# Smart Search Agents for Image/Graphics-based Educational Databases

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## ABSTRACT

In this paper, a smart agent is proposed to search image/graphics based database for students and an instructor. The search procedure is based on content-based image retrieval (CBIR). In addition, the smart agent can also gives help in searching image/graphics data, answering simple questions, and optimizing educational activities graphically.

**Keywords**: intelligent agents, educational agents, graphics, databases

## 1. INTRODUCTION

An autonomous agent is a system situated within and a part of an environment that senses that environment and acts on it, over time, in pursuit of its own agenda and so as to affect what it senses in the future [2]. A good agent needs the following capabilities: It must be *communicative*: able to understand your goals, preferences and constraints. It must be *capable*: able to take options rather than simply provide advice. It must be *autonomous*: able to act without the user being in control the whole time, and it should be *adaptive:* able to learn from experience about both its tasks and about its users preferences [5]. Building intelligent educational agents based on image/graphics databases is challenging in the computer science research community, especially the teaching/learning agents for students and an instructor. The difficult problem is how to do image/graphics retrieval efficiently.

Many picture libraries use keywords as their main form of retrieval – often using indexing schemes developed in-house, which reflect the special nature of their collections. Index terms are assigned to the whole image, the main objects depicted, and their setting. Retrieval software has been developed to allow users to submit and refine queries at a range of levels, from the broad to the specific [1].

Problems with traditional methods of image indexing have led to the rise of interest in techniques for retrieving images on the basis of automatically-derived features such as color, texture and shape – a technology now generally referred to as *Content-Based Image Retrieval* (CBIR) [7,8,9,13]. After a decade of intensive research, CBIR technology is now beginning to move out of the laboratory and into the marketplace, in the form of commercial products like QBIC and Virage. However, the technology still lacks maturity, and is not yet being used on a significant scale.

In this paper, content-based image retrieval (CBIR) is adopted for the design of a smart agent that is used to search image/graphics based database for students and an instructor. The CBIR techniques used here include three different levels, i.e., by primitive features, by logical features, and by abstract attributes [6]. In addition, the smart agent can also gives help in class searching, and answering simple questions.

## 2. SYSTEM ARCHITECTURE

The system architecture of the smart agent to retrieve information from the database is shown in Figure 1. As shown in Figure 1, the system architecture includes three parts, i.e., web client, which is usually a browser, web server, in which the smart runs, and image/graphics based database. The users give requests and may also include some preferences. The browser sends back this information to the web server. Then the web server calls the agent to process this information. The agent uses CBIR techniques to search the image/graphics database and send the results to the users. In addition, the agent can also answer simple questions and give class scheduling, calendar, etc.

The function modules of the smart agent are shown in Figure 2. The functions of each module are as follows,

***Web Interface***: Web client use metadata [4, 12] for users to send queries to the agent. Dublin Core [3, 4] is adopted here. The web interface receives the metadata from the web client and parses it. Then it sends the metadata to the appropriate module.

***FAQ (Frequently Asked Questions) Agent:*** the FAQ agent is an intelligent system that can not only answer some common questions from students when instructors are not available, but also perform intelligent tasks. For example, the FAQ agent allows a student type in key words for searching some graphics of art works in the digital library, and then the FAQ agent will start to search the digital library, and finally return results back to the student.

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***Database Search***: the database search uses content-based image retrieval (CBIR) techniques to search information for the users from the image/graphics database.

***Class Scheduling Agent:*** the class scheduling agent is designed to optimize class scheduling and update class scheduling for instructors.

In summary, the smart agents can help instructors and students find image/graphics data easily, get quick answers, and optimize class activities using intelligent techniques such as genetic algorithms. As we know, an instructor is not always available for students, so an instructor agent with basic knowledge running 24 hours a day can help students solve some problems efficiently.

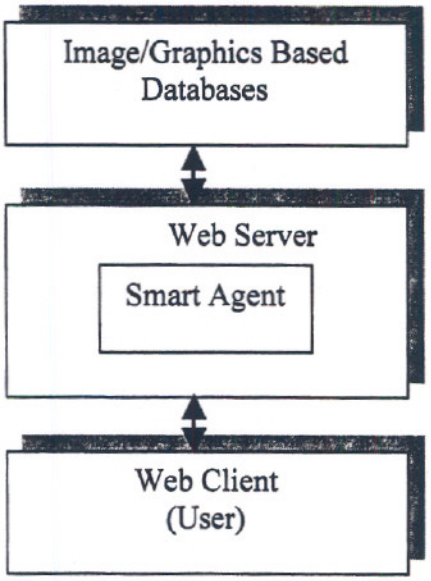


**Figure 1. System Architecture**

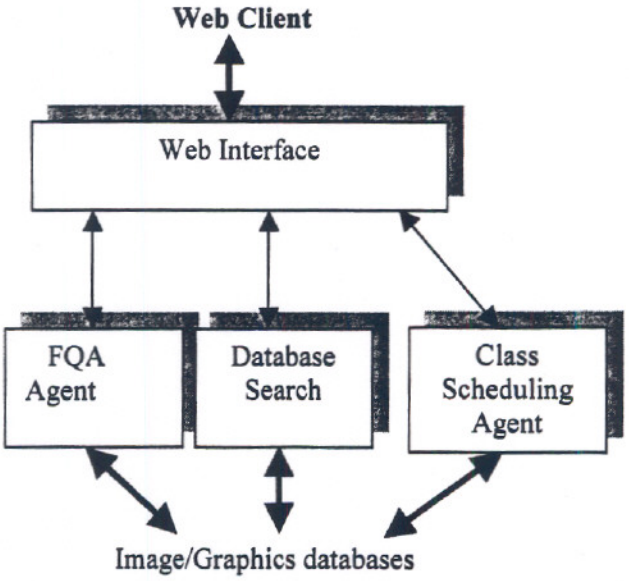


**Figure 2. Function modules of the smart agent**

## 3. DESIGN OF THE SMART AGENTS

### 3.1 Content-based Image Retrieval (CBIR)

A classification of query types into three levels of increasing complexity [6]:

***Level 1*** comprises retrieval by *primitive* features such as color, texture, shape or the spatial location of image elements. This level of retrieval uses features which are both objective, and directly derivable from the images themselves, without the need to refer to any external knowledge base.

***Level 2*** comprises retrieval by *derived* (sometimes known as *logical*) features, involving some degree of logical inference about the identity of the objects depicted in the image. It can usefully be divided further into: retrieval of objects of a given type and retrieval of individual objects or persons.

CBIR differs from classical information retrieval in that image databases are essentially unstructured, since digitized images consist purely of arrays of pixel intensities, with no inherent meaning [10]. CBIR draws many of its methods from the field of image processing and computer vision, and is regarded by some as a subset of that field [6, 10].

To optimize class scheduling, a cost function is needed to show the class scheduling performance. Different factors are needed to be taken consideration such as:

(1) balance of the three-day ( *Mon, Wed, Fri*) and the two-day ( *Tue, Thu*) schedules.
(2) classroom limitations.
(3) balance of day-time classes and evening classes.
(4) distribution of part-time students and full-time students.
(5) instructors' preferences.
(6) distances among different teaching buildings.
(7) …, etc.

Now the smart class scheduling agent can not only show text-based optimization results like numbers as usual, but also display 2D or 3D graphics-based results to make users have a better understanding of the optimization results.

The smart FAQ agent for instructors and students has the following features:

(1) searching image/graphics-based data by key words.
(2) searching image/graphics-based data by categories like different art works from different countries.
(3) answering FAQs listed on the GUI.
(4) mining image/graphics data (it's a very challenging function in the future) in a digital library to find out new useful information so as to better serve students and instructors.
(5) providing image/graphics-based on-line test databases, so students can enjoy taking such interesting tests with vivid images and graphics like playing a game, then the FAQ agent can grade the tests graphically. This way may encourage students to learn more knowledge.

## 4. CONCLUSIONS

In this paper, we design the basic architecture of a smart agent to search image/graphics based databases easily and optimize teaching activities efficiently for students and instructors. The search procedure is based on content-based image retrieval (CBIR). The major future goal is to input image/graphics data and intelligent agents into classrooms and homes to make instructors and students enjoying teaching and learning in very interesting 2D or 3D virtual teaching/learning world, and finally enhance quality of teaching and learning and produce more and more high-quality students.

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