A KNOWLEDGE-BASED MULTI-MEDIA SYSTEM

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Abstract: It is proposed that the management of large, multi-media hyperbases should not be treated as a new technology but rather achieved through the integration of existing technologies. Hypermedia and hypertext abstract machines implement the same conceptual structures as do KL-ONE-like knowledge bases. The recent advent of fast, powerful and principled knowledge representation servers makes it possible to implement this part of a multimedia management system as a knowledge base. The individuals or objects within the knowledge base are not abstractions, however, but have concrete presentational characteristics as text, sounds, video,and so on. These presentational aspects have to be organized spatially, temporally and in relation to one another. They are also vehicles for user interaction. This paper describes a multimedia management system in which a knowledge representation server has been coupled to a range of media management tools providing control of, and interaction with, typographic quality text, interactive graphics, videodiscs and sound. The representation and parametrization of the interface between the server and tools has been designed to preserve the integrity and flexibility of each medium while presenting a uniform interface to the knowledge base. The approaches taken and problems met are discussed, as is the feasibility of taking such a general-purpose approach. Some experience with the system in different applications is presented, including knowledge base applications involving multimedia, and a sports coaching system managing video disks through knowledge structures.

INTRODUCTION

In recent years the primary focus of the Knowledge Science Institute has been on knowledge-based systems applications in a wide range of disciplines and the development of tools support such system development and delivery. The demands of practical applications have forced us out of the purely symbolic paradigms of much of AI and involved the development of hybrid systems incorporating high quality textual material and graphics, speech and sound and video tapes and disks. Initially these additional sources were treated as 'peripherals', rather as robotics and machine tools are treated as peripherals in manufacturing applications in AI. However, in our studies in knowledge acquisition, where large quantities of audio, visual and textual materials have to be stored and analyzed, we have found in practice that the 'informal' initial sources, and the various stages of their refinement to computational form, are best not discarded in the final product. The provide a rich, and essential resource, for explanation and knowledge-based system maintenance. We have come to regard conventional media, under computer control but carrying knowledge that is not computer-processible, as just as much part of the 'knowledge base' as the classes, properties, relations, objects and rules that conventionally have that role.

This has led us to consider architectures for generalized knowledge support systems (Gaines, 1989, 1990) that have far wider objectives than 'expert systems' in supporting human knowledge processes. The Knowledge Science Institute is strongly interdisciplinary by mandate and we have developed such systems in a deliberate diversity of applications, including:

- Flexible manufacturing (Gaines, 1986; Norrie, Fauvel, Gaines & Mowchenko,, 1989) where we have combined an object-oriented knowledge base representation of tools with videodisc and graphic data about them.
- Sports coaching (Gaines & Vickers, 1988, 1989; Vickers and Gaines, 1989) where a new cognitive approach to sports education has been developed (Vickers, 1990) based on 'knowledge structures' supported by video disks of skilled athletes developed specifically to illustrate the knowledge structures.

- Knowledge acquisition for expert systems (Gaines, Rappaport & Shaw, 1989; Gaines & Linster, 1990) where we have closely integrated hypertext, knowledge acquisition tools, and expert system shells to provide a system development, application and maintenance environment that is highly robust and knowledge rich.

In the past year we have been attempting to bring all our activities within a unified theoretical and tools framework that encompasses both KL-ONE-like knowledge-based systems and all aspects of hypermedia. We have redeveloped our knowledge-based system tools around a very high-speed and efficient implementation of a knowledge representation server, KRS, as a class library in C++ (Gaines, 1990, 1991). We are using KRS for a variety of purposes including holding knowledge acquisition data at all stages of system development and as a final 'performance engine' for large knowledge bases with thousands of concepts and rules. However, in the context of this workshop, the most interesting application is that we are using KRS to support a 'hypermedia abstract machine' managing the storage, linkage and presentation of a wide range of media. At the knowledge level this is straightforward since the server provides a richer set of operations than existing hypermedia tools. Our major developments have been to try to provide some degree of uniform parametrization of media objects so that we can manage a heterogeneous diversity of media and material, their interrelationships, and interactions with them, while preserving the integrity and flexibility of the media. We have developed and implemented the notion of parametrized 'gateways' to media objects (Gaines, 1990), similar in concept to IRIS InterMedia's 'anchors', and implemented these for documents, sounds and video sources. We have brought all our existing media usage within a common framework, but it is not clear whether this approach is indefinitely extensible to all requirements, for example, artistic rather than informational applications.

We would like to take the opportunity of this workshop to exchange ideas and problems with others working on knowledge-based multimedia management.

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