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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. 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>

Key Words: 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 French and especially the 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.

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.

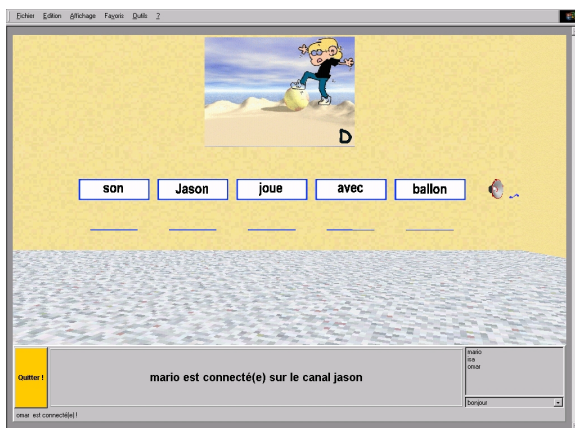


Fig. 1. First game: sentence and picture

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.

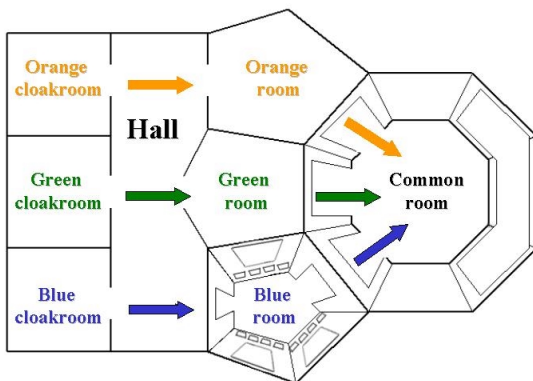


Fig. 2. Virtual environment: sky view

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.

The teacher can implement any kind of story; choose pictures, sentences and words in order to fit with children evolutions along school year.

This cooperative work demonstrates that children in a multicultural framework are able to work together if they comply with a common rule.

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 (Fig. 3), 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.

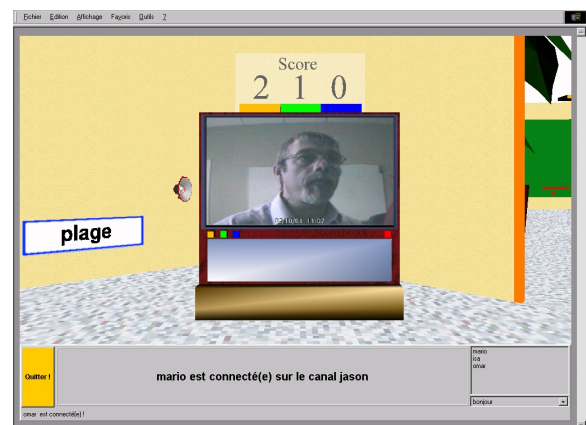


Fig. 3. Scoreboard and virtual TV

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. 4):

- 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 (Fig. 3) where children may watch each others using web cams;
- a chat that enables children to discuss and explain their choices.

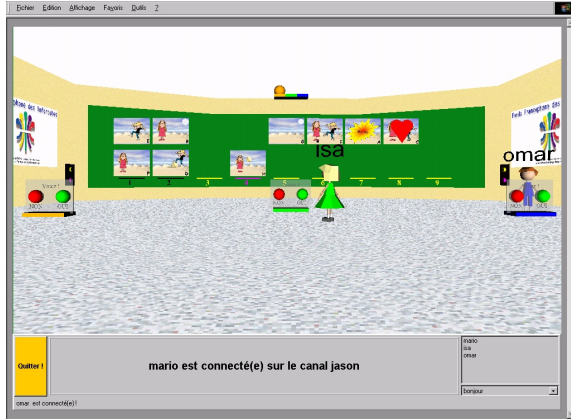


Fig. 4. Second game: voting mechanism

4. 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. 5) manage user interactions within the virtual world according to VRML specifications [4]. On the VRML side we use eventIn and eventOut definitions as follows:

```
DEF SCRIPT_END Script {
  url [ "scripts/game.class" ]
  ...
  eventIn SFTIME Request
  ...
  eventOut SFBOL Active_Button
  ...
}
```

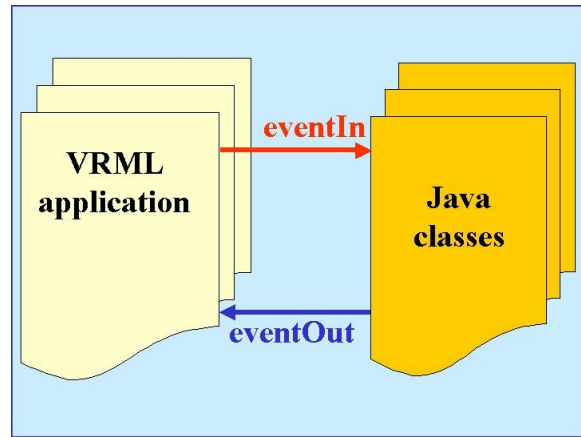


Fig. 5. Interactivity Management

According to the previous example :

- The SFTIME VRML variable “Request” will be linked to the Java variable “Game_Time” using getName() and getValue() methods.
- The SFBOL VRML variable “Active_Button” will be linked to the Java variable “Start” using getEventOut() and setValue() methods.

The following code describes this example :

```
public class game extends Script {
  ...
  private SFTIME Game_Time;
  ...
  private SFBOL Start;
  ...
  public void initialize() {
    ...
    Start = (SFBOL)getEventOut("Active_Button");
    ...
  }
  ...
  public void processEvent(Event e) {
    ...
    if(e.getName().equals("Request") == true){
      ...
      Game_Time = e.getValue().getValue();
      ...
    }
    ...
    Start.setValue(false);
    ...
  }
}
```

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. 6).

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 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 plug-in updates the Java applet about users position and orientation in the virtual world.

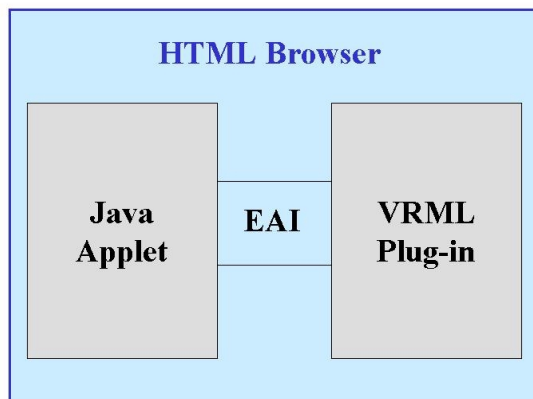


Fig. 6. External Authoring Interface

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.

5. CONCLUSIONS 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.

Experiments have pointed out that:

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

On a pedagogical point of view, new applications should be developed in other domains of interest such as : foreign languages, geometry, algebra, ... Virtual Reality enables new products developments that will help teachers and children in their tasks of teaching and learning through friendly interfaces.

On a technical point of view, streaming audio and video should be implemented in order to make children cooperative work easier.

A more sophisticated 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.

Another direction is 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.

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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