Eye & Why: A Prototype for Learning Objects Visualization in Virtual Environment

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Abstract

In this paper, we have introduced a 3D Car gaming metaphor, an interactive interface for searching learning objects from distributed search repositories. By analyzing the semantic information of the search results, the metaphor creates groups and presents them as virtual roads, where each rendered traffic sign corresponds to the visual representation of a learning object. The road network based learning object visualization scheme assists the learner in realizing the relationships (if one exists) among the displayed results. Hence, the learner would be able to discard or explore a group of information very easily from the rendered visual relationship constructs, thus resulting in an effective information navigation process. Additionally, the game motivated car metaphor employs customized and interactive 3D visual schemes to make the learning and navigational process more entertaining.

1 Introduction

3D information visualization offers several possibilities such as perceiving more information at a time, displaying meaningful patterns in the data and understanding the relationship among different data items [2]. These possibilities may be utilized in different contexts especially in visualizing Learning Objects (LOs) [1] as it requires novel and intuitive presentation techniques rather than what is provided by the traditional 2D approaches. To simulate this concept, we designed and implemented a prototype of a 3D virtual gaming environment (Eye&Why) as an intuitive interface for visualizing distributed LOs. The gaming interface incorporates several entertaining features that enhance the user's learning experiences while searching and navigating the virtual environment. Moreover, we have proposed an algorithm that considers different criteria such as keyword, type, location, semantic distance between search items, and synonym sets to group the search results retrieved from the distributed learning object repositories.

In the next section we will present the overall system architecture along with brief description of the elements of the metaphor. Followed by the presentation model section, where we will illustrate various implementation issues and a summary of the features of the prototype.

2 System Architecture

A number of researches have focused on the presentation of information using 3D visualization schemes [10], [5] in order to take advantage of the added dimension that is effective to render more information at a time. Our approach differ from traditional models in a number of ways. Instead of using general web information or multimedia contents, our research takes standard data elements [4] for the visualization. In order to enhance searching, the metaphor applies an intuitive and entertaining car navigation approach which is attractive and easy to use. Finally, a grouping scheme handles the clustering of the search results. A general overview of the elements of the system is illustrated in figure 1.

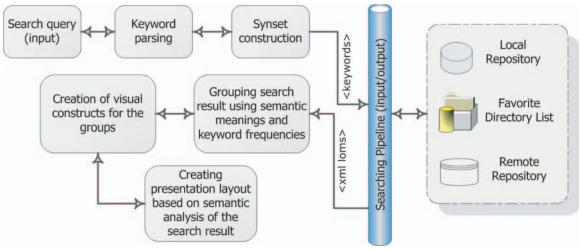

Figure 1. Architecture illustrating the grouping and presentation style creation steps in the 3D car metaphor

In the metaphor various customization parameters could be selected at real time. For example, the learner can customize different learning object repositories [6] from which he/she wishes to search LOs. The user favorite search directory will automatically be included in filtering the search results. Basically, the learner places one or more keywords in order to search for a topic of interest. The prototype then analyzes the semantic meanings [12] of the keywords and commits the search. The semantic information is augmented in the search result processing module [9] to categorize them into different groups. In the next step, the metaphor creates the road network where each road depicts a group of information. The semantic meaning is further processed to produce the presentation layout which assists the learners in navigating easily to a particular group of learning objects.

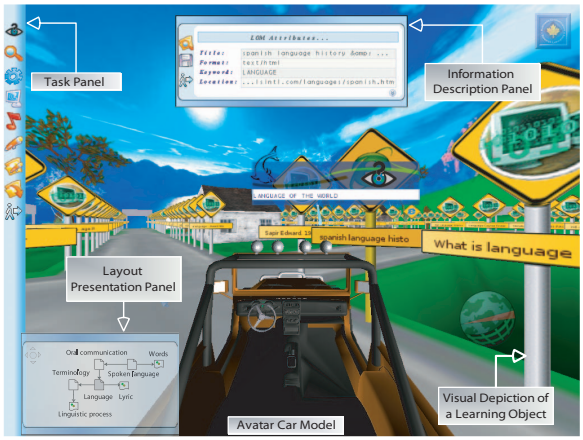

Figure 2. Search results are grouped according to the keyword semantics and associated with each road in the metaphor

3 Presentation Model

Communicating meaning and an information transformation process is very challenging in the research of information visualization. The effective presentation schemes not only process information but also show the context and relationships to the learner in an entertaining information acquisition process. In this regard, the use of visual metaphors are effective tools for transferring knowledge, and to structure and coordinate communication [3]. The primary target of the prototype is to allow an easy to use interactive 3D interface so that learners are entertained and attracted to the learning process. The metaphor aims to display meaningful patterns in the data, enhance grouping facility, and offer a better understanding of the relationships among different data items. Figure 2 represents a glimpse of the 3D car metaphor.

In addition of presenting the intuitive interface, the multi modal interaction was another important issue that is covered in the prototype. Different user have different tastes and preferences in their interaction with the visualization applications. We have explored joystick, mouse, keyboard and audio recognition [8] based interaction schemes in our prototype. The audio recognition based interaction scheme is particularly remarkable. The interaction scheme entertains the learner and makes the navigation process more flexible.

The user can choose any interaction model to further navigate the 3D metaphor and interact with the learning objects (search, view, close, and store). Simple to use interactions will promptly bring results into the metaphor. The mouse movement or keyboard interaction (left or right) will bring forth the relevant group information with respect to the current group and the user can select and navigate to the related groups at any time. Additionally, a group navigation panel (as a subgraph) is provided for better group exploration. The presentation layout sketches the relationship (heypernym) [12] among the groups that constitutes the 3D graph elements. Overall, the features of the EYE & WHY prototype are summarized as follows:

- Highway metaphor interface for searching LOs
- Entertainment in Education
- Navigation in local and distributed eduSource LORs
- Speech recognition based command
- Different 3D world templates to view the information
- Learning Object Metadata [4] view panel
- Viewing and playing LO
- Audio synthesis based feedback to guide the user
- Visualizing the user's search history in VE
- World overview layout for efficient navigation
- Graphical user interface
- 3D graph based group navigation layout
- OpenGL rendering power
- Portable and accessible using standard web browsers as a standalone Java applet
- Java-based implementation

Audio synthesis based feedback [7] adds an extra dimension to the interface. The learner is notified of the status and the results of all his/her major actions in the prototype. Basically, it acts as a virtual assistant in the interface. For example, after committing a search, the audio synthesizer will notify the user of the maximum number of search results found or it may simply store the learning object into the favorites directory upon the user's request. Of course there are simple shortcuts in the keyboard, but the audio based command and interaction makes the learning process more interesting.

4 Conclusion

We have presented a prototype developed in OpenGL [11] for presenting the LOMs to allow better control over the arrangement of the information. We have presented a new way of visualizing LOs in a 3D virtual gaming environment. The spatial landscape of the 3D environment that is used to represent more information at a time proves to be advantageous. In addition, the use of the car gaming metaphor in our system is very entertaining, and provides intuitiveness in the search and exploration operations while navigating the 3D world.

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