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## Intelligent Agent Architecture for Digital Library

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**Abstract** The new challenge in artificial intelligence is extending the functionality of traditional expert systems to be able to work on distributed information systems, such as digital library, electronic commerce, etc. Artificial intelligence allows us to build system, which is smarter than it otherwise would be, and which is qualitative better than system that does not use artificial intelligence techniques. In this paper we present the architecture of digital library by adopting multi agent approach from artificial intelligence. By using this approach is expected there will be a smart digital library, which can handle the need of the more complex digital library systems.

**Keywords** : intelligent agent, digital library, artificial intelligence

### 1. INTRODUCTION

The new challenge in artificial intelligence is extending the functionality of traditional expert systems to be able to work on distributed information systems, such as digital library, electronic commerce, etc. Artificial intelligence allows us to build system, which is smarter than it otherwise would be, and which is qualitative better than system that does not use artificial intelligence techniques.

The size, complexity and as yet undetermined nature of digital libraries mean that a centralized development strategy is not likely to work. Agent-based systems are naturally decentralized, and can potentially be used to implement large-scale digital libraries. Researchers mean many different things by *agent*, but there is agreement that agents are computational process that operate without direct supervision from humans, and that they interact with other agents to carry out tasks or otherwise pursue their objectives.

In this paper we present the architecture of digital library by adopting multi agent approach from artificial intelligence. By using this approach is expected there will be a smart decentralized digital library, which can handle the need of the more complex digital library systems.

### 2. CONCEPTS AND DEFINITIONS OF DIGITAL LIBRARY

Digital Library is a collection of information that is stored and accessed electronically. The information stored in the library should have a topic common to all the data. For example, a digital library can be designed for computer graphics, operating systems, or networks. The separate libraries can be combined under one common interface that deals with computers, but it is essential that the information contained within each library remain separate. The purpose of a digital library is to provide a central location for accessing information on a particular topic. A digital library must keep topics separate; otherwise it would be totally useless. A digital library should also have a user interface that is easy to use [5].

In contrast, a digital library is a library of digital rather than physical objects. The concept includes the potential of infinite growth in both materials and numbers of users. A corollary of the concepts of infinite growth in materials and users is infinite growth in genres and formats. In other words, the vision of a digital library assumes that that its full realization would share many similarities with its traditional academic counterparts.

It is important to differentiate the concept of a

multi-disciplinary, multi-format digital library from that of specific genre database. Libraries have focused primarily on the latter, both because of the difficulties in integrating multi-format and multi-disciplinary materials, and perhaps because funding has been more easily acquired from agencies with interest in specific subject areas. Moreover, the problems associated with multi-disciplinary materials are easier to surmount when the focus is well-defined and limited.

The vision of a digital library is that, for instance a child in the public school, a professor in an academic research institution, a scientist in the field, or a patient in a hospital, could access, in an easily usable and conceptually integrated fashion, whatever information is needed. The vision also must assume that future archivists can add new collection acquisitions to the archive in ways that further enrich the existing contents, so that future researchers with unknown research questions can ask and answer new kinds of questions, using new methodologies, and teachers can use these materials to teach in new ways.

### 3. CONCEPTS AND DEFINITIONS OF AGENT-BASED SYSTEM

Workers involved in agent research have offered a variety of definitions, each hoping to explicate his or her use of the word *agent*. However, we can define agents as a computer programs that:

1. *Encapsulate one or more well-defined services*
2. *Team with other agents to satisfy user request*

For example, an agent might provide access to a particular collection, provide an interface to users doing some type of task, or contribute some particular capability to the process of forming a team to complete some task. Agents can team in a combinatorial number of ways to satisfy user requests; potentially, even in ways that were unanticipated at the time of design of the agent or the digital library. Flexibility is a hallmark of good tools. A key requirement for flexibility is the agents' ability to communicate

their capabilities to one another in order to form teams.

According to a somewhat stronger notion of agency, agents also:

3. *Make decision according to preferences*

According to an even stronger notion of agency:

4. *Agents use mentalistic concepts such as belief, desire, intention, and commitment*
5. *Agents are proactive (i.e., they initiate action to pursue their desires)*

The advantage of mentalistic representation of agent behavior is that humans are very comfortable with using this kind of reasoning to describe complex behavior.

Although we might call some of the more sophisticated agents *intelligent*, we do not believe that they will be adequate substitutes for human librarians. Digital libraries will be relatively complex compared to traditional libraries, and the role of librarians will thus be augmented, not reduced. In fact, librarians may well act as catalysts of change, since they will be in the best position to identify users' needs and visualize solutions to address them.

The most profound benefit of agent-based architectures in digital libraries is their potential for facilitating system evolution to meet user needs. In such a system:

- ?? It should be straightforward to develop new agents. It should not be necessary to reinvent capabilities required of all agents.
- ?? Agents should recognize when new agents can meet their needs better than existing agents. New agents should be utilized without requiring any modification of the existing agents.
- ?? Agents should reap benefits for their developers, financial or otherwise, appropriate to their participation in tasks performed by the system.

### 4. COMPUTATIONAL MODEL OF DIGITAL LIBRARY AND ITS AGENTS

#### 4.1. Agent Model of Digital Library

In this research, digital library is viewed as a society of software agents that interact and negotiate with each other. We have devised five types of agents: customer agent, search agent, catalog agent, dealer agent, and delivery agent. Each agent is an intelligent in its own field and may interact with its human counterpart or behave autonomously.

Each agent has a local knowledge base and a reasoning engine. All agents have a communication engine and a documentation engine. The communication and documentation engines facilitate communication and navigation of each agent on the network environment.

#### 4.2. Reasoning Engine and Knowledge Base

It is believed that human experts possess a conceptual model of how the objects in the external world interact based on standard operating procedures. Conceptual models have a hierarchical structure defined best by the Skill-Rule-Knowledge (S-R-K) levels [3] concerning with routine, innovative and creative problem solving tasks, respectively.

##### *Level 1 Skill-Based Level*

This level is deal with routine task. It denotes the kind of task for which problem solving knowledge and strategies are well defined. At this level, reasoning is governed by stored patterns of predefined rules. Such context specific pattern are called rules-of-thumb, that map directly from an observation to a ready-made solution.

At this level a query of agent is accepted and by searching the knowledge base, proper immediate action is selected. For instance, in case of search agent the query comes in the form of a list of keywords, submitted by the customer agent. Then search agent finds related keywords and conducts search using the new set of keywords.

##### *Level 2 Rule-Based Level*

This level deals with the innovative tasks when dealing with familiar or similar problems. It

denotes the kind of task for which problem solving knowledge is well-defined. Rule base behavior is conventionally described by case bases, decision tables, diagraphs, fuzzy sets and natural language models.

At this level a query of an agent is accepted and a case database is consulted to determine the action. For example, in case of a search agent, the initial query comes in the form of a sentence with reduced and restricted grammar. This is adopted to avoid unnecessary overload of natural language processing. Then a set of similar cases are searched and cases matching the needs of the user are retrieved. Further research is conducted based on the instructions recorded on the matched cases.

##### *Level 3 Knowledge-Based Level*

This level deals with the creative tasks for which common pattern in stored knowledge form do not exist and reasoning should start from the so called first principles, starting from problem identification. In other words, neither problem solving knowledge nor the strategy is well-defined.

At this level a query is accepted and the agent uses its knowledge base to interact with the other agent and identify the actual needs. After this problem identification level, the proper action is determined by consulting other agents.

#### 4.3. Communication Engine and Documentation Engine

Digital library agents must communicate with other agents in order to flexibly and autonomously. In this project, we have considered using Knowledge Query and Manipulation Language (KQML) [7] speaking and Common Object Request Broker Architecture (CORBA) enabled agents that communicate over network environment. The Communication engine is mainly responsible for maintaining connection to the network, communicating with other agents and managing messages.

Documentation engine performs three main tasks:

- ?? Acquiring data from the other agents, as requested by the reasoning and communication engines.
- ?? Preparing and reformatting data items to be appropriated for transferring over the network environment.
- ?? Maintaining index of data items transferred and retrieved.

Using documentation and communication engines, the local knowledge can be shared with other agents.

## 5. CONCLUSION

We presented the architecture of digital library by adopting multi agent approach from artificial intelligence. By using this approach is expected there will be a smart decentralized digital library, which can handle the need of the more complex digital library systems.

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