行政院國家科學委員會補助專題研究計畫成果報告

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※ 跨國網路學習環境之建置：科學教育 ※

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計畫類別：個別型計畫

計畫編號：**NSC 90-2520-S-032-009**

執行期間：90 年 08 月 01 日至 91 年 08 月 31 日

計畫主持人：郭經華

共同主持人：衛友賢

計畫參與人員： 吳炳煌、賴銘沂、江彥廷、廖淑淩

本成果報告包括以下應繳交之附件：

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- □出席國際學術會議心得報告及發表之論文各一份
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執行單位：私立淡江大學

中 華 民 國 91 年 10 月 17 日

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一、中文摘要

在與加拿大多倫多大學 Marlene Scardamalia 教授進行的合作計畫中，我們將運用多媒體技術與網際網路進行互動式學習環境的建置，列爲研究工作之一。初期的工作係針對影像資料庫的建置，所建置之系統主要著力於個人化、語意式的影像擷取功能以及系統化的瀏覽功能等，這些功能因應教學與學習所須來思考與設計，以期對網路上建構式學習提供助益。

ABSTRACT

We present an image management system, called CanFind, for lecturing and learning. The designed web-based image management system aims to facilitate lecture and learning activity design purposes. It supports the following special features such as user personalization, semantic image retrieval, and systematic browsing. In order to provide semantic image retrieval feature, we integrate keyword extraction and keyword expansion schemes in the construction of indexing for the corresponding images. As a result, the demand images can be retrieved in the sense of abstract level. Meanwhile, images upload and sharing functions are embedded in the system. As a result users may share their personal works among users. We have implemented the above system for the online and classroom lecture and the learning activity designs at Tamkang University.

1. Introduction

Appropriate integration of multimedia in the learning process can stimulate learning interests, improve learning efficiency, and build creative learning environment [1] [2]. Today, with the increasing availability of digital images, image retrieval tools that provide an efficient means for users to navigate, browse, search, and query through them becomes highly demand for lecture design and common usage. The efforts in the last decade have lead to some results. Image management systems, e.g., QBIC [3], MARS [4] as well as commercial image retrieval web sites, e.g., Altavista [5], Google [6] are built.

The designed web-based image management system, called CanFind, aims to facilitate lecture and learning activities design purposes. It supports the following special features such as user personalization, semantic image retrieval, and systematic browsing. In order to provide semantic image retrieval feature, we integrate keyword extraction and keyword expansion schemes in the construction of indexing for the corresponding images. As a result, the demand images can be retrieved under the *semantic* level of images. Meanwhile, images upload and sharing functions are established in the system and manipulated by users. Therefore, users may share their personal works among users. This feature enhances the utilization of each image.

The designed system can be applied in many applications. We have integrated the image management system in Intelligent Web-based Interactive Language Learning (IWiLL) for lecture contents and writing activities design [7] [8]. Meanwhile, the system is used in a Basic Computer Concepts course homework assignment at Tamkang University, where students can learn cooperatively to improve their computer graphic design works. We will describe in more detail about these cases in Section 4.

The rest of the present paper is organized as follows. In section 2, we first summarized the main challenging issues in the design of image management system. The details of the designed system are presented in Section 3. Applications of the designed system are illustrated in Section 4. In section 5, we conclude our work.

2. Background

An image may contain many meanings, from the human perceptional level, the semantic object level, to the abstract level. The keyword-based approach is used in the first generation image database. The input keywords by users are compared with the annotated keywords to get the corresponding images. It is clear, the system may fail to extract the desired images if users do not provide accurate keywords in the corresponding image indexing. The second generation image database makes use of low level features of images, such as color, shape, texture, and spatial relationship as the main means for similarity comparison. User demand may be expressed through user graphic user interface. Although progresses have been made, the above approaches are not able to achieve our demands for a general-purpose image management system. In other words, at the present time, image processing technology is immature to provide a complete solution in bridging the gap between user demands and machine capability.

Research in image management design is toward an interdisciplinary effort. It is an integration of many related areas such as natural language processing, pattern recognition, computer vision, and image processing, and so on. Our work represents one of these approaches. We attempt to integrate both machine intelligence and human intelligence to develop an image management system. And this image management system is suitable to teachers or lecture designers in designing their lectures and learning activities.

3. System Overview and Design

The designed image management system consists of the following blocks, image upload and annotation, semantic indexing, retrieval subsystem, see Figure 1. The features of each block are described as follows.

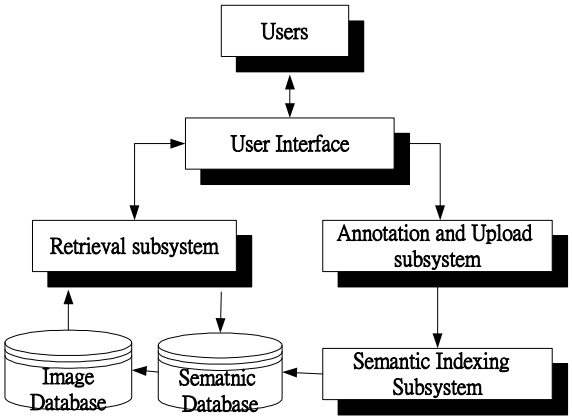

Fig. 1 The system architecture of the image subsystem, CanFind

Image annotation and upload

The user interface for image annotation and upload is shown in Figure 2 and Figure 3. In the annotation phase, users are requested to describe the image with meta data and main data [9].

The meta data includes:

Category;

Type (still or moving);

Texture; and

Color (black/white or color).

The main data consists of the following items:

Object (who, what object);

Event (what action);

Place (where);

Time (when);

Abstract description; and

Subject description.

These features are used in keyword-based search and semantic indexing. The purposes of these semantic information fields aim to establish high level concept in the image retrieval mechanism. We use these items to have users are able to express the semantic expression of the images.

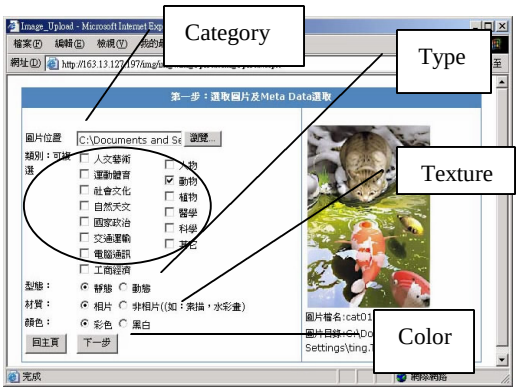

Fig 2. The interface of meta data annotation

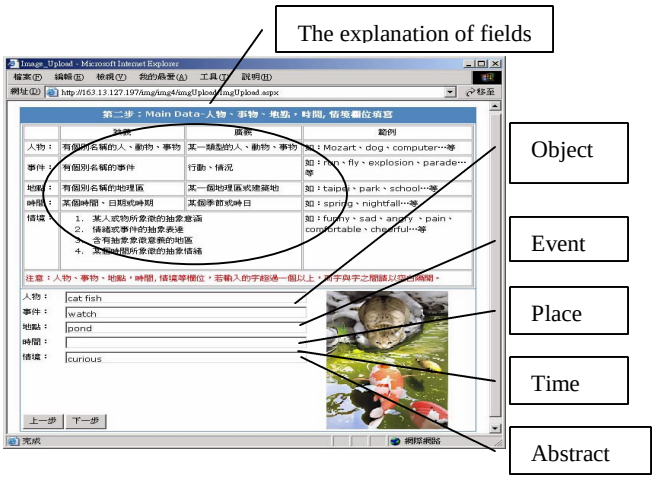

Fig3. The interface of main data annotation

Semantic Indexing

There are many ways to extract the features of the images. In order to gather high level information about the images and to use the annotated data, keyword extraction, keyword expansion, and keyword weighting mechanisms are used as the fundamental building blocks. Keyword extraction is a common task in natural language processing and text retrieval, we make use of this feature to extract the key concepts in the corresponding images. Thus, the efficiency of the retrieval can be enhanced. In

keyword expansion, we use WordNet [10], an electronic lexical database, which its design is inspired by current psycholinguistic and computational theories of human lexical memory. The versatile semantic relationship in WordNet compensates the limitation of keyword search only. It enables the system to get the semantic similarity words. Therefore, we extend the keyword sets of the corresponding image. This extension may result in too many keywords. To reduce this disadvantage, we also introduce a filtering process here. We utilize the appearance frequency of each keyword in the corpus as a decision parameter to eliminate the unusual words. In keyword weighting, the utilization appearance frequency of each word in the annotated data is used as weighting parameters. These related words indexing are established in the designed semantic database. As a result, system can present images in semantic similarity match sense. The block diagram of semantic indexing in CanFind is illustrated in Figure 4.

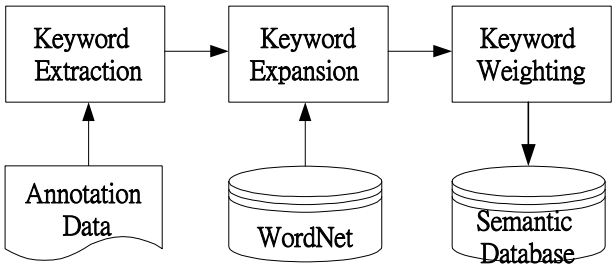

Fig 4. The system block diagram of semantic indexing

Retrieval

In order to obtain the user demand with suitable effort, the proposed image query process is shown in Figure 5. It is based on the *similarity measure* and *ranking* [11]. CanFind supports image retrieval in two stages, keyword-based searching and browsing, see Figure 6 and Figure 7. Based on user inputs, the system computes the image similarity and presents the results in the keyword-based searching. The technology used in the above stage is not able to provide a "best match of image." Therefore, some kind of human intelligence need involve. In the browsing phase, the images obtained in the first stage are not shown in the same spatial resolution. The high-ranking images are displayed in resolution higher than lower one. This facilitates users to identify target images.

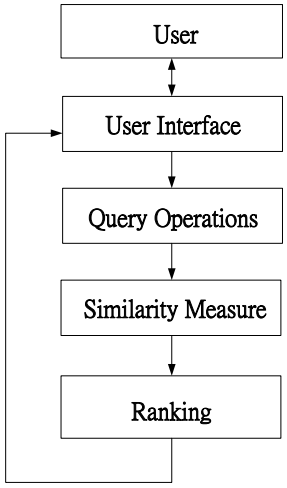

Fig 5. The system block diagram of query processing

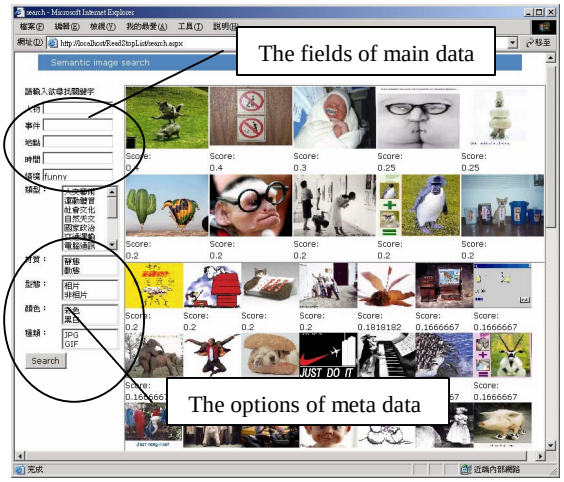

Fig 6. The interface of keyword-based searching

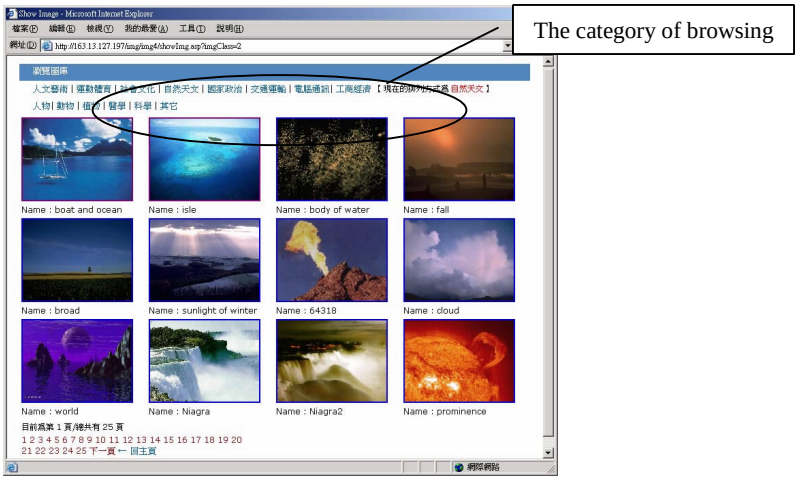

Fig 7. The interface of browsing

Sharing

The system provides mechanism to share their works or organize their personal collections. In the first setting, the shared images are managed by CanFind global image management system. In the second setting, the image collections by each individual are treated by CanFind personal image management system. Thus, each individual user can retrieval his/her preference in an efficient manner.

4. Applications

The designed image management system, CanFind, can be used in many places. We report two cases that we use this system on a web-based class learning activity and the design of active writing using images. In the first case, see Figure 8, students are asked to use an image processing software in their assignment. Students select an image and manipulate the toolsets in an image processing software to do design work. After students can submit their designs with detail descriptions of their design process and design concept by using annotation and upload subsystem. Moreover, teacher is able to correct the students' submissions online. In addition, some students' designs are selected for final open voting to select the best one. Due to each image include the detail of their design processes. The voting process helps students in learning each other and understanding the design processes of

their classmates. We have witnessed that students improve the quality of design in their second assignments.

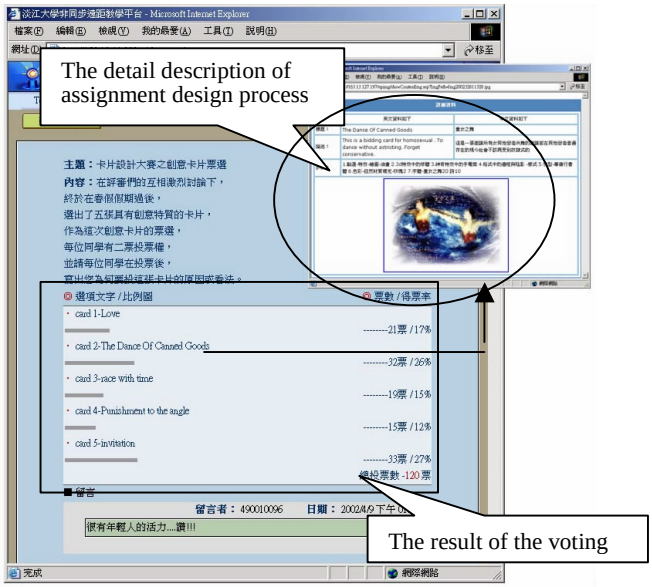

Fig 8. The voting result of student assignment

In the second case, the demand image in a learning activity design can be easily obtained by using the designed system. We integrated the image retrieval system with IWiLL. In a writing activity case, students are asked to view an image and then write an essay to describe the corresponding image. Depending on the students' language level, they are asked to write a sentence, a paragraph, or an essay. As shown in Fig. 9, students are asked to write a short article to express what he/she thinks about the corresponding image from the angle of fish or from the angle of cat. This active writing environment is designed to be an open forum. Thus, students can view the outputs from other students. They can also vote on the best writing article among peers, see Fig. 10. The display between Figure 9 and Figure 10 are hyper linked. Students are able to switch between these two figures to view the correspondence.

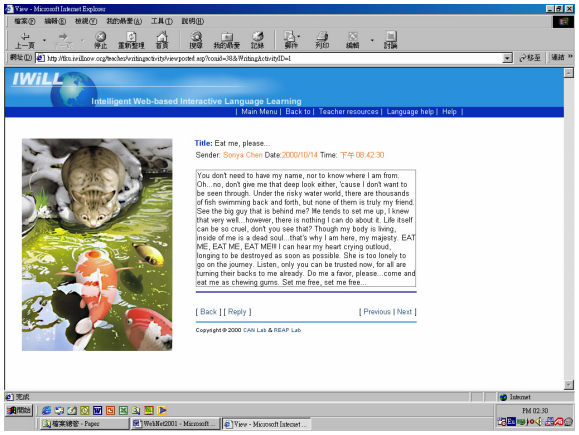

Fig 9. User interface of the active writing environment

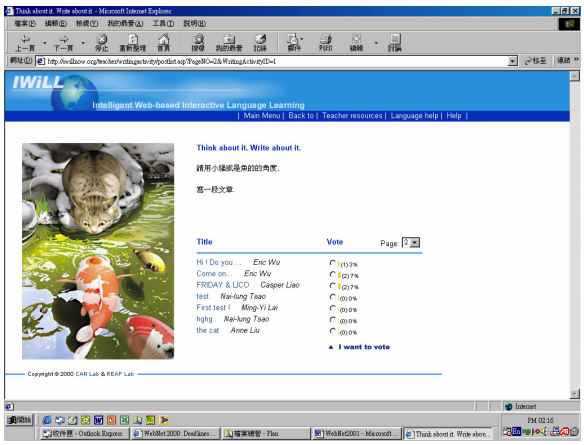

Fig 10. Voting mechanism in the active writing environment

5. Conclusions

An image may represent several meanings. The design of a general purpose image management system is not a simple issue. At the present stage, however we cannot capture the meanings of image from the low level up to the abstract level effectively. In our work, CanFind makes use of keyword extraction and keyword expansion scheme to identify images in the semantic level. The designed system does not solve all challenges in the image retrieval field, but it provides a way to users in the

design of lectures and learning activities. We report two cases of making use of such an image retrieval system to illustrate the design concept. As we have shown, it is of benefit to learning activity design and lecture design. Meanwhile, it inspires learners learning interests.

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