EDUCATIVE DISTRIBUTED VIRTUAL ENVIRONMENTS FOR CHILDREN

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Abstract:

This paper presents a distributed virtual reality environment for children. This virtual environment supports cooperation among members of a dispersed team engaged in a concurrent context. The virtual environment maintains a shared information space described in a standard Virtual Reality Modeling Language (VRML) format. Users are allowed to interact and to give decisions using cooperative mechanisms. A user-friendly interface enables teachers to create their own stories that fit with children pedagogical requirements and generates new virtual environments according to teacher's specifications. The implementation is based on DeepMatrix as environment server, VRML and Java as languages and Cortona VRML plug-in from ParallelGraphics. It is actually running on the Internet: http://www.enib.fr/eve

Keywords: Distributed Virtual Reality, Virtual Environments, Virtual Reality Modeling Language, Java, External Authoring Interface.

1. Introduction

This paper describes a pedagogical project called EVE: Environnements Virtuels pour Enfants (virtual environments for children). The EVE project involves nine partners (Universities, Primary Schools and SMEs) from three countries: France, Morocco and Romania.

The target of the project is twofold:

- To implement new cooperative working environments.
- To initiate new products development such as pedagogical software for primary school children.

On a pedagogical point of view, the main goal is teamwork. Children from different classrooms and countries are involved in a cooperative work. They have to achieve a common task together, hoping that this will encourage curiosity and respect in a multicultural framework, at a children level, and not only.

On a technical point of view, the EVE project implements distributed virtual reality technologies. Software had been developed using Virtual Reality Modeling Language (VRML) and Java languages.

From both perspectives, we can define our project as a NICE-like one, being narrative immersive constructionist and collaborative [5]. Even if it doesn't consume a lot of resources, as KidsRoom [1], it can offer to its young users great satisfactions.

2. Pedagogical content

The EVE application has been developed in order to help primary school children to learn reading. It offers children a pleasant approach of learning by means of two games that implements emulation and cooperation.

This first game is a self-training step according to a global learning method of reading. The target of the first game is to built sentences. A picture illustrates each sentence (Fig. 1). The child must discover the sentence using a disordered set of words and moving words to the right places. In case of doubt, the child can hear the sentence by clicking on the appropriate icon.

When the sentence is correct the child win the picture. The child must win three pictures before to be able to join the second game.

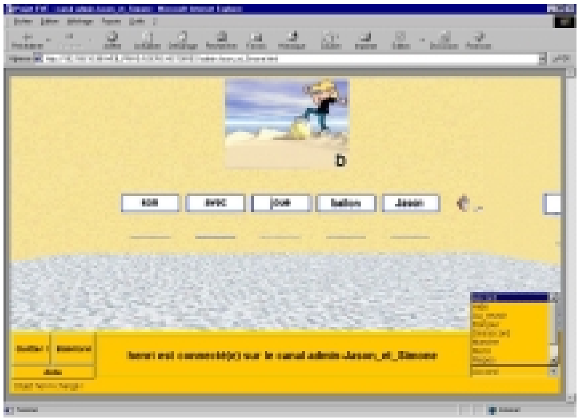

Fig. 1. First game: sentence and picture

Three children are working concurrently in three different virtual rooms (Fig. 2). The first one winning three pictures is the winner. He will be allowed to start the second game. The second game is carried out in a common virtual room (Fig. 2) where children will meet each other. Each child owns a personal avatar. The team of three children must now build a story using the previously won pictures.

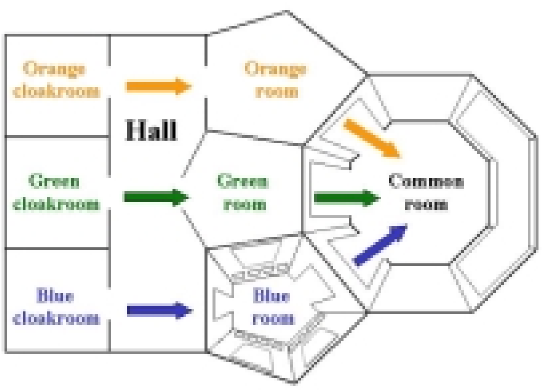

Fig. 2. Virtual environment: sky view

Walking from the cloakroom to the first virtual room will enable children to get use of the VRML plug-in functionalities before starting the first game or joining the common room.

3. Cooperation mechanisms

Generally speaking, children are eager to see what children in other rooms are doing. The application lets them to perform this task, because emulation concept is the basis of the first game. According to this fact, two mechanisms have been implemented:

- a scoreboard, which indicates the number of pictures that each child has won, and
- a teleporting “device”, which enables the child to view what happens in other rooms.

In the framework of the second game, a cooperative work is expected. A special mechanism is needed in order to avoid conflicts: for example if two children want to move the same picture to two different positions. We have chosen to implement a voting mechanism (Fig. 3):

- A child moves a picture to a chosen position and request a vote from the others.
- The two other children tell him if they agree or not. They are voting (green stands for yes, red for no).
- According to the vote result, the chosen position for the picture will be accepted or not.

When the team has ended to build the story two cases may appear:

- Pictures order is wrong. Badly placed pictures are removed and the team must start again to build the story.
- Pictures order is right. An agent comes in the virtual common room and tells the story to the children.

In order to complete the above-mentioned mechanisms we have implemented:

- a virtual TV where children may watch each others using web cams;
- a chat that enables children to discuss and explain their choices.

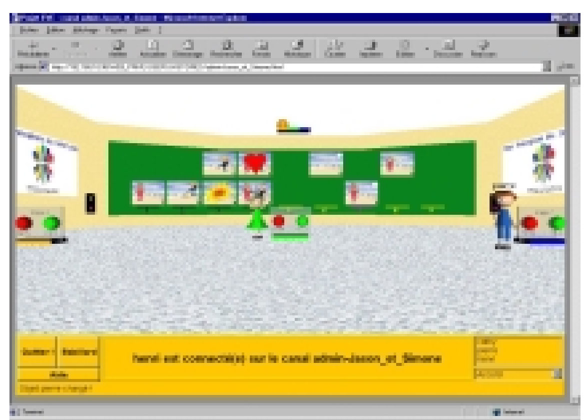

Fig. 3. Second game: voting mechanism

4. Designing stories

4.1 The Story

A story is defined by an ordered set of nine sentences. As previously mentioned, a picture illustrates each sentence. A sound file is also linked to the sentence in order to enable children to hear the sentence.

A sentence is defined by an ordered set of words. As it is presented in figure 1, a picture is associated to each word. The story data model is presented hereafter (Fig. 4).

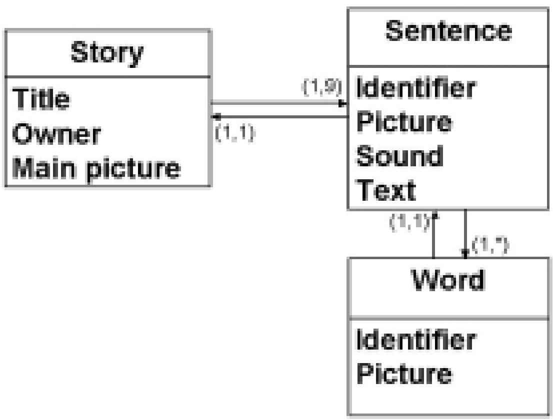

Fig. 4. Story data model

According to this data model, which is really simple, we have chosen to implement this model using a simple directory structure.

4.2 The User Interface

Our challenge is to provide teachers with a user-friendly interface (Fig. 5) (Fig. 6) that enables them to build their own stories. Using this tool, teachers can create stories that fit children pedagogical requirements all along the school year. Teachers can also involve children in designing new stories for their friends.

For each sentence, the teacher will choose:

- A gif file (the picture)
- A wav file (the sound)

and write the text of the sentence.

When this job ended, the teacher **saves** the story on the server. Before to proceed to data transfer, the application, automatically:

- Generates a gif file for each word taking into account word length in order to use the best characters font size;
- Transforms each wav file into a mp3 file in order to reduce the amount of data.

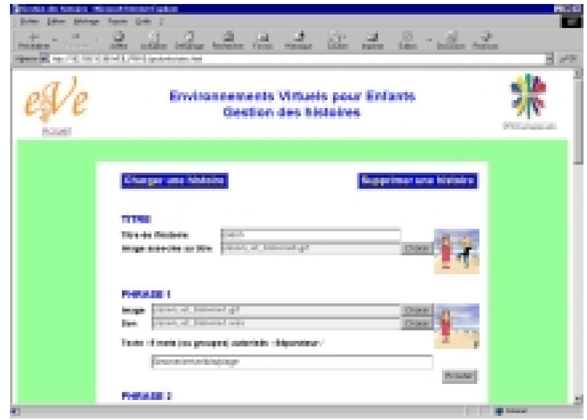

Fig. 5. Story interface: top

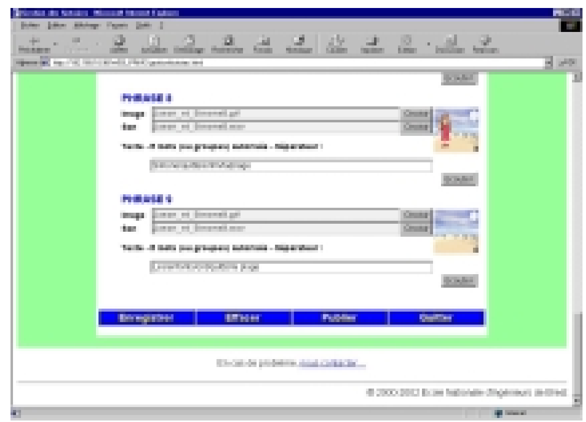

Fig. 6. Story interface: bottom

The teacher can **clear** the interface, **load** or **delete** a story from the server, previously created.

A new virtual world that implements the new story is generated when the teacher decides to **publish** its story. On the server side, symbolic links to the virtual world are created in the new story directory structure. At the same time, an E-mail is sent to a moderator.

A special interface (Fig. 7) has been implemented that enables the moderator to view the story and to hear sentences. The moderator will read the new story and decide whether he accept it or not according to its content.

The last interface (Fig. 8) enables children or teachers to choose a virtual world. The list of all published stories is showed on the left up corner of the page. The user:

- Chooses a story in the list;
- May click on the picture to view all pictures;
- Can press a button to read sentences - sentences disappear when the mouse is released.

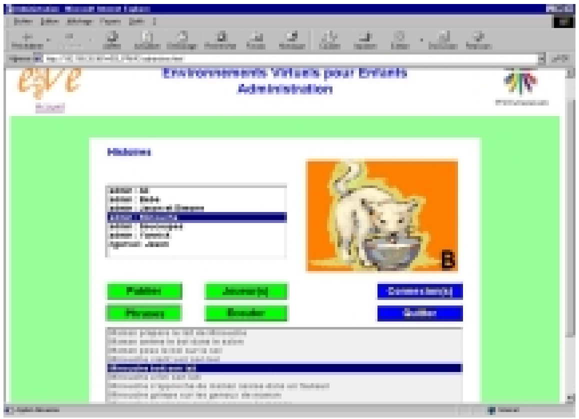

Fig. 7. Moderator interface

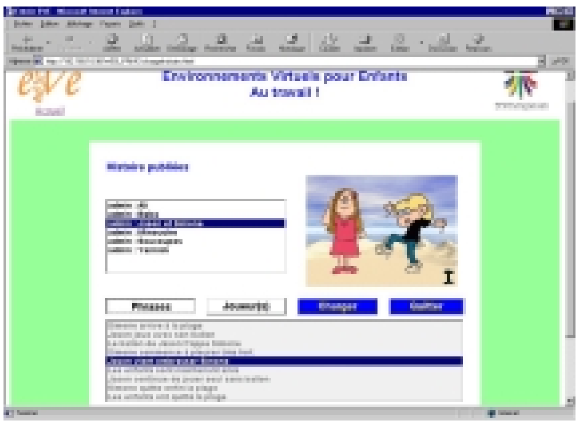

Fig. 8. Choosing a virtual world

This interface enables the teacher to read the story before he starts working with children.

All these interfaces have been implemented in Java language with a special attention due to the fact that users are viewing the pages with Internet Explorer and running the Microsoft Virtual Machine.

5. Technical point of view

Virtual environments have been developed with Virtual Reality Modeling Language (VRML) ISO standard [6]. Users may view 3D contents with a Web Browser and a VRML plug-in. The actual implementation is using Cortona VRML plug-in from ParallelGraphics, but it was also tested with Blaxun and CosmoPlayer browsers. This choice is platform independent.

Java classes (Fig. 9) manage user interactions within the virtual world according to VRML specifications [4]. On the VRML side we use eventIn and eventOut definitions.

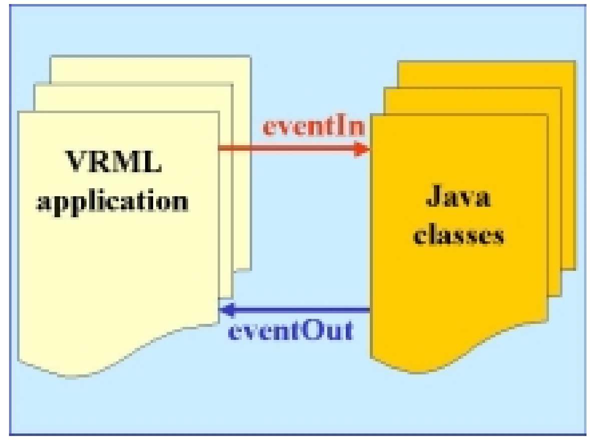

Fig. 9. Interactivity Management

The server implementation is based on the DeepMatrix software [3] from GEOMETREK. This software enables users to enter 3D websites where they can interact with other users and objects. DeepMatrix implements client-server architecture. On the server side, all messages are broadcasted in the same order to all clients. We have refined the proposed implementation from GEOMETREK, by introducing a filtering and pseudo-deadreckoning mechanism [5], that permit a more friendly and flexible connection of young users.

Clients are Java applets running in a HTML Browser. The communication between VRML world and client applet is made by use of External Authoring Interface (EAI) (Fig. 10). On the client side the EAI permits to achieve complex tasks by connecting the VRML Web Browser plug-in with a Java applet within the same web page. EAI enables a two-way communication between the Java applet and the plug-in. The Java applet loads VRML content into the plug-in and adds avatar representation to the virtual world. The plug-in updates the Java applet about users position and orientation in the virtual world.

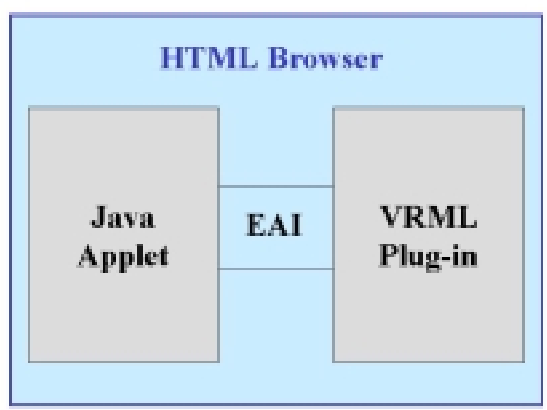

Fig. 10. External Authoring Interface

There is one more type of information that is published between all the clients of a virtual world, on DeepMatrix server, the other shared informations, like pictures, sounds, and strings. Generally, everything is declared as shared node in VRML files. By doing this, we can rich an optimized solution for a distributed virtual environment, with non-shared information downloaded locally.

6. Avatar's behaviours

A first idea when developing the EVE project was to implement a chat that enables children to discuss and explain their choices especially during the second game. Previous experiments demonstrate that this choice was not suitable for inexperienced in reading and writing learners. Actually, teachers are the main users of the chat!

We have decided to implement avatar's behaviours (Fig. 11) so that:

- It increases the realism of avatars that are virtual representations of children playing in a virtual world;
- It induces a better communication between children.

Fig. 11. Avatar's behaviours

The avatars were designed on an approximate-body approach [2], which provides frequently position and orientation information to remote hosts, taking into account a minimal set of joint points.

The implemented behaviours are:

- Avatar's realism: Walk, Standby,
- Children communication: Hello, Help me! Thank you, I agree, I disagree, Laughing, Smiling, Good Bye.

These previous lists are not exhaustive and should be easily completed according to current experiments with teachers and children.

The child may select a behaviour, which will be broadcasted (gesture and sound) to other children through its personal avatar.

Avatars are implemented in VRML using a PROTO structure. Behaviours are designed with the 3DStudioMax software. This software enables to export data into VRML format. The resulting code is then inserted into the avatar PROTO structure.

7. Conclusion and future works

In this paper we have presented a virtual environment especially dedicated for pedagogical purposes. This virtual environment is accessible with standard Web Browser and VRML plug-in without any specific or additional software.

The application has been successfully tested with children from three countries : France, Morocco and Romania. This application has been used as a complement of traditional learning method. This cooperative work demonstrates that children in a multicultural framework are able to work together if they comply with common rules.

Experiments have pointed out that:

- games increase children motivation, and
- new technologies such as virtual reality increase children autonomy.

On a technical point of view, current experiments will help us to design and implement new avatar behaviours according to end users' needs.

We are also working on a more sophisticated mechanism, which is the integration of streaming audio and video into the virtual world. This should make increase the performance of children cooperative work.

Another mechanism, which enables to avoid blocking of game caused by unexpected logouts, is under development. For this we have introduced a new type of user, a virtual one, who acts in the absence of a real one, and who can vote according to the scenario described on the server. This virtual user role is to maintain cooperation sense until the end of the game.

A new direction would be to use a platform independent VRML interface, based on Java3D. Doing so, we could reach a total independence together with a higher performance in 3D rendering.

On a pedagogical point of view, new applications should be developed in other domains of interest such as : foreign languages, geometry, algebra, …

A special benefit of the authoring tools lies in the fact that the teacher can easily create new exercises. Especially, the teacher can design exercises that fit with children' interest.

Consequently, it strengthens children' attention to exercises contents. As stories are shared between classrooms or schools, it increases the quantity of exercises teachers can propose to children.

The EVE application acts as a supplementary tool to traditional exercises. Such exercises already exist using scissors and paper. But the difference here is twofold:

- Children get an immediate validation of their works, for example an animal appears when the sentence is correct (Fig. 1);
- Children don't realize that they are working; in fact they feel as if they were playing together.

It is important to remember that a computer is only a machine, which is programmed to provide positive encouragements, congratulations so that children can consider it as a friend.

On the one hand, it encourages children to be more active so that they dare answer something; it enables children to make the exercise as many times as necessary. On the other hand, it enables children to go faster and then increase the number of exercises.

The second game (Fig. 3) is meant to text understanding and logics. Generally children have difficulties to read themselves and to correct themselves. They often make the same mistakes. Here, it is impossible because they have to change something if they are wrong; they have to build a new reasoning. This point out that our application contributes to increase the ability of children to reason by themselves.

Our experiments had shown that it was very easy for children to take over the virtual world and to move into the virtual space. For example, after a short time of practice, children have transposed into the virtual world one of their real game: "hide-and-seek".

To conclude, we believe that Virtual Reality is likely to enable the development of new products that will help children and teachers in their tasks of learning and teaching through friendly interfaces.

Finally, cooperative experiments pointed out that such cooperative work introduces a kind of subliminal target, which is: *"training children in learning democracy"*.

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