VIENA: An Intelligent Interface for a Virtual Environment*

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The VIENA System. The overall goal of VIENA is to apply artificial intelligence techniques in interactive 3D computer graphics. Instead of using the mouse and menus to manipulate objects in a virtual scene we use specialized software agents to convey changes (fig. 1). Input in simple written natural language is currently used for communication. The agents produce an action-oriented semantic interpretation to translate the user's input to new images. The current working environment includes a Silicon Graphics Indigo equipped with the SOFTIMAGE modeling and rendering software.

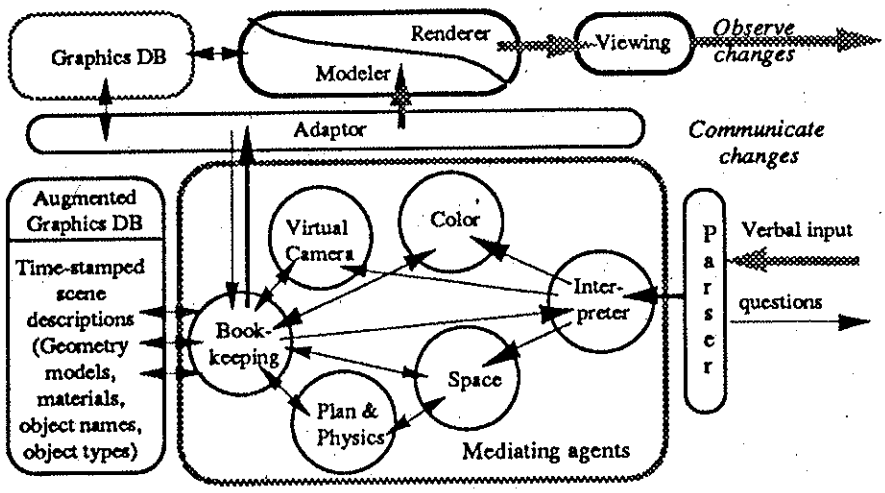

Fig. 1. The architecture of the VIENA system

An agent model was chosen which subdivides the functional structure of an agent into three components: local functionality, communication, and cooperation. The local functionality consists of functions for announcing the agent's existence, for checking the feasibility of subtasks, and for solving subtasks. For example, the space agent can calculate an object's transformation in space (translation, rotation) knowing that an object must be supported by something and

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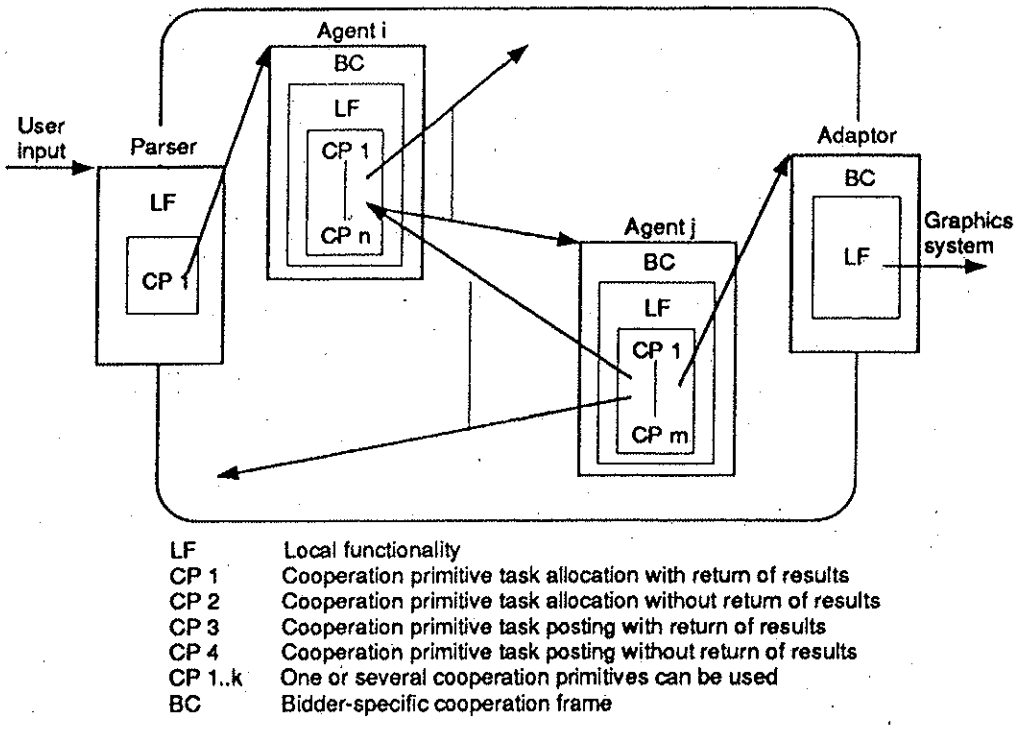

Fig. 2. The cooperation framework in the VIENA system.

can only be placed in positions not occupied by other objects. Regarding communication, a Client-Server concept was designed which formally defines the agents as clients, and a communication subsystem as server to handle the messages exchanged by agents. The cooperation method is basically characterized by a negotiation process similiar to the "contract-net" approach [1]. In addition, it is possible to allocate tasks to agents directly ("master-slave") or address them to groups of agents simultaneously ("blackboard"). Each agent of the VIENA system is equipped with a bidder-specific cooperation frame which triggers the activation of the agent's local functionality. Out of this, contractor-specific primitives are inserted depending on the situation and the task (see fig. 2).

Prototype Environment. The VIENA system is tested in a prototype scenario with various items of furniture as well as color and light impressions of a virtual office room which can be changed interactively. In mediating verbal instructions, agents cooperate to offer a goal scene corresponding to a user's inquiry. The offer can be changed in further interaction, that is, the user can negotiate the computed semantics of instructions.

A sequence of interactions with the VIENA system is shown in fig. 3. The inputs shown allow interactive modification of the visible scene as well as changes of the viewpoint and, finally, the processing of simple deictic instructions (17./21.); these can either refer to the observer's viewpoint or to a detail pointed out from this viewpoint. For the sake of interactivity we wish to meet the requirement of

real-time. Because of the various demands, above all to the quality of visualization, so far a more or less "step-keeping processing" is feasible in practice[2]. As a

1. move the chair to the left .
2. a bit less .
3. turn the chair left .
4. put the desk behind the chair .
5. put the palmtree on the desk .
6. move the palmtree to the left .
7. put the bowl on the desk .
8. put the chair on the table .
9. move the chair to the window .
10. turn the desk right .
11. move the chair to the front of the desk .
12. put the bowl on the ground .
13. put the palmtree on the floor .
14. show the palmtree .
15. show the shelf .
16. move the chair to the right of the desk .
17. move the chair here .
18. put the plant between the desk and the chair .
19. display the plant .
20. point to the plant .
21. put the bowl there .

Fig. 3. Sample interaction with the VIENA system.

further feature, models of individual objects can be exchanged; e.g., "real" CAD models of a kitchen manufacture company were imported to probe adaptability of our prototype system to more realistic conditions. We have also started to work on voice input and simple hand gestures, indicating directions. In our most recent work, we manipulate the virtual environment via an anthropomorphic virtual interface agent (VIA) present in the virtual scene [2].

References

1. Davis, R. & Smith, G. (1983). Negotiation as a Metaphor for Distributed Problem Solving. In Bond, A.H. & Gasser, L.: *Readings in Distributed Artificial Intelligence*, 333-356, Morgan Kaufmann.
2. Jörding, T., Lenzmann, B., Wachsmuth, I. (1995). Ein anthropomorpher Interface-Agent für die Interaktion mit einer virtuellen Umgebung (in diesem Band).
3. Wachsmuth, I., Cao, Y. (1995). Interactive Graphics Design with Situated Agents. In W. Strasser & F. Wahl (eds.): *Graphics and Robotics* (pp. 73-85), Springer.

[2] As a benchmark the interactions shown in fig. 3 currently require about 3 minutes on an Indigo Elan. This session is part of our IJCAI-95 demo video.