Designing Image Content Retrieval method
By using Color Information in SCORM LMS

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Abstract: One of the important parts of learning processing is retrieving images that are related to learning context. The SCORM uses metadata to retrieve various learning content in the e-learning environment. There are some possibilities to make metadata differently depending on individual interpretations even though the content is same because metadata is made manually. This paper proposes a new method that uses a combination of the SCORM metadata model and a content-based image retrieval method for enhancing the efficiency of retrieving image content. The proposed method can help to develop a specific area of e-learning courseware and provide more convenient and accurate image retrieval in many e-learning applications.

1. Introduction

Due to the improvement and increasing use of e-learning systems, various educational content for use in the field of e-learning environments have been developed. To provide reusability and sharing of developed educational contents, the United States Government's government has established the initiative in Advanced Distributed Learning initiative (ADL) to establish technical standards for e-learning systems. The ADL has published the Shareable Content Object Reference Model (SCORM) as technical standards for e-learning systems.

Educational content consists of multimedia data format such as text, image, animation, video, sound, audio, html, and so forth.

Learners and instructors use these formats for accomplishing learning and teaching processing.

One of the important parts of learning processing is retrieving images that are related to learning context. The SCORM uses metadata to retrieve various learning content in the e-learning environment.

Metadata is a mechanism for describing specific instances of the content of the SCORM. However, metadata is made manually. People need to see the content to create metadata. During manual processing, there are some possibilities to make metadata differently depending on individual interpretations even though the content is same. In addition, the metadata includes keywords that are made by using vocabularies. When search processing is performed, the searching processes are accomplished only based on the vocabulary meaning. This paper proposes a new method that uses a combination of the SCORM metadata model and a content-based image retrieval method for enhancing the efficiency of retrieving image content.

2. SCORM and Metadata

The SCORM is a suite of technical standards published by the US Government's initiative in Advanced Distributed Learning (ADL). The SCORM standardizes the way web-based content works with the systems that use the content. The SCORM defines a web-based learning "Content Aggregation Model" and "Run-time Environment" for learning objects. At its simplest, it is a model that references a set of interrelated technical specifications and guidelines designed to meet the high-level requirements for web-based learning content for the Department of Defense (DoD). The SCORM expects to enable below high-level requirements of the DoD [1].

• Accessibility: the ability to locate and access instructional components from a remote location and deliver them to many other locations.
• Interoperability: the ability to take instructional components developed in one location with one set of tools or platform and use them in another location with a different set of tools or platform.
• Durability: the ability to withstand technology changes without redesign, reconfiguration or recording.
• Reusability: the flexibility to incorporate instructional components in multiple applications and contexts.

SCORM consists of three parts: content aggregation model, run-time environment, and sequencing and navigation. The

content aggregation model includes metadata that are used to share content among different e-learning LMS. Metadata is a mechanism for describing specific instances of the contents of the SCORM.

The purpose of metadata is to provide a common nomenclature to describe learning resources. Metadata can be collected in catalogs as well as directly packaged with the learning resource it describes. Learning resources that are described with meta-data can be systematically searched for and retrieved for use and reuse[7]. Currently, SCORM metadata is organized into nine broad categories, some of which are optional for one or more types of resources: [2]

- General: information about the resource or content aggregation as a whole.
- Lifecycle: history and current state of the resource and those who have contributed to its development (optional for assets).
- Meta-Metadata: specific information about the metadata record itself, as opposed to the resource described by the metadata.
- Technical: technical requirements and characteristics of the resource.
- Educational: key educational or pedagogical characteristics of the resource (optional for all resource types).
- Rights: intellectual property rights and conditions for use.
- Relation: relationship between the resource and other resources (optional for all resource types).
- Annotation: comments on the educational use of the resource, generally by parties other than the original author (optional for all resource types).
- Classification: Where the resource is placed in relation to a specific taxonomy or classification scheme (optional for assets).

3. Designing a New Method for Retrieving Image Content in SCORM LMS

3.1 Overall Scheme

In this paper, the proposed new method for retrieving image content in SCORM LMS uses color features in images. Color features are very strong information to distinguish different images. The proposed method uses a histogram to extract color information from each image already filtered metadata in a SCORM e-learning environment.

The color histogram for an image is constructed by counting the number of pixels of each color. Retrieval from image repository using color histograms has been investigated in tools automatically. One query image is used to retrieve similar images.
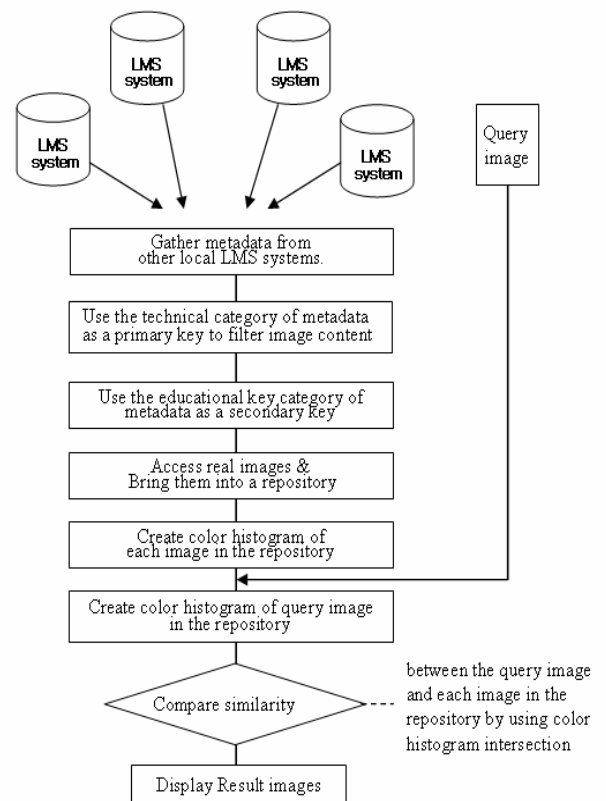
Following [Picture 1] shows overall processing
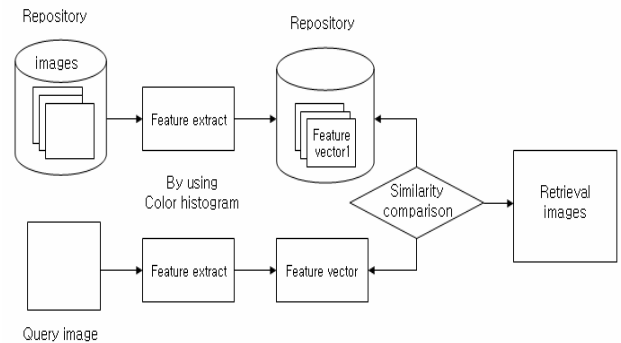
[Picture 1] Overall processing for image retrieval

3.2 Designing a new image retrieval method

The flow of the experiment in [Figure 1] follows the procedure of the general image retrieval system .

[Figure 1] Detail procedure for image retrieval

3.2.1 Color Space

To get color histogram, this study selected R,G, B color space. A color space is defined as a model for representing color in terms of intensity values [3]. The RGB model forms its gamut from the primary additive colors of red, green and blue. When red, green and blue light is combined it forms white. Computers generally display RGB using 24-bit color. In the 24-bit RGB color model there are 256 variations for each of the additive colors of red, green and blue. Therefore there are 16,777,216 possible colors (256 reds x 256 greens x 256 blues) in the 24-bit RGB color model.

In the RGB color model, colors are represented by varying intensities of red, green and blue light. The intensity of each of the red, green and blue components are represented on a scale from 0 to 255 with 0 being the least to. Following RGB color model shows each red, green, and blue intensity.
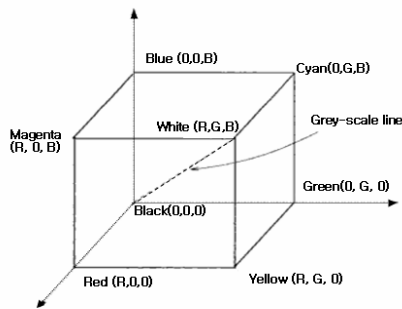
[Picture 2] RGB color model [5]

3.2.2 Color Histogram

Smith and Chang denoted a color histogram as the joint probabilities of the intensities of the three color channels [4]. According to them, the color histogram for R,G,B color space is defined as

$$h_{R,G,B}[r,g,b] = N (\text{Prob}\{R = r, G = g, B = b\}) \quad (1)$$

Where R, G and B are the three color channels and N is the number of pixels in the image.

3.2.3 Histogram intersection distance

In this study, Swain and Ballard's color histogram intersection[6] was used for color image retrieval. The intersection of histograms h and g is given by:

$$d(h,g) = \frac{\sum_A \sum_B \sum_C \min(h(a,b,c), g(a,b,c))}{\min(|h|,|g|)} \quad (2)$$

where $|h|$ and $|g|$ gives the magnitude of each histogram, which is equal to the number of samples. where a, b and c represent the value of the r, g, b color channels.

3.2.4 Procedure of image retrieval

Gather metadata from other local LMS systems
This study is designed based on a SCORM system. The basic search method was using metadata in the initial stage.

Use the technical category of metadata
As a primary key to filter image content. This study's purpose is retrieving image content in the SCORM system. However, a SCORM system has many different types of multimedia data. Technical category of metadata has information of the data type and format. Using the technical category, the system can filter image content from LMS systems.

Use the educational key category of metadata
As a secondary key to filter images more narrowly. The purpose of designed system is to use educational e-learning system based SCORM. To provide more narrow range of retrieving, the system uses the educational key category of metadata.

Access real images & Bring the images into a repository
Images that are filtered above two keys are needed to bring a repository to create color information. To get the images located in different positions, location information in the technical category is used. Bring retrieved images from the different positions and save the images to a repository.

Create color histogram
Creat color histogram of each image in the repository and color histogram of a query image.

Compare similarity
It is needed to compare similarity to select most similar images from the repository. To compare similarity between the query image and each image in the repository, the color histogram intersection is calculated

Display retrieval images
Display retrieval images that are most similar to the query image.

4. Conclusion

When learners learn in e-learning environments or instructors design instructional courseware, they may wish to search for specific image data. For example, learners learn about the human heart in a science class. At that time if e-learning system provides one heart image. If a learner wants to see more heart images, the e-learning system should provide other

related images. In another example, an art instructor is designing one e-learning course to teach patterns. The instructor has one pattern image and wants to find other similar patterns from other e-learning environments. It is more efficient to use the proposed retrieval method that combines SCORM metadata and color information.

The proposed method can help to develop a specific area of e-learning courseware and provide more convenient and accurate image retrieval in many e-learning applications.

The study just suggested a new method for image retrieving in SCORM LMS. The proposed method should be implemented in the future. The image retrieval effectiveness also will be evaluated by comparing the retrieval results of the current metadata retrieval method.

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