised*
  - *Think*
- Basic gestures
  - *Point*
  - *Look*
  - *Speak (Speak, Argue, Explain)*
  - *Idle (Blink, Gaze, breathe)*
  - *Show, Hide*
  - *Move*



- Specific gestures
  - *Suggest*
  - *Acknowledge, Decline*
  - *Congratulate, Pleased*
  - *Greet, Wave*
  - *GetAttention*
  - *Uncertain*
- Specific animations
  - *Read*
  - *Process*
  - *Write*
  - *Magic*
  - *Search*

Rhythm

- Rhythm of every behavior



- General rhythm
  Alternate small gestures with strong or fast ones
  Have a goal for every behavior
  Animation (GetAttention) for non activity.

An animated paper clip who blinks the eyes every time we click on him is received like someone insisting to exit your office with a large wink. [Picard, 01].

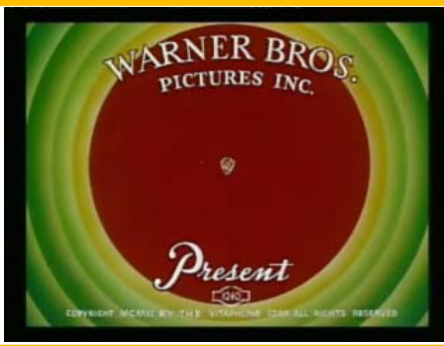
Other

- Voice - No voice : balloon
  The users get more attention to a text associated to a face than a simple text without illustration [Sproull et al., 96].

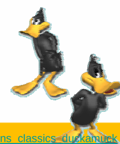
  People spend just 20% of their time looking at the agent, about 50 to 60% reading the text. (research from M.Witkowsky, Imperial College of London, 2003*)*
- Position, scale, View, light
  In the screen
  Outside the screen (visibility, sound)

Research on turn taking depending of the Agent visibility by Erklund (2003)

Duck Amuck



Duck Amuck
Chuck Jones
1953



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Appendix 6: **Paper**

Title
Living Actor ™ Technology Overview

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Living Actor™ technology overview

Laurent Ach

January 2006

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1. Introduction

The goal of his document is to provide a general understanding of Living Actor™ technology and show what it allows to do. Living Actor™ is a set of software tools and runtime players that give visual forms and behaviors to virtual characters. Living Actor™ technology defines a general framework that allows creating and playing interactive scenarios and it does not rely on a specific type of visual model. It provides a character production line with alternative components to choose between different kinds of visualization.

The appearance of Living Actor™ characters is produced by the rendering of animated 3D models with materials and textures as well as morphing data for facial expressions. The behavior of a character is built upon animation tracks, as a graph of possible states connected by actions.

The process to create a Living Actor™ currently involves different steps:

- **3D model edition**: use of standard 3D modeling tools (like XSI, 3dsMax or Maya) to create a character with bones, skin, animation and morphing;
- **Living Actor™ edition**: use of Living Actor™ Editor to create expressions and actions based on the 3D model, its animations and morphing data;
- **scripting**: use of Living Actor™ SceneMaker (or direct scripting of commands) to create interactive scenarios, based on connected sequences of actions;
- **visualization**: creation of movies or integration of scenarios into web pages or into other kinds of applications;

The rendering of Living Actor™ characters may be performed through Macromedia Flash player, using precomputed images or by real-time 3D rendering, using Living Actor™ ActiveX 3D player.

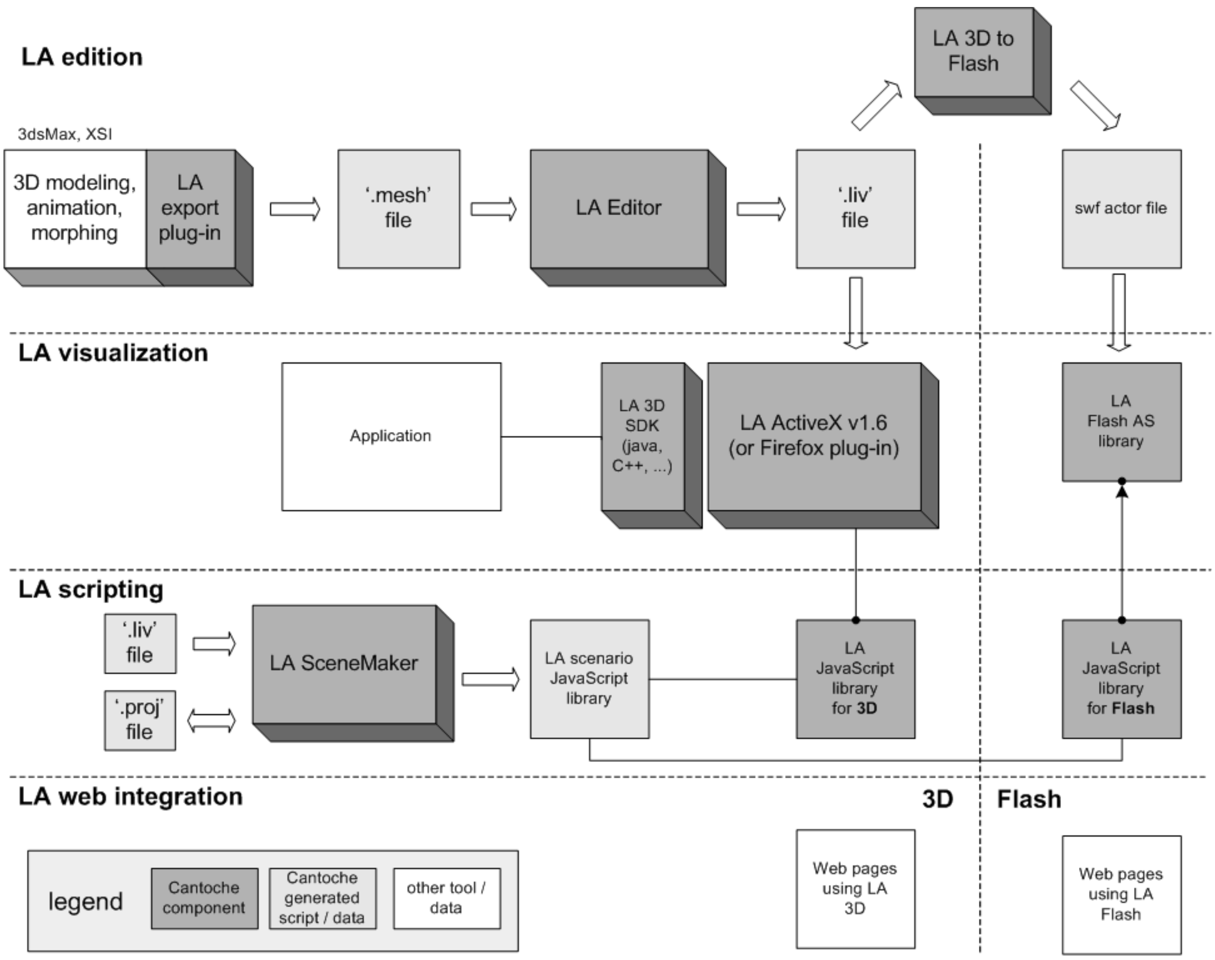

Figure 1: Living Actor™ components

2. Direction of actors

2.1. Scripts and players

Living Actor™ **3D player** is an ActiveX component, which computes images in real time. It may be used by JavaScript function calls (through a web browser) or by a java or C++ application through an encapsulating Living Actor™ SDK. It can also be used as a plug-in into commercial software with ActiveX compatibility, like Microsoft PowerPoint.

Living Actor™ **Flash player** consists in Flash Action Script libraries, used from JavaScript calls inside web pages. It makes use of precomputed images produces by Living Actor™ 3D player.

The scripting functions are very similar from a Living Actor™ player to the other and usually even use exactly the same syntax to keep command compatibility. But the Living Actor™ Flash player has fewer capabilities because it is not able to combine animations and expressions, except when pre-processed to image sequences. It is also more limited regarding character locomotion.

The JavaScript library associated with each player takes into account the management of initialization, configuration and events that are specific to players and browsers. Again the syntax is very similar between the two sets of commands to give a scenario some compatibility with both players.

The player is responsible for the execution of any command sent to the actor and for the management of all automatic behaviors. The data it needs to define actor appearance, gestures, actions and behaviors are contained in one file for each character (called `actor_name.liv` if visualized by the 3D player or `actor_name.swf` if visualized with Flash).

In a scenario, usually created using Living Actor™ SceneMaker, each sequence is defined by a list of function calls to the JavaScript library, which itself calls the player functions.

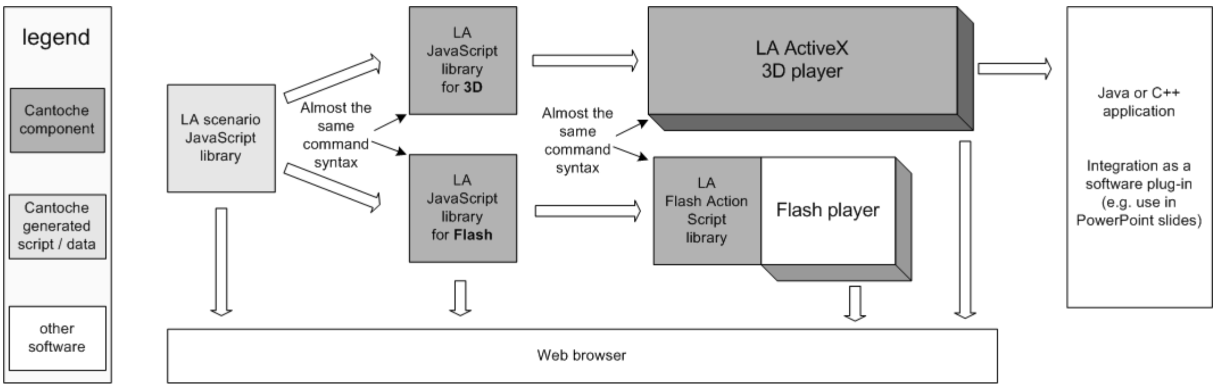

Figure 2: Living Actor™ scripts and players

2.2. Scripting actions

While a player is running and after an actor is loaded, the commands sent to a character tell him which action to perform. Some available commands are predefined and other ones depend on actions that are customized using Living Actor™ Editor. The main commands are relative to the character placement, gestures, expressions, speak actions and animations.

Here is an example of scripting code:

```
ACTOR.PlaceAtPixel(200,500)     // places the character on screen
ACTOR.Show()                    // makes the character appear
ACTOR.Play("anim_name")         // play animation (go to a target state)
ACTOR.SetExpression("happy");   // change actor face expression
ACTOR.Speak("some text")        // tell actor to say a text
ACTOR.Hide()                    // makes the character disappear
```

It is important to understand that the actual sequence of played animations is usually not explicit. We will describe later, in chapter “Actor behavior”, how animations are played according to the succession of commands sent to the player. It depends on several mechanisms introduced to give the impression of a living character:

- automatic animations preventing static attitudes : eye blinking, breathing, little moves;
- automatic animation of lips when speaking (lip-synch);
- path finding from a state to another;
- automatic motion and gesture management;

The argument given to the play command is the name of the final state given as a target to the character instead of the name of an animation to be directly played. This lets the player decide what to do according to character personality and make him finally adopt a specified attitude. However, it happens that only one animation sequence goes from the current state to this target state so we sometime do not distinguish the name of a state from the name of an animation sequence.

2.3. Event management

When a Living Actor™ character is on screen, it receives commands from the web browser or from any other application connected to a Living Actor™ player. It also sends events that can be managed by the application. In the case of web integration, events are managed by JavaScript event handlers. A handler function name is associated with each type of event and tells what to do depending on event, for instance:

- process an answer given by a click in a dialog balloon
- proceed to some function when actor reaches some particular state
- take into account the value of an item selected in a popup menu, which may appear when clicking on the actor

Technical note about event management:

The technical event channel from Living Actor™ ActiveX player to JavaScript is implemented by polling (periodically get Living Actor™ events by calling player functions) or directly by giving a JavaScript function as a handler for player events. The communication from Living Actor™ Flash player to JavaScript is realized using "FScommand", a standard Flash to JavaScript communication channel.

In the opposite direction, events are transmitted from JavaScript to Living Actor™ ActiveX player by directly calling the player functions. From JavaScript to Living Actor™ Flash player, events are transmitted by calling the Flash function "setVariable" to modify the value of a Flash parameter, which is defined by Living Actor™ player.

3. Rendering

3.1. 3D rendering

The core material used to generate a Living Actor™ is a 3D character built from:

- triangle meshes, material colors and textures
- articulated bones and skin deformation parameters
- bone animation
- vertex morphing vectors

Other animated objects may be associated with the character and are considered as character accessories. They are built using the same type of data than the character.

Living Actor™ editor uses all these data to create character expressions, animations of lips, breathing and blinking, actions and locomotion functions. It also defines the different possible states of the character and the animations to be played to go from one state to another (see details later about the graph of states).

Living Actor™ 3D player manages the animations to be played according to the graph of states and is able to combine general expressions, lip-synching and animations. As it performs real time rendering, several graphical attributes may be changed dynamically like its colors and textures for example. Moreover, the character can be configured to use chosen accessories before entering a scenario.

3.2. Flash

The process to play a scenario in Living Actor™ Flash player is first to create a character for Living Actor™ 3D player, than play the sequences while rendering images to files. Some semi-automated process converts these images into short movie clips, each one corresponding to a character animation that makes a transition between two states. Then, Living Actor™ Flash player triggers these prepared clips when needed according to the scenario.

Image sequences used by Living Actor™ Flash player are produced according to the transitions defined in the graph of states for the character and do not depend on any scenario. Images sequences are played according to the graph of states and to the script commands composing a scenario.

Some limitations are attached to this mechanism. It is difficult to mix pre-rendered images and produce a combination of expressions and animations like it happens in 3D. The use of a Flash player also makes it very difficult to synchronize character motion with a walking animation and thus, "move to" commands are disabled. Changing graphical attributes like with 3D rendering is also impossible to achieve dynamically without a preprocessing.

Living Actor™ Flash player manages the dialog balloon in a separate window and has to create a communication between the character and its dialog window for each web page.

3.3. Movies

The 3D player functions used to create image files for Living Actor™ Flash player are also used to create movies. During this process, the movie generator program takes a Living Actor™ character and a scenario as input data and produces an AVI file for each sequence of the scenario.

4. Actor behavior

4.1. Graph of states

All actions performed by a Living Actor™ character and involving animations may be described as transitions between two states. All possible states are connected in a graph that tells what transitions are allowed and which animations should be used to go from one state to another. The transition between two states is composed of one or more animations. All these graph data are created in Living Actor™ editor.

The name given as argument to the ***Play*** command is the name of a target state. In simplest cases, it corresponds to a single animation that is played directly. But the way the character goes from its current state to the target state, depends on the graph of states. The player finds the right sequences of animations to make a path in the graph from the current state to the target.

Besides the *Play* commands, the player triggers some animations by itself. These animations are called **idle** and are also associated with some of the states through Living Actor™ Editor. These states usually have a name ending with "ing" like "sitting" or "reading" to indicate that the character remains in these states until told to do something else.

Play commands tell the player to find a way to a target state. Once the character gets to this target state, a sequence management process chooses the next action to do, which depends on:

- the current stack of commands
- the presence of idle animations associated with the current state

If there is no command in the stack and no idle animation, the player brings back the character to the base position called "rest pose". Otherwise, if there is a *play* command pending, it is processed. If there is no command in the stack and if the state has idle animations, they are played randomly while the character remains in the same current state, until a new *play* command is sent.

There are two **levels** of idle animations. Animations of level one can not be interrupted. Animations of level two are interrupted as soon as a new *play* command is sent to the player.

Special states called **loops** (or **commands**), bring back the character into its current position. Like idle animations, loops are associated with some states through Living Actor™ Editor. After a *play* has been processed to a state having loops, a "*Play*(loop_name)" call may be done to tell the player to keep the character in its previous target while playing a loop animation.

Speak animations are special types of idle animations that are played only during the processing of command "*Speak(*some_text*)*". The character is kept in its current state until the text is said. These animations can not be interrupted. They are different from lip animation, which is performed by giving special expressions to the character (see later lip-synch).

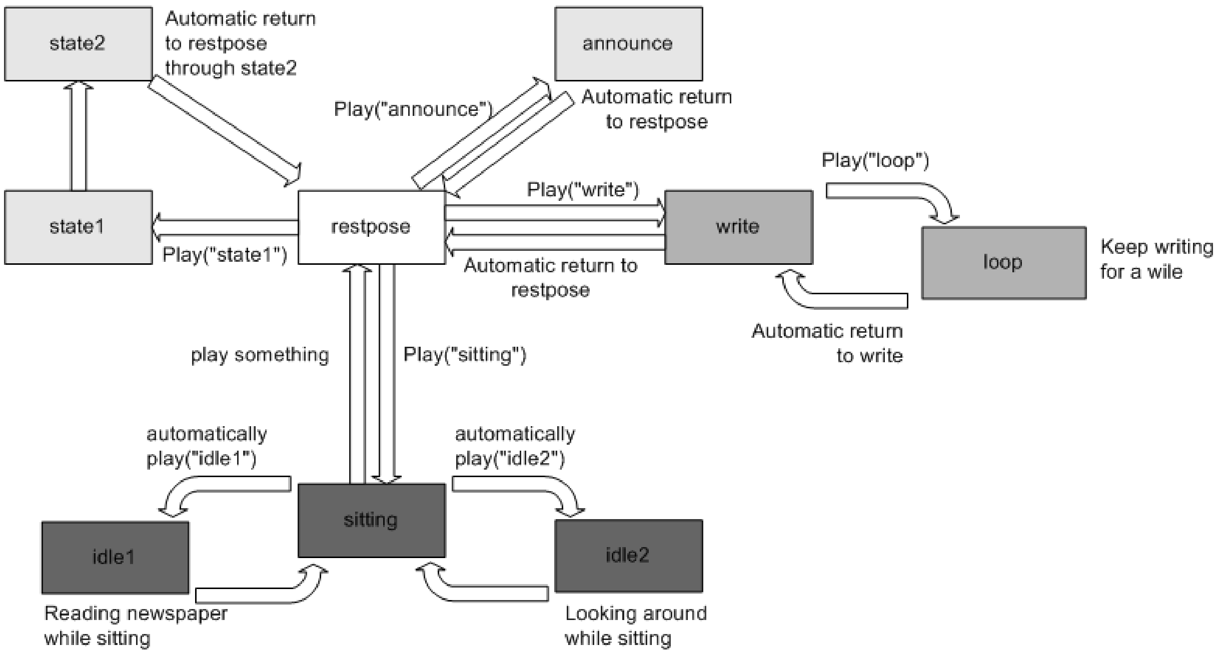

Figure 3 : graph of states

4.2. Insert mode

Some commands may be inserted in the text to be said through a *Speak* command. Some syntax with square bracket characters is defined to send *Play*, *MoveTo*, and other commands from the text given as argument to *Speak* like: Speak("hello [Play(hello_animation)] how are you ?"). A delay must be estimated from the text to define the time when commands must be executed. The delay is computed by a TTS (text to speech) component if available (see lip-synch) or by a ratio of the total speech, estimated from text length. Inserted commands are triggered by bookmarks (see sequence management).

4.3. LookAt, GestureAt and MoveTo

In addition to animations triggered by *play* commands, some animations are automatically chosen to complete an action toward some point or direction. When using Living Actor™ 3D player, *LookAt* and *GestureAt* commands compute the relative direction from an actor to the point whose coordinates are passed as function arguments. Then, they play an animation sequence having a name corresponding to the required action and direction, like "GestureDownLeft" or "LookRight".

MoveTo commands trigger the same kind of actions from animation sequences with special locomotion attributes. According to the required vertical and horizontal motion, appropriate sequences are chosen to combine moves along each axis. Locomotion sequences require special tuning inside Living Actor™ editor so that the character feet do not appear to slide on the ground.

LookAt, GestureAt and MoveTo functions are only available when using Living Actor™ 3D player.

4.4. Accessories

A Character may have objects called accessories, associated with some its animations. When such an animation is played, all associated objects are made visible. They may be attached to a part of the character body and also have their own animations.

5. Expressions and lip-synch

Morphing data are stored as displacement vectors associated with vertices. A scaling factor is applied on these vectors to amplify or reduce the resulting expression. A character expression may combine several morphing sets and associated control values. Morphing data come from a 3D modeler and expressions are defined in Living Actor™ editor.

If using Living Actor™ 3D player, any number of expressions may be combined additively and this combination can be added to an animation.

Some specific expressions are phoneme expressions (also called visemes). They are associated with phonemes through Living Actor™ editor. Living Actor™ player automatically put visemes on character's face when he is speaking, according to the phonemes found in the text or in the sounds of the speech.

If only text is available, extraction of phonemes can be made by external TTS (Text To Speech) software, compatible with Windows SAPI 4.0 programming interface. If no phoneme data is available Living Actor™ player put random visemes on character's face during all the time speak animation is running.

TTS programs are also used to compute the length of speech from a text in order to trigger "insert mode" commands at the right time. If no TTS is available, the player computes an approximated time length from the number of characters or words in the text.

If there is a recorded voice, blank detection is performed into speech and Living Actor™ players select random visemes between silent periods. The blank detection is a preprocessed task, which produced a file indicating silences and speech periods. This file has the *lps* extension.

6. Speech, sounds and voices

There are several ways of adding sounds in a scenario. A sound track may be associated with an animation or directly played by the command *playSounds*.

When an mp3 file is associated with a *Speak* command, by adding *playSounds* in insert mode, the sound file is played and any associated *lps* file is used for lip-synching. If there is no *lps* file, phonemes are chosen randomly.

Any time a character speaks, a speech balloon is displayed with the text of the speech, unless this feature is deactivated. The balloon appearance may be customized at edition time.

7. Scenarios and sequence management

The list of commands to be sent to the player defines a scenario. The way these commands are executed depends on a real time process that includes user interactions and character state management. The commands are accumulated into a stack and the player decides when to trigger the next actions and what precise action must be achieved at each time, according to a set of rules. The rules take into account the graph of states and the type of the commands.

Calling a player function for a character, adds a command to the stack and the next player command or JavaScript call is sent before the previous function is complete. To ensure that some JavaScript command is executed precisely after some actions are finished, users may add **bookmarks**. They are pieces of data inserted in the stack of commands and generate JavaScript events referring to bookmark names. Bookmark events are sent when the bookmark is reached and can be handled to trigger actions at the right moment without knowing in advance how the stack of commands is executed.

Scripting commands may be written directly or using Living Actor™ SceneMaker. When using SceneMaker, commands are relative to scenario sequences that may be connected with each other through dialog boxes. A sequence is a list of commands, gathered in a JavaScript function. SceneMaker exports the JavaScript code for these functions as a result of the designed scenario, as well as HTML pages with event handler to connect the sequences.

8. Different production lines

As described in the introduction, the construction of a scenario with a Living Actor™ character involves some edition in a standard 3D computer graphics authoring tool, editing character actions in Living Actor™ Editor and scripting with Living Actor™ SceneMaker. The final result depends on the preferred type of visualization: video, 3D or Flash, with different limitations and constraints attached to it.

The production tools where initially created for 3D rendering and the production of other types of rendering using precomputed images adds a few manual tasks. For instance, using Macromedia Flash player involves cutting out images and creating masks to optimize the weight of the movie clips representing animation sequences.

The result of a scenario may take different forms like an executable file for 3D rendering, PowerPoint scripts or web pages with JavaScript. A scenario may also be directly managed by an application issuing commands to a player.

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Appendix 7: **Presentation**

Title
Interactional Level Scenarios

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Mary Zajicek

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OBU

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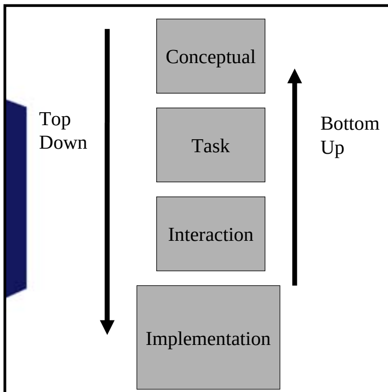
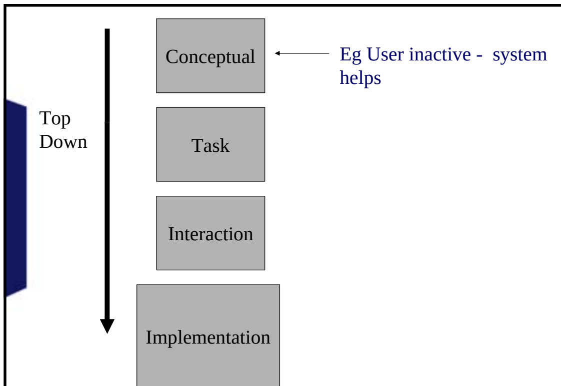
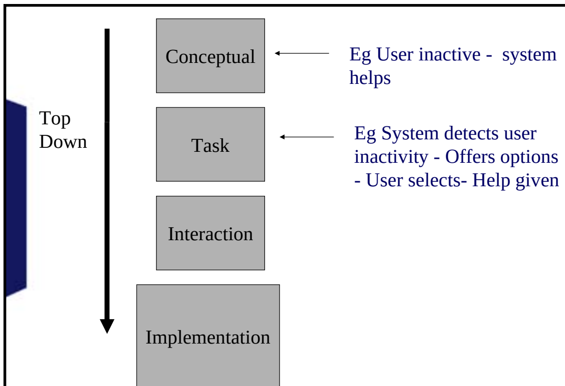
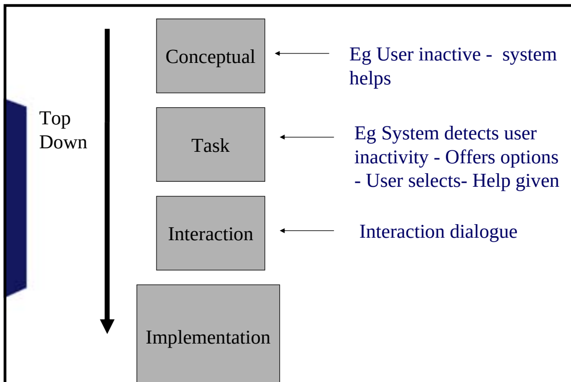
Interactional Level Scenarios

Dr Mary Zajicek
Oxford Brookes University

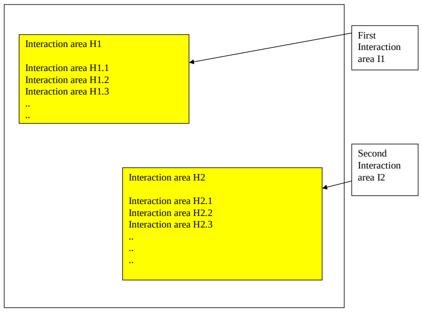








- These scenarios help us to think about the **attention detection component** and the **agent intervention component** of the AtGentive system, and do not address the **agent reasoning component** of the system.
- The following scenarios are Interaction Scenarios and model the user interaction for the attention software at a generic level. Pedagogical models are not dealt with here.
- These are Interaction Based Scenarios rather than Task Based Scenarios. A useful approach would be to perform Task Analysis on the two systems Ontdeknet and ICDT and then produce task scenarios which will be at a higher level than Interaction Scenarios
- The scenarios assume that a screen can be assigned a document object model identifying individual discrete areas of interaction arranged in a hierarchy.



Scenario 1. User takes too long on screen Sr - find problem information area using **mouse click**

Assumptions

* Screen Sr is of the type that can be decomposed into discrete interaction areas
* Using mouse click as an indicator (rather than eye tracking) at the start of the dialogue we cannot know which area of the screen the user is looking at or which area is causing them problems.

Pre conditions

* Screen Sr assigned a maximum reading time. - Tr (user dependent)
* Screen Sr assigned a document object model identifying individual interaction areas Ir1, Ir2, ..

Each interaction area Ir1, Ir2... has pre-encoded additional explanation to help the user, with several layers of explanation

Scenario 1. User takes too long on screen Sr - find problem information area using **mouse click**

Dialogue

1. User: pauses on screen Sr longer than Tr
2. Avatar: asks user to mouse click on the section that they find difficult.
3. User: clicks on relevant interaction area
4. Avatar: provides further explanation

Either User progresses satisfactorily

Or 1 - 4 repeated

Post conditions

* User progresses satisfactorily

Formative evaluation criteria

* User satisfied with the explanation - satisfaction questionnaire (subjective)
* User moves to suitable area (objective)

Scenario 2. User remains too long on screen Sr - find problem **using information headings**

Assumptions

* Screen Sr is of the type that can be decomposed into discrete interaction areas

Pre conditions

* Screen Sr assigned a maximum reading time. - Tr (user dependent)
* Screen Sr assigned a document object model identifying individual interaction area headings IHr(1), IHr(2)... arranged in a hierarchy IHr(1.1), IHr(1.2) ....
* Each interaction area and sub area is assigned a helpful further explanation.

Scenario 2. User remains too long on screen Sr - find problem **using information headings**

Dialogue

1. User: pauses on screen Sr longer than Tr
2. Avatar: asks user which section is confusing them giving menu of top level interaction area headings IHr(1), IHr(2)...
3. User: selects one of the heading e.g. IHr(p)
4. Avatar: asks whether the whole section or a subsection of the information area is confusing them

Either

5. User: selects whole section and whole section is explained

Or

6. User: selects subsection
7. Avatar: asks user which subsection is confusing them giving menu of second level interaction area headings IHr(p.1), IHr(p.2)...

...

...

Scenario 2. User remains too long on screen Sr - find problem **using information headings**

Post conditions

* User progresses satisfactorily

Formative evaluation criteria

* User satisfied with explanations - satisfaction questionnaire (subjective)
* User moves to suitable area (objective)

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Appendix 8: **Presentation**

Title
Czech Efficient Learning Node

Author
Barbora Parakova

Company
CELN

Back

Czech E-learning Network

Czech Efficient Learning Node

Our task is to:

- **test pupils´ learning results** when using animated agent – collaboration with Ontdeknet
- **measure attention** when using animated agents – collaboration with the University of Tampere

What needs to be defined:

1. **Learning content** (what to teach, in what way, etc.)
2. **Age groups** – (9,10,11,12???) or one of them
3. **Teaching scenarios** with/without the agent
4. **Time limit** (teaching class takes 45 min)

When to test?

- timing should be the same for all age groups

When to test?

- Right after class?
- One week from „agent“ teaching?
- Once in fortnight from „agent“ teaching?
- One month from „agent“ teaching?

All four options are possible

ICT Situation on Czech Primary Schools:

- Computer literacy of teachers is under average
- Average equipment: 1-2 computer labs (10 computers)/ per school
- ICT in school curricula – technical subjects or foreign languages; involvement in other subjects - rare

Our suggestions

- **Subject:** English Language
- **Content:** translation of an article with up to 20 words/phrases, grammar….. Followed by the test
- **Students per class:** 10-15 pupils
- **Pilot sites**: 10 primary schools
- **Scenarios**:
  - 100-150 pupils of one age group (e. g. 9 yrs) using agents/no agents
  - 400-600 pupils of age groups (9,10,11,12 yrs) using agents/no agents

???

- Clearly and exactly define **target group** (age and number of pupils)
- Content of measuring: What are the teachers going to measure?
- Time horizon and number of measurings
- **Who** prepares the learning content?
  - If us – not part of „our activities"…
  - If Ontdeknet – should be created a solver group? (e. g. Ontdeknet, Thiery, CELN…)

???

- Who prepares tests in what form???)
- How many pupils will be tested attention wise (questions for Finnish partners…)
- How many eye tracking systems will be deployed and who will install them in schools?
- Who evaluates the tests and what is the procedure? We recommend tests in eletronical form for easier manipulation
- How the expert environment will be measured?

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Appendix 9: **Presentation**

Title
Psychophysiological experiments in AtGentive

Authors
Toni Vanhala and Harri Siirtola

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Psychophysiological experiments in AtGentive

Toni Vanhala[1] and Harri Siirtola[2]

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Tampere Unit for Computer-Human Interaction
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Practical Issues at UTA

- Kimmo Koivunen has left the university
- Harri Siirtola will take over Kimmo's tasks concerning this project
- Harri will be working part time for the first six months
- Kimmo Vuorinen will assist during this time

Aims of AtGentive

- Measuring the attention of a person
- Manipulating the attention of a person
  - Redirecting attention (e.g., interruptions)
  - Maintaining attention (e.g., motivating)
- Adapting the system
  - Reducing attentional load (?)
- … in order to support learning

Psychophysiological measures

- Several psychophysiological measures exist for different mental phenomena
- Psychophysiological measures show potential as continuous, unobtrusive, and objective measures
  - Valuable for early design (e.g., selecting between competing designs)
  - Valuable for evaluating the final system (e.g., identifying the effect of different interventions)

Psychophysiological experiments

- Selecting appropriate measures
- Investigating basic phenomena associated with agents and learning environments
  - Providing a basis for design solutions
- Evaluating the final system
  - Estimating the success of the design solutions
- Developing novel, robust measures
  - Integrated to the final system

An Example Scenario

- The student is performing independent study (i.e., browsing the Web) for an assignment
- Another user (i.e., peer or tutor/teacher) posts new information that might be relevant
- The system estimates the relevance (e.g., on the basis of author and keywords)
- The system chooses an appropriate method of notification/interruption

Related Experiments

- Estimating the effectiveness (and, e.g., pleasantness) of different methods of directing attention
- Investigating the effect of repeated interruptions on the attentional and emotional response

Investigating Methods for Directing Attention

- Participant performs an (educational) task
  - The attentional demand is varied (e.g., performing simple arithmetic vs. watching an educational video)
- Participant is interrupted with different methods
  - Audio/speech only, gestures only, speech and gestures
- Task performance is measured either during the task (e.g., reaction times) or after the task (e.g., post-study test on the subject)
- Psychophysiological measures are taken continuously
  - Quantifying the attentional demand of the task
  - Estimating whether attention was redirected (short-term effect)
  - Identifying other (long-term) effects of the interruption (e.g., general level of attention/alertness, readiness to redirect attention, performance in succeeding tasks)
  - Refining the existing measures of attention
- The pleasantness and other subjective experiences are collected with a post-study questionnaire

Effects of Repeated Interruptions

- Student performs an information retrieval task (e.g., "*What were the names of the seven dwarfs in Snow White*?")
- The system interrupts by providing information
  - The ratio of relevant (e.g., "*One dwarf was called Grumpy.*") and irrelevant information (e.g, "*The capital of Finland is Helsinki.*") is varied
  - The method of interruption is varied
- Psychophysiological, verbal, and behavioral measures are taken as in previous experiment
  - Identifying the general effects of interruptions
  - Investigating how responses evolve when interruptions are repeated
  - Suggests appropriate methods and minimum relevancies for interruptions

Another Scenario

- Student is studying with the help of the learning environment
- New material becomes available
- The system evaluates the relevancy of the material and the attentional demand of the current task
- The system chooses the appropriate method of notification
  - Support from previous experiments

Concerns

- Background knowledge of students
  - Prior education, hobbies, etc.
  - Learning material specific to this project (e.g., word lists, stories)
- Loads of other variables that might affect attention
  - Preferences, learning style, motivation
- Evaluating attention in the final system
  - Limited resources (e.g., webcam for eye tracking)
  - New measures have to be developed

Discussion

- Psychophysiological experiments can provide information for the design and evaluation of the system
- The investigated phenomena should be clearly defined and high-level
  - Results generalize for many individual scenarios
- New, robust attentional measures for end users' context can be developed
  - E.g., Conati and others (2005) found that 16 second time limit could predict student self-explanation at ~70% accuracy.
  - Can be used for evaluating the final system

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Appendix 10: **Paper**

Title
Psychophysiological experiments in AtGentive

Authors
Toni Vanhala, Veikko Surakka, Harri Siirtola, and KariJouko Räihä

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Psychophysiological measures for estimating attention

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1 Introduction

The present project aims at developing educational systems that adapt according to a person's estimated state of attention. However, the evaluation and manipulation of attention are very challenging tasks. Firstly, attentional processes are connected with other mental (e.g., emotional and cognitive) processes. Secondly, the sources of information that can be used to infer attention are very limited in the end user's context. In other words, no special devices will be available for measuring attention in, e.g., a classroom. Thirdly, the measurement can affect the results, when attention is to be estimated. For example, self-reports (or the evaluation of learning) require attention to be directed to reporting the requested information, which can influence other tasks the person is performing. Self-reports are also vulnerable to numerous external factors, e.g., bias in accuracy when recalling episodes involving different emotions (e.g., Hufnagel and Conca, 1994). The time resolution of self-reports is also very limited, as it is not preferable to constantly interrupt the person. Finally, the effect of different types of interventions and adaptations in directing attention while interacting with a learning environment has not yet been extensively studied.

In the present paper, we give a brief overview of different psychophysiological measurements. We believe that these measurements can help in estimating attention, both in early states of design and when evaluating the final system. Using these measurements as indexes of attention, we can investigate in real time how attention can be directed and influenced by different methods, for example, instructions given by an embodied agent. These results can help to determine which design solutions should be chosen for the final system. Further, the evaluation of the final system can be supported by psychophysiological measures, which can be taken continuously while using the system. Thus, effects of individual aspects of the system can be better identified.

We also present potential solutions for influencing attention in the form of scenarios that could be supported with results from experimental research. Some potential experiments are briefly discussed after the scenarios.

2 Psychophysiological measures

Psychophysiological measures have potential as continuous estimates of the cognitive and emotional state of a person. It is difficult to acquire as accurate information on a competitively fine time scale and in real time with other measures (Öhman, Hamm, and Hugdahl, 2000). For example, the exact time of a reaction to a certain surprising event is more easily identified as a change in physiological parameters than using, for example, a post study questionnaire. Thus, if attention is to be continuously monitored, psychophysiological measures potentially offer a viable alternative that is less invasive and does not require intervention during acquisition.

2.1 Brain

The activity of the brain can be measured with several techniques. Probably the most feasible online measurement technique is electroencephalography (EEG). In EEG the activity is measured with electrodes placed on the scalp. The EEG involves relatively small equipment, and the electrodes can be applied on the subject with little restriction to her position and movement (compared to, e.g., functional magnetic resonance imaging). Further, wireless measurement prototypes for EEG have recently been developed, for example, in a project coordinated by Dr. Surakka (see http://www.cs.uta.fi/hci/wtpc, Retrieved on January the 17th, 2006). Wireless devices allow even more freedom of movement and they can be employed in several contexts.

Brain response associated with a certain stimulus is called an evoked response potential (ERP). Studies with auditory ERPs have shown that different characteristics of the ERP vary depending on whether the stimulus was attended to or not (Fabiani, Gratton, and Coles, 2000). Thus, ERP analysis seems a promising basis for inferring whether certain information (e.g, a gesture of an embodied agent) was attended to or not. On the other hand, they can also suggest whether certain stimulus was perceived at all. Like most other psychophysiological measures, the ERP reflects a multitude of psychophysiological phenomena, including emotional arousal and cognitive activity (Bradley, 2000; Coan and Allen, 2004).

Power spectrum analysis of the EEG has been used to estimate alertness (Jung et al., 1997). The level of alertness is associated with performance in tasks that demand sustained attention and fluctuations in EEG power. Further, asymmetries in the power spectrum of frontal EEG have been associated with motivational approach and withdrawal tendencies (Coan and Allen, 2004). Thus, measures of EEG spectrum could also be useful in estimating how engaged a person is in a task. Perhaps this type of analysis would be one promising direction for the current project.

2.2 Heart

Heart activity reflects both parasympathetic and sympathetic activity of the autonomic nervous system (ANS). Many cognitive processes are associated with the autonomic nervous system and thus induce changes in heart activity (Öhman, Hamm, and Hugdahl, 2000). As an example, viewing (emotionally neutral) pictures induces an initial deceleration of heart rate (HR), which is then followed by an acceleratory response and a secondary deceleration (Bradley, 2000). Further, unpleasant stimuli induce greater initial deceleration of HR, while pleasant pictures prompt the greatest peak acceleration. Generally speaking, previous studies suggest that ANS activity recovers significantly faster towards baseline during and after positive emotions than during and after negative emotions (e.g., Aula and Surakka, 2002). Thus, heart rate response and other physiological response patterns can provide cues about the experienced emotional valence (Anttonen and Surakka, 2005).

Spectral analysis of the heart rate variability (HRV) is often used to separate parasympathetic, sympathetic and respiratory influences on heart rate (e.g., Wilhelm et al., in press). The spectral power of lower frequencies is strongly associated with blood pressure regulation. Higher frequencies of HRV are associated with parasympathetic activation. In practice, heart rate variability has been used to index mental stress during computer work as well as a basis for adapting the operation of a mobile phone according to mental load (Hjortskov et al., 2004; Chen and Vertegaal, 2004). Concerning the current project, we can assume that high cognitive load demands also attentional resources. Thus, the potential connections of HRV and attentional load seem very promising for the present work.

There are several options for measuring heart activity. Measuring the electrical activity of the heart is possible with electrocardiographic (ECG) sensors. Other available measures include ballistocardiography (BCG) and photoplethysmography (PPG). Presently, we at the University of Tampere have the capability to measure wireless ECG, noninvasive BCG with electromechanical film embedded within a regular office chair, and PPG with a sensor attached to an earlobe (Anttonen and Surakka, 2005). If two or three of these measures are taken simultaneously, it is further possible to derive pulse transit time measures, which reflect general cardiovascular sympathetic influences, that is, the other branch of ANS.

2.3 Muscles

Electromyographic (EMG) measures have been studied extensively. Thus, several connections to psychological processes have been established. For example, the activity of certain facial muscles is associated with the experienced emotional valence (pleasantness) (Larsen, Norris, and Cacioppo, 2003; Surakka and Hietanen, 1998). Using electromyography it is possible to measure changes in facial muscle activity that might not be visible and thus very hard to measure with other, e.g., video-based, techniques. Most often used measures reflect the power of muscle activations. These measures seem the most promising for the present project also. However, it is also possible to extract spectral measures, which have been used to, for example, estimate fatigue in muscles (Tassinary and Cacioppo, 2000).

The face is well represented in the motor cortex of the human brain (Rinn, 1991). Further, facial musculature system is very fine grained. For these reasons, it is probable that correlations exist also between facial muscle activity and cognitive states, including arousal. For instance, it has been suggested that the activity of the corrugator supercilii muscle (activated when frowning) might be associated with large commitment of attentional resources (Öhman et al., 2000).

As in EEG, the subject must be prepared before measuring EMG. When conventional cup electrodes are used, the skin is usually abraded and treated with conductive paste in order to reach sufficiently low electrical impedances. Also, the measurement can be quite obtrusive due to attached electrodes and their wires, which limit the movements of the subject. However, we have recently participated in a project that created a number of wireless measurement prototypes, including a headband with embroidered electrodes for EMG measurement. This technology provides more freedom of movement and requires very little preparation prior to measurement.

2.4 Posture

The posture of a person can tell us how she or he experiences different stimuli. For example, previous studies have found sex-differences in approach-withdrawal reactions to affective stimuli (Hillman, Rosengren, and Smith, 2004). In two unpublished studies, we measured changes in posture while the person viewed affective stimuli (Surakka et al., in prep.). During the experiments, the person stood on a platform equipped with force sensors in order to measure where the person leaned or swayed.

A yet unexplored possibility is to measure the same response using an office chair with embedded electronics. The backrest of the chair can measure the force that is applied on it.

Potentially, direction of movement (i.e., approach or withdrawal) could be derived from this data. Thus, this measure could be taken non-invasively and discreetly. Also, the measure could be taken when the person is sitting, which is a more common position than standing when using computers. However, this measurement is most likely very vulnerable to artifacts and requires quite heavy investment of resources for developing the appropriate signal analysis methods. Further, as measuring posture provides significant data concerning the basic responses to certain stimuli, these responses and the related mental processes are likely to be similar whether the person is standing or not.

2.5 Eye

Eye tracking is presented in Wikipedia (http://en.wikipedia.org, Retrieved on January the 13th, 2006) as: "… a technique used in cognitive science, psychology, human-computer interaction (HCI), advertising, and other areas. A camera focuses on one or both eyes and records their movement as the viewer looks at some kind of stimulus. Most modern eye-trackers use contrast to locate the center of the pupil and use infrared beams to create a corneal reflection, and the triangulation of both to determine the fixation point."

The data acquired from eye tracking consists of fixations and saccades. During fixations the eyes stay relatively stable and the gaze is fixated to some point. Saccades are fast and ballistic movements between fixations. The gaze is sharp during fixations and most of the visual information is gathered during them. The number of fixations in a certain area of view and the duration of these fixations can be used as a measure of attention. For example, Predinger and others (2005) studied the effect of an audio-visual agent in directing visual attention. Their results suggest that people interact socially with artificial embodied agents and that an embodied agent can help in interpreting ambiguous references.

Eye movements can also tell much about the cognitive processes of a person. For example, gaze paths, that is, sequences of saccades and fixations, are affected by the tasks given to a person as well as her or his perception strategy. As an example of using eye movement analysis in supporting learning related tasks, Hyrskykari and others (2003) have implemented an application that proactively responds to difficulties in reading text. As another example, Merten and Conati (2006) studied the estimation of a student's self-explanatory behavior from eye movements. They found that eye tracker data could significantly improve the accuracy of their probabilistic student model.

Some eye-trackers are capable of measuring pupil size variations in addition to eye movements. For example, one of the trackers at the University of Tampere is a floor-mounted tracker (ASL model 4000) that can measure the pupil size using video-based tracking. The pupil size is affected by both affective and cognitive processing (Aula and Surakka, 2002; Partala and Surakka, 2003; Beatty and Lucero-Wagoner, 2000). However, the pupil size is also very sensitive to artifacts, for example, changes in lighting and luminosity. Thus, the measure is error prone when visual stimulation is involved. Eye blink characteristics (e.g., frequency, latency, and amplitude) are also promising measures for estimating attention. Previous studies have found them to correlate with alertness (Dinges et al., 1998).

Most eye trackers need to be calibrated before using the tracker. There are some trackers which are able calibrate on the fly, but those are not reliable enough for purposes of the

AtGentive project. In summary, calibration can be problematic with some users and in many cases recalibration is needed if the tracker is used for a longer time.

2.6 Composite measures

The extraction of attentional information from psychophysiological signals is a challenging task for several reasons. First, the signals are affected by the context in which they are collected. Second, in addition to attention each signal can be associated with several other mental processes (e.g., emotions). For example, as previously noted, pupil size is affected by both cognitive and affective processing. Affective information also facilitates succeeding problem solving activity, indicating that the two types of processes are inter-connected (Aula and Surakka, 2002). Thus, estimating attention from any one signal and disregarding other processes is problematic. On the other hand, as attention is connected with several other psychophysiological states (e.g., arousal and cognitive effort), measuring these states is relevant, even if the main focus is on attentional processes (Pessoa, Padmala, and Morland, 2005; Surakka et al., 1998). Finally, physiological responses are highly individual (Cacioppo et al., 2000; Matthews and Wells, 1999; Ward and Marsden, 2004).

The challenges associated to this non-specificity of psychophysiological relationships have been addressed by acquiring converging data from multiple simultaneous measurements (Chen and Vertegaal, 2004; Kapoor, Picard, and Ivanov, 2004; Lisetti and Nasoz, 2004; Teller, 2004). This approach is based on evidence suggesting that distinct patterns of physiological responses exist for different mental states, such as the tendency to withdraw or approach stimuli (Christie and Friedman, 2004). We suggest that it is necessary to acquire multiple converging measures in order to assess mental states, including attention. In addition to indexes of psychophysiological states, these measures should be mixed with verbal (e.g., self-reports) and behavioral (e.g., task performance) measures.

3 Scenarios

3.1 Final system

In this chapter we present some preliminary scenarios that describe how the system could support the user by estimating and influencing attention.

3.1.1 Providing the student highly relevant information

The student is focused on an attention demanding task, for example, viewing an educational video. The system notices that new information becomes available (e.g., is posted to the student by a peer or a tutor). The system notifies the student of the new information, for example, by using an embodied agent and speech synthesis.

This scenario could benefit from experiments that inspect the effectiveness and other characteristics of different notification methods in shifting the focus of attention.

3.1.2 Notifying the student of possibly relevant information

The student is performing independent study for an assignment, for example, browsing different web pages. The system notices that new information that might be relevant becomes available (e.g., is posted to the student by a peer or a tutor). The system estimates how likely it is that the information is relevant to the current task (e.g., on the basis of keyword frequencies and sender information). Depending on the estimated relevance, the system chooses a method of notification that is appropriate.

This scenario could be supported by experiments that inspect the effectiveness and other characteristics of different notification methods. Further, experiments that investigate how repeated notifications influence the response would be useful.

3.1.3 Notifying the student depending on attention and relevance

Based on the two previous scenarios, the final system could take both the current level of attention and the relevance of the information into account. In other words, the system could demand attention to the new information only when it is estimated sufficiently relevant. The system could also choose a method of interruption that would be suitable. For example, very effective methods (e.g., loud noises) could be required when the student is engaged in another task. However, they could be very irritating, if the student is already inclined to refocus her or his attention.

3.1.4 Maintaining the alertness and motivation of a student

Student performs a task that demands attention, such as viewing an educational video. The system infers that the student's level of alertness is less than optimal. The system raises the alertness of the student by redirecting her attention to an agent that motivates the student, for example, explains why the task is important and interesting.

Experiments could inspect how attention can be estimated from different signals. The best ways to raise and uphold the level of alertness could also be experimentally investigated.

3.1.5 Estimating the focus of attention from conventional input devices

Tasks involving independent study are assigned to the student, but the student is not focused. The student begins to write a document without any reference material. The system recognizes the patterns of mouse and keyboard activity as typing related instead of information retrieval (e.g., web browsing) related. The system interrupts the user and finds out the reasons behind the unexpected behavior.

Algorithms for identifying different types of mouse and keyboard activities (i.e., the focus of attention) could be developed. The effect of different modalities and methods in motivating students could be experimentally investigated.

3.2 Experiments

3.2.1 Upholding the attention

The participant views an educational video. The video is preceded by instructions. The method how these instructions are presented is varied. For example, the instructions may be presented only as text on the screen or by an agent that reads them to the participant. As another example, the instructions are given by an embodied agent that turns to face, that is, to "watch", the video, or keeps looking at the participant instead. The level of attention during the video is estimated from psychophysiological signals. The effect of presentation is estimated on the basis of psychophysiological data and a post-study learning measurement.

3.2.2 Redirecting attention

The participant performs tasks with varying levels of attentional demand. During a task, different methods of interruption are imposed on the person. For example, the person can be interrupted by an agent that gestures only, speaks without gesturing, or gestures while speaking. The effectiveness of these methods in redirecting attention and their effect on task performance is investigated. Also, the subjective experiences (e.g., emotions) associated with each method are collected using a post-study questionnaire.

3.2.3 The effect of repeated interruptions

The participant performs a task that involves information retrieval. The system interrupts the participant irregularly by providing small bits of information. The ratio of irrelevant and relevant information is varied. The method of interruption is also varied. The effect that the relevancy of information and the method of interruption have on the response is investigated. For example, if the information is less than likely to be relevant and it is delivered by an agent, it could be that the agent is considered to be unintelligent. Consequently, the person might not longer attend to it. This hypothetical finding could suggest that information that is more likely to be irrelevant should be delivered using some other method or that the relevancy of provided information should be kept above a certain level.

4 Discussion

Generally speaking, the estimation and manipulation of attention is a challenging task. We suggest performing several complementing measurements in order to accurately estimate attention and investigating several methods for manipulating attention. Psychophysiological measures have good time resolution and avoid some of the difficulties of other (e.g., self-report) measures. Further, previous studies have found them to provide complementing information and thus they serve as a good basis for estimating complex mental phenomena (e.g., Chen and Vertegaal, 2004).

Performing controlled experiments that employ different methods for manipulating attention can help in implementing support for certain scenarios to the final system, for example, by suggesting the best ways for interrupting the user and redirecting her or his attention. Thus, experimental research provides a firm ground for design solutions. These solutions might involve small parts of the system, but they can accumulate into large effects that can be difficult to identify in the final, large-scale system.

In conclusion, we have shown that controlled experiments involving psychophysiological measurements can be valuable for both the early stages of design and when evaluating the final version of the attention-aware learning platform.

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Appendix 11: **Presentation**

Title
Initial analysis of Atgentive's conceptual framework and application scenarios

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American University of Paris

Atgentive

Initial analysis of Atgentive’s conceptual framework and application scenarios

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Aims

- ***Definition of main hypothesis***
- ***Definition of an event-based conceptual model for Atgentive***
  - ***Event types***
  - ***Event handling***
- ***Definition of essential concepts, measures, and processes***

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Hypothesis

- Agents may support users in their attentional choices, examples:
  - help in recollecting essential information when resuming an interrupted task
  - help in situations of impasse
- Agents may act as guides steering the user's focus towards better foci, examples:
  - notifying users of important events,
  - reminding them of deadlines,
  - suggesting different foci

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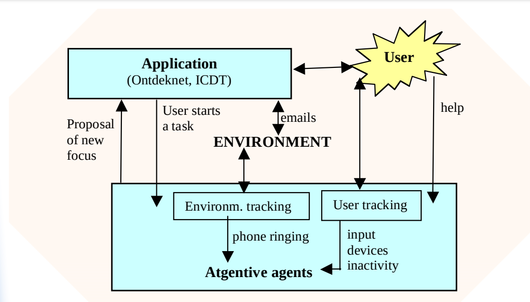
Elements of Conceptual Model



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Further hypothesis

- Users' attentional choices, preferences, and prospectives are revealed by events that can be captured and analysed by Atgentive agents. This analysis results in agent's interventions

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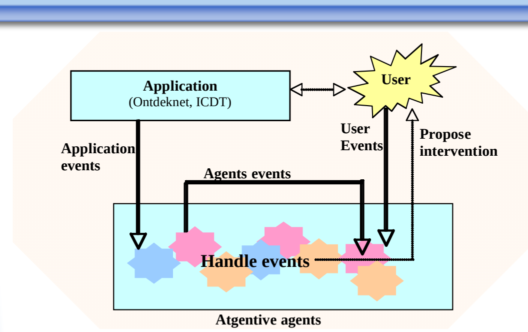
Event-based conceptual framework



Events

- Atgentive agents are triggered by events generated by the application, by the user, or by their own tracking mechanisms.
  - Example: application generate *resume*; the agents propose to restore elements of the environment that had been saved when the task was interrupted.

Scenario 1: Support to task resumption, restoring task context (I)

- Student is building mind-map using: expert's introduction diary and personal information, and a pdf document opened in a Acrobat window.
- The student switches to a questionnaire (start event).
- Agents recognise task interruption and save context of previous focus
- Student returns to the mind-map building (resume event)
- Agents proposes to restore the saved context.

Events types

- Application generated (ref. table 1)
- User generated (ref. table 2)
- Agents generated (ref. table 3)

Application generated events

- The application generates events by:
  - Observing the user activity (user-application events)
  - Observing the environment (environment-application events)
  - Reasoning on the user activity (application-events)

Application generated events: user-application events

- The application generates events by directly observing the user activity and recognising user's actions indicating a certain focus.
  - Assumption: application is capable of recognising the task being performed by the user (and it is possible to create a hierarchical description of user's tasks)
  - Examples: (1) user starts a new activity; (2) user continues on a task by performing a new subtask; (3) user has completed a task.

Scenario 2: Support to limited time resources allocation

- Student starts working at the mind-map (start event).
- Agents recognise that:
  - a relevant exercise task was previously interrupted (or previously suggested by the application)
  - mind-map task requires longer than time available
  - exercise task could be completed within time available
- Agents suggests to work at the exercise.

Application generated events: environment-application events

- The application generates events by observing the environment.
- Examples: arrival of an email, addition of a file to a shared board.

Scenario 3: Notification of external events

- The user is performing a task (working at an assignment, browsing a space).
- An email addressed to the user is received by the application (*new focus event*).
- The agents recognise:
  - message is of average importance (e.g. sender listed in social network, subject relevant to interrupted task)
  - current task is urgent and it requires a heavy workload.
- The agents delay notification until breakpoint in task execution (new *user-*

Application generated events: application events

- The application generates events by reasoning on the user activity.
- Assumes application capable of:
  - making inferences on the quality of user's chosen activity

Scenario 4: Learning guidance

- The user is visiting a knowledge area
- The application evaluates that the user should also visit another knowledge area, and informs the agents (*propose focus*).
- Agents suggests new focus to user.
- User disregards suggestion (without dismissing it).
- Agents save the proposed focus to be able to propose it later.

Events types

- Application generated (ref. table 1)
- User generated (ref. table 2)
- Agents generated (ref. table 3)

User Generated events

- The user generates events by interacting directly with the agents:
  - User supplies information
  - User requests services
  - User provides a feedback on the usefulness of the agents' interventions.

User supplies information events

- Users supply information about:
- Attentional preferences:
  - Maximum frequency of interruption
  - Preferred method of interruption
  - Don’t interrupt at this time
  - Don’t interrupt this task
- Attentional constraints:
  - Tasks deadlines
  - How long available until the next off-line interruption. (Scenario 2)

User requests service event

- Users may request attention-related services.
- Examples:
  - Requests for notification
  - Requests to restore the context of a certain task
  - Requests for help in interacting with the agent

Scenario 5: User requests notification

- User requests to be notified *immediately* and *with confirmation*, about any message coming from a given sender (notify-me).
- Application notifies agents (new-focus).
- Agents recognise that user wants to be notified about the email.
- Agents notify the user immediately
- Because *with confirmation*: notification is repeated at successive breakpoints until the

User feedback events

- Users may supply feedback on the agents' behaviour:
  - Explicitly accept or dismiss agents' suggestions
  - Indicate to the agents how "good" an intervention has been: was it useful? Did it come at right time? Was it too disruptive? (tune agents' behaviours to particular users; for project evaluation)

Scenario 7: I don’t want to do this … bug me no more!

- Agents propose to perform a certain task; the user dismisses it.
- Agents will not propose the task again unless the application requires it again, in which case the task will be proposed with further motivation
- *… I am not too sure how long this fight should continue! May ask for reasons for dismissal to the user (e.g. obsolete, too busy, etc.)*

Events types

- Application generated (ref. table 1)
- User generated (ref. table 2)
- Agents generated (ref. table 3)

Agents generated events

- Agents track attention-related events that are application-independent.
  - User tracking
  - Tracking of the environment.

User tracking events

- User-tracking devices generate events reporting user's states (keyboard activity, alertness, …).
- May need information from application to decide if tracked behaviour is significant. Examples:
  - Upper limit for input inactivity during task
  - Lower limit for user 'alertness'

Scenario 7: Re-attracting idle user attention

- Student browsing the expert's information
- Student does not provide input (*idle input*) for longer than *maximum input inactivity* for task.
- Agents propose:
  - Continue idle task (provide motivation
  - Receive help on the task
  - Switch to another relevant task (if available).

Environment tracking events

- Environment-tracking devices generate events reporting environmental changes that might affect the user attentional state. Examples:
  - User being active in a different application
  - Phone ringing
  - Person entering the room
- Difficult to use
- May improve agents' understanding of users' behaviour in "unknown" applications

Scenario 8: Re-attracting distracted user's attention

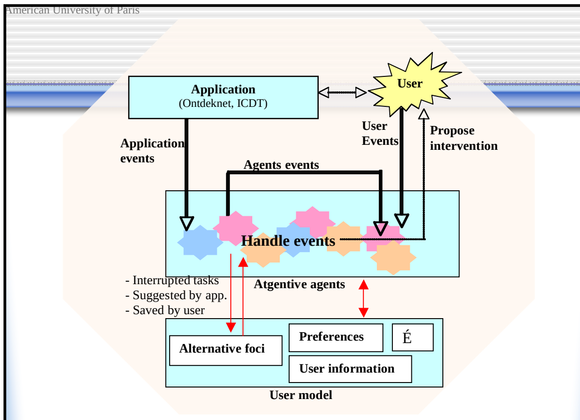
- The user is active in a different application
- Impossible to assess whether the user's current focus is more "important" than any of the foci associated to the application.
- No interruption
- Possible to infer which "unknown" windows are part of the context for the current task
  - copy and paste
  - frequent windows switches between an

Aims

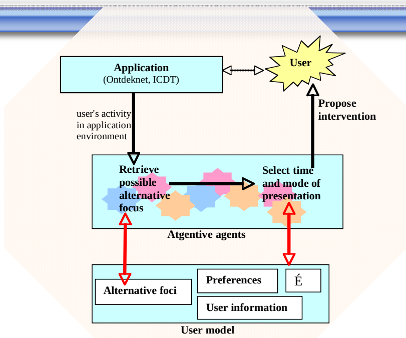
- ***Definition of main hypothesis***
- ***Definition of an event-based conceptual model for Atgentive***
  - ***Event types***
  - ***Event handling***
- ***Definition of essential concepts, measures, and processes***

Event Handling

- How do agents react to various types of events?
- What are the information and measures necessary to be able to reason about these events?
- We will only look at user-application events



Handling user-application events



Handling user-application events

- Task switch management. If focus switch, the context of the interrupted task is saved.
- Evaluate possible alternative foci
  - Importance of current task VS alternative foci
  - Complexity of current task resumption
  - If task is just starting, consider available time.
- Determine the best time for intervention
  - Task urgency
  - Estimated time to completion
- Determine the best modality for intervention
  - user preferences

Handling user-application events

- Task switch management. If focus switch, the context of the interrupted task is

•Application must be able to recognise *task context*

•Includes the set of application windows used by the user in order to complete the task

•User help

•Also agents' deductions over window activity

•How to recognise obsolete foci?

• *Task context* includes time of interruption

Handling user-application events

- Task switch management. If focus switch, the context of the interrupted task is saved.
- Evaluate possible alternative foci
  - Importance of current task VS alternative foci
  - Complexity of current task resumption

•Importance of the task to the learner (*priority*). Supplied by user and evaluated by agents (psycho-physiological measures)

•Task *relevance* with respect to the learning goal. Supplied by the application

•Task *urgency*, Supplied by user and evaluated by agent (learner agenda)

Handling user-application events

- Task switch management. If focus switch, the context of the interrupted task is saved.
- Evaluate possible alternative foci
  - Importance of current task VS alternative foci
  - Complexity of current task resumption

•*Estimated workload* associated to task. Supplied by the application and evaluated by agent by observing the user performing similar tasks (task similarity indicated by the application)

•size of the associated environment

Handling user-application events

•*Final scenario*

- If task is just starting, consider available time.
- Determine the best time for intervention
  - Task urgency
  - Estimated time to completion
- Determine the best modality for intervention
  - user preferences

Scenario 9: Determine best time for intervention

- After having initiated the design of the mind-map (saved focus), student has been working at multiple-choice assignment (current focus).
- Agents evaluate (as a result of a continue event) that resumption of the mind-map design task would be more appropriate
- Because student is near to completing assignment task, the proposal for the mind-map resumption is only presented once the assignment has been completed (complete event).

Atgentive

Initial analysis of Atgentive’s conceptual framework and application scenarios …

A LONG WAY TO GO!

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Appendix 12: Pr**esentation**

Title
AtGentive Formative Evaluation

Author
Mary Zajicek

Company
OBU

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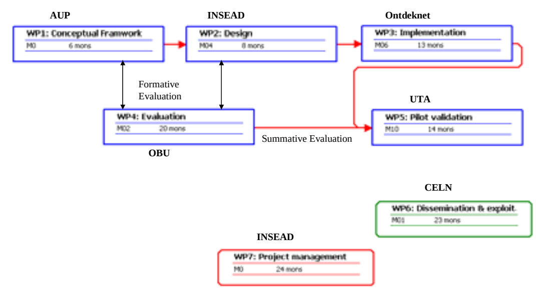
AtGentive Formative Evaluation

Dr Mary Zajicek
Oxford Brookes University



Objectives of WP4

- to develop a robust and effective evaluation program
  - Evaluation of early prototyping of the concepts developed in WP1 and WP2
  - Evaluation of final demonstrators.
- document the results of evaluation, for all concepts and models developed within the project

Evaluation will be at three different levels

- **Formative** evaluation: the objective is to identify the users' needs and to define or validate usage scenarios
- **Summative** evaluation: The objective is to evaluate the work that has been produced
- **Substantive** evaluation: The objective consists in assessing the substantive value of the knowledge (technical components or approaches) that has been generated in this project.

- Evaluation relies upon the specification of a well defined set of **key indicators** (qualitative or quantitative) that will be used to access the achievements of the project (including the value of the ideas and the knowledge assets generated in the project).

Work for WP4

T4.1: Formative evaluation:
- elaborating high-level scenarios with users, and collecting user's preliminary feedbacks
- information will be used as input for the elaboration of the conceptual framework (relevance), and will be used for adjustment purpose in the design.

T4.2: Elaboration evaluation frameworks for attention
- (oriented toward effectiveness rather than efficiency)
- for advanced user interface (with cognitive rather than ergonomic orientation)
- focus on the evaluation of the substantive value contributed by each of the mechanisms (for instance protocols of tests with or without artificial characters, with out without support for attention and direction, could be considered)
- will include the specification of a set of **key indicators** to assess the attention software

T4.3: Definition of the evaluation plan (summative evaluation)
- Development of a methodology (the characteristic of the test groups, specification of the evaluation action and of the schedule of execution)

T4.4: Analysis of the result (summative evaluation)

T4.5: Strategic Evaluation (Lesson learned, prospective, etc.).

WP4 Milestones

M4.1 Evaluation approach. – *M06*
- The project has now a good idea of the methodological part of the evaluation (methods that will be used for the evaluation, balance between qualitative versus quantitative evaluation, first draft of the key indicators, etc.).

M4.2 Formative evaluation has been completed – *M09*
- The result of this evaluation (first result available before *M09*) will validate, guide, and help to redefine the design.

M4.3 Evaluation Plan is ready – *M12*
- This report will provide the information necessary for organising the work of the validation pilot.

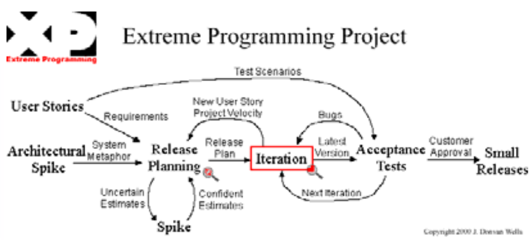
M4.4 Evaluation Report – *M23*

Formative Evaluation carried out by August 2006 (M9)!!!

WP	Milestone	Month	Description
WP1	M1.1	M04	State of the art completed
WP1	M1.2	M06	Conceptual Framework first draft done
WP2	M2.1	M07	Design of the components completed
WP2	M2.2	M12	Design of the learning platforms completed
WP3	M3.1	M12	First delivery of components
WP3	M3.2	M16	Working prototypes AtGentSchool and AtGentNet
WP4	M4.1	M06	Evaluation approach has been defined
WP4	M4.2	M09	Formative evaluation has been completed
WP4	M4.3	M12	Evaluation plan is ready
WP4	M4.4	M23	Evaluation Report done.
WP5	M 5.1	M12	The Specification of the implementation of the pilots have been completed
WP5	M 5.2	M17	The pilots have been deployed
WP5	M 5.3	M22	Experiences from the pilots have been gathered, analysed and reported.
WP6	M6.1	M06	The first draft of the exploitation plan has been completed.

Formative Evaluation

Techniques
- Extreme Programming
- Agile Software Development



Agile Development – Manifesto
http://agilemanifesto.org/

- **Individuals and interactions** over processes and tools
- Working software over comprehensive documentation
- **Customer collaboration** over contract negotiation
- **Responding to change** over following a plan

What this means for AtGentive

- Early and continual focus on the user
- Developing a series of small manageable prototypes encapsulating concepts/agents/scenarios
- Continuing to be open to change
- Clear evaluation criteria or key indicators

Formative Evaluation

Key indicators
- Measure the success of strategies for evaluating attention
- Measure the success of strategies for redirecting attention.
- Measure the success of the new attention position
- …
- …

Depends on the proposed prototypes

Formative Evaluation questions

Users for formative evaluation

- Sweden - users of ICDT, sample user group of interested individuals?
- Czech Rep. - school children or Dutch school children?

Evaluation criteria - key indicators – metrics?

Subjective

- Accept or reject suggestion
- User satisfied
- User agrees redirection is a good idea.
- Does the user want the agent to continue

Objective

- System log
- …

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Appendix 13: **Presentation**

Title
Psycho-physiological measurements in AtGentive

Authors
Toni Vanhala and Harri Siirtola

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UTA

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Psychophysiological measurements in AtGentive

Toni Vanhala[1] and Harri Siirtola[2]

[1]Research Group for Emotions, Sociality, and Computing
[2]Information Visualization Research Group

Tampere Unit for Computer-Human Interaction
Dept. of Computer Sciences
University of Tampere, Finland

Aims of AtGentive

- Measuring the attention of a person
- Manipulating the attention of a person
  - Redirecting attention (e.g., interruptions)
  - Maintaining attention (e.g., motivating)
- Adapting the system
  - Reducing attentional load (?)
- … in order to support learning

Challenges in estimating attention

- Attentional processes interact with other mental processes
- Limited resources for inferring attention in the end users' context (e.g., classroom)
- Measurement can be invasive (with, e.g., self-reports)
- Attention in learning (environments) has not been extensively studied
  - Effects of and methods for directing attention

Psychophysiological measures

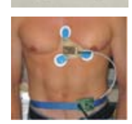
- Continuous
  - Responses to short term events (e.g., a gesture) can be identified and separated
- Unobtrusive
  - Do not require conscious effort from the subject
- Objective
  - Less vulnerable to subjective biases, e.g., in recalling events and responses
  - Reflect also involuntary and unconscious responses
- (Some can) reflect basic psychological phenomena
  - Safer to generalize over subjects and cultures
- Valuable both for early design and evaluation of the final system!

Measuring the Brain

- Electroencephalography measured with electrodes placed on a person's scalp
- Evoked Response Potential
  - Associated with a certain (type of) stimulus
  - Characteristics vary depending on the level of attention and cognitive activity
- Power spectrum analysis
  - Level of *alertness*
  - Approach-Withdrawal tendencies

Measuring the Heart

- Heart activity is influenced by both branches of the Autonomic Nervous System
- Derived measures can separate the activity of these two branches
- ANS is influenced by cognitive processes
- Emotional valence affects the heart rate response pattern
- Several options: wireless ECG, unobtrusive (discreet) BCG, PPG.



Measuring Muscles

- Electromyography is acquired with (skin) surface electrodes
  - Skin preparation required
  - New methods recently (being) developed, e.g., embroidered silver thread electrodes
- Most often the intensity of muscle activations is estimated
  - Other measures (e.g., fatigue could be derived)
- Known to reflect emotions and attention (e.g., frowning)

Measuring the Posture

- Approach-Withdrawal reactions
- Measured using a platform with force sensors
- Could possibly be measured with an office chair with embedded electronics (i.e., EMFi chair)
  - Requires a heavy investment of resources in order to develop signal analysis methods

Measuring the Eye

- A camera tracks the movement of one or both eyes
- Data consists of fixations and saccades
- The number of fixations on an area has been used as a measure of attention
- Gaze paths reflect cognitive phenomena (e.g., the task and perception strategy of a person)
- Pupil size reflects both affective and cognitive processing
- Eye blink characteristics vary according to alertness

Composite measures

- Difficulties in using psychophysiological signals
  - Context affects the measured signals
  - Signals reflect a number of other mental processes besides attention
  - Responses are highly individual
- Previous studies have found distinct patterns of physiological responses for different mental states
  - Several converging measures are needed
  - Also verbal and behavioral measures should be taken

Discussion

- Several psychophysiological measures exist for different mental phenomena
- Psychophysiological measures show potential as unobtrusive, objective, and accurate measures
  - Valuable for early design (e.g., selecting between competing designs)
  - Valuable for evaluating the final system (e.g., identifying the effect of different interventions)

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Appendix 14: **Presentation**

Title
Dynamic Agent !?

Author
Jaroslav Cech

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Czech E-learning Network

Dynamic agent ?!

Our task is to:

- **test pupils´ learning results** when using animated agent – collaboration with Ontdeknet
- **measure attention or learning results** when using animated agents – collaboration with the University of Tampere

What needs to be defined:

1. **Learning content** (what to teach, in what way, etc.)
2. **Suitable age groups**
3. **Teaching scenarios** with/without the agent
4. **Art of usage** teaching class – home usage

What we have in hands

1. **Learning environment with "fuzzy" – not certain content**
2. **Children, teachers and experts with low or intermediate computer and Internet skills**
3. **MANY external resources concerning the learned topic(s)**
4. **Interactive technologies enabling to handle tons of information (fulltext, WebServices and APIs to realy modern systems (Google, Skype etc).**

Scenario 1

- Barbora spoke about before

Scenario 2 ("SciFi")

- "Traditional" OntDekNet environment
- "Intelligent" agent collecting automatically information from external resources via Google, RSS channels, notification etc.
- Agent provides direct communication to the experts (if they are online) via "direct" channels

Let's discuss it please !!!

What to measure:

1. Overall attention how it was planned originally
2. General knowledge growth concerning the learned topic during the project
3. Frequency and art of usage of the agents
4. Knowledge difference between two tested groups

Necessary technical enhancements

- To have possibility to easily add new information channels (SOAP/XML based ?)
- To have possibility to connect the agent with external program
- To be able to add agent behavior caused by external events (e.g. emails, change of external webpage etc.)
- Interactivity between learning content and agent actions

Problems ?

Of course, but ….

1. Not technical problems
2. “New” functionality goes far behind “old” MS and Cantoche agents
3. Dynamic behavior

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Appendix 15: **Presentation**

Title
Attention & Embodied Agents: Attentional states and Living Actor states

Author
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Attention & Embodied Agents:

Attentional states and Living Actor states

WP1 Worshop

January 24 2006

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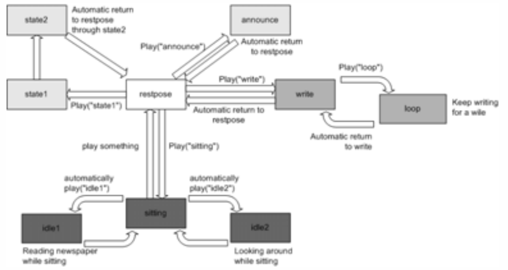
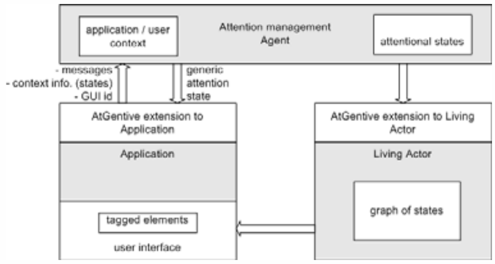
Living Actor™ graph of states



management of states



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Appendix 16: **Presentation**

Title
Diagrammatic Framework

Author
David Kingma

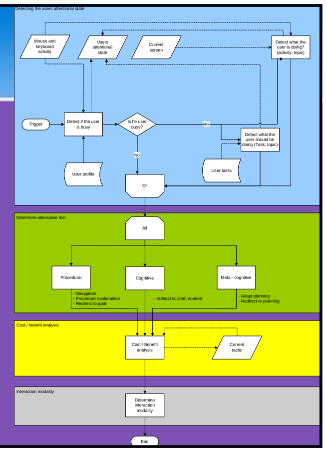
Company
Ontdeknet

Back

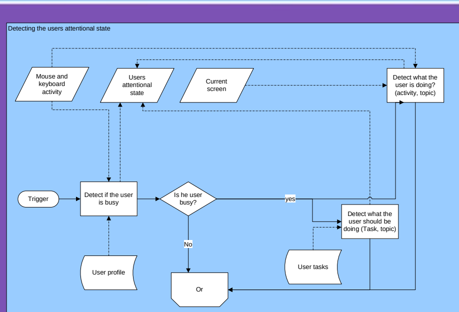
Meeting WP1

David Kingma
24 January 2006

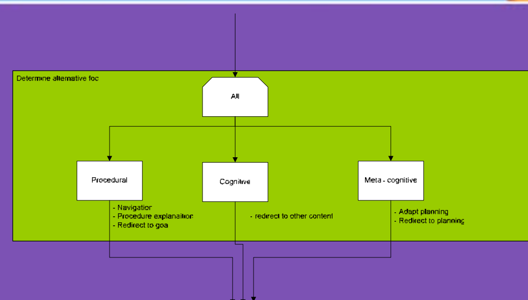
Framework



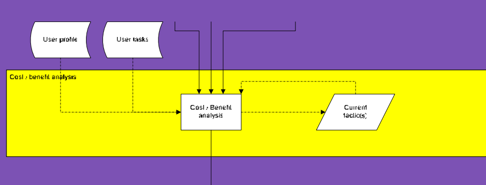
Attentional state



Foci



Cost / benefit



Modality