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Interactive remote image retrieval platform design for physical education

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ABSTRACT: As an important aspect of the measure of people's living standards, the sports industry and education should be adapted to the developments in the modern information society. With the rapid development of multimedia technology, image retrieval has become an area of growth and it is of particular relevance and interest to the sports industry and education. Provided in this article is an overview of digital image retrieval, based on content. More specifically, the author focuses on the design of an interactive remote image retrieval platform for college physical education and describes it in detail.

INTRODUCTION

The rapid development of multimedia technology underpinned by computer and network performance has characterised an evolution, from textural displays to graphics, images, animation, video and other forms. In many government departments, business organisations, research institutions and hospitals, digital image and video data are needed and frequently used. An urgent problem in the information age is how to effectively express, organise, manage, query and retrieve these massive data resources.

This demonstration teaching using images is a new form of on-line teaching that integrates multimedia, communications and computer image technology [1]. In traditional teaching, resources such as textbooks and laboratory equipment are relatively fixed, and a single, centralised teaching method is used. Therefore, education is not tailored to the individual. On-line education, by comparison, makes teaching resources available anytime and anywhere; it also maximises the sharing of resources and allows students to learn when and where it suits them and, hence, to achieve personalised learning.

DESIGN OF CONTENT- BASED IMAGE RETRIEVAL

Processing Overview

Content-based image retrieval (CBIR) refers to the integrated software and hardware system used to retrieve images based on characteristics of the images. Comprehensive functions include the image operations, management, maintenance, and others [2]. Image features that can be extracted include colour, shape, texture and semantic characteristics. As well, contrasts and similarities between a retrieved image and images in the database can be determined. The typical structure of a CBIR system and the functions are shown in Figure 1.

The processing carried out to retrieve the images similar to a submitted image using the CBIR system is shown in the following four steps [3]:

Step 1: The query image is submitted by the user.

Step 2: The image is analysed to extract the set of defining features - the result is referred to as the feature vector.

Step 3: Matching images in the image database are determined using similarity measurement criteria, which can include colour, shape and texture, as well as semantic content, e.g. time, location.

Step 4: The retrieval result is output in similarity order.

The colour and shape of the image, as well as the feature of texture has relatively intuitive characteristics; the semantic content has relatively subjective and abstract characteristics [3].

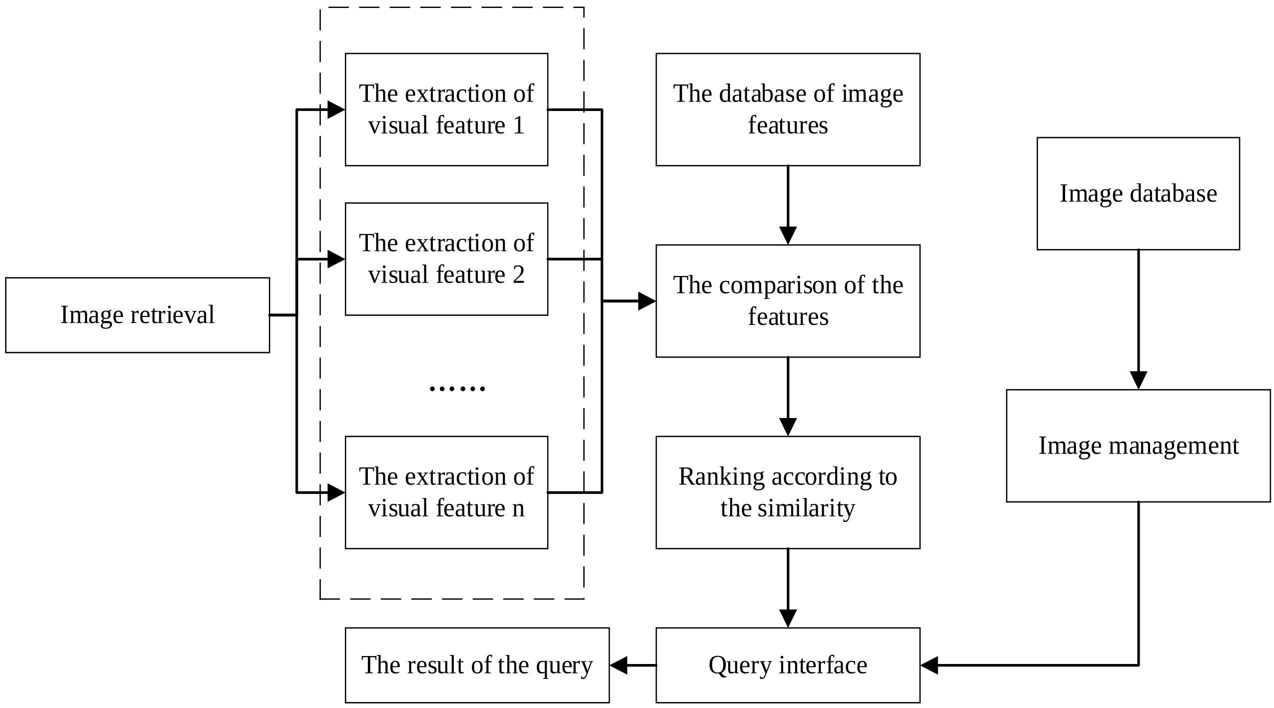

Figure 1: Structure of a CBIR system.

Querying semantic content is precise, but the semantic content may not be known to the issuer of the query, whereas querying on visual features produces a result that can be easily appraised.

Technology Used for the CBIR System

The work reported in this article made use of the following technology: SttImageRetrieval, Visual C++ and Oracle9i, using ADO technology to access the database. This system must run on Microsoft's Windows 7 operating system, the hardware environment has Celeron2.66GCPU and 512MB memory is required.

Modules of the CBIR System

The function of the management module is to maintain the database data. The data for an image consists of three parts; namely, the original image, the features of the image and other information. The function of the retrieval module is to support various methods of inquiry according to the specific requirements of different users. This system uses an example query, which provides a wide range of inquiry options. Users can combine query options to produce complex specific queries.

MULTIMEDIA IMAGE DEMONSTRATION TEACHING

An image demonstration teaching platform helps communication between teachers and students during physical education. One of the features of multimedia image demonstration teaching is the use of real-time communication technology. A multimedia image demonstration teaching platform provides a most powerful information resource-sharing function. Timely communication between teachers and students is conducive to the smooth conduct of physical education. In traditional physical education, teachers teach students in class and communication between teachers and students is restricted because of the large number of students.

By comparison, multimedia image demonstration teaching enables students to interact with teachers on-line. Support of multimedia image demonstration teaching technology can allows students to interact with teachers on-line. Further, multimedia image demonstration teaching allows students and teachers to achieve remote *face-to-face* communication.

Thus interaction between students and teachers is improved, as well as teaching standards and efficiency. Table 1 shows the interaction of teachers and students based on the traditional sports teaching mode, as well as a comparison using multimedia image demonstration teaching [4].

Table 1: Comparison of traditional with multimedia image demonstration teaching.

Teaching mode	Communication between teachers and students	Relationship between teachers and students
Traditional	Directly, face to face	One-to-many
Image demonstration	Indirectly	Many-to-many

Multimedia Image Demonstration Teaching: Sharing and Optimisation

Multimedia image demonstration teaching helps to realise the sharing and optimising of college physical education information resources. In fact, a multimedia image demonstration teaching platform provides a large database for college physical education, which is innovative for college physical education information resource sharing and optimisation [5][6].

The database for college physical education will include resources from schools, institutes and libraries from around the world. The type of material covered will include physical education news, sports education statistics and research papers. Also available on the Internet are teaching materials, as well as methods, and material on conducting on-line sports education that includes, such things as visits, the use of laboratories, and so on. This caters for individual choices from among the sharing of resources [7].

THE REALISATION OF A DIGITAL IMAGE RETRIEVAL SYSTEM

Representations of Colour

The colour of the image can be expressed in a variety of ways. The HSV (hue, saturation and value) model can be represented by a three-dimensional co-ordinate system. The RGB (red. green and blue) model represents a colour as a weighted mixing of the three primary colours - the weightings are the co-ordinates in the RGB *space*.

Conversion Algorithm between RGB and HSV Colour Models

The conversion algorithm is shown below. Define the RGB colour space with colour value *(r, g, b)* with $r, g, b \in [0, 255]$, then, the value of h, s, v in the HSV space can be calculated using the following formulae:

$$v' = max(r, g, b)$$

$$v = v' / 255$$

$$s = \frac{v' - min(r, g, b)}{v'}$$

$$h' = \begin{cases} (5 + b'), \text{ if } r = max(r,g,b) \text{ and } g = min(r,g,b) \\ (1 - g'), \text{ if } r = max(r,g,b) \text{ and } g \neq min(r,g,b) \\ (1 + r'), \text{ if } r = max(r,g,b) \text{ and } b = min(r,g,b) \\ (3 - b'), \text{if } g = max(r,g,b) \text{ and } b \neq min(r,g,b) \\ (3 + g'), \text{if } b = max(r,g,b) \text{ and } r = min(r,g,b) \\ (5 - r'), \text{otherwise} \end{cases}$$

$$h = 60 \times h'$$

r', g', b' are defined as:

$$r' = \frac{v' - r}{v' - min(r, g, b)}, \; g' = \frac{v' - g}{v' - min(r,g,b)}, b' = \frac{v' - b}{v' - min(r,g,b)}$$

Here $r,g,b \in [0,255]$, $h \in [0,360]$, $s \in [0,1]$, $v \in [0,1]$.

Realisation of Colour Features

An image storage system will calculate and store the colour distribution of the image. This colour distribution can be used in determining the similarity of an image to another image.

The specific algorithm is as follows:

Step 1: Image pre-processing: first, image format can be converted into 256 by 256 pixels. The HSV model is used to quantify the colour in regions of the image by assigning weights to the H, S and V components.

Step 2: The image is divided into nine, labelled regions.

Step 3: The colour distribution is calculated for the nine regions, i.e. $(E_i, \sigma_i, S_i), 1 \le i \le 9$.

Step 4: Calculate the degree of similarity between the images by:

$$D(Q,I) = \sum_i W_i \left[W_E \left| E_I^Q - E_i^I \right| + W_\sigma \left| \sigma_i^Q - \sigma_i^I \right| + W_S \left| S_i^Q - S_i^I \right| \right]$$

$i \in [l, 9], W_i, 1 \le i \le 9$ represent the weights for each region.

Realisation of Shape Features

Shape is an important feature of an image, but the perception of shape is highly subjective.

The image retrieval steps to extract shape are as follows:

Step 1: Extract edges, to determine the shape and contour of the targeted object in the image.

Step 2: Surround the targeted area by the contour line.

Step 3: Calculate the invariant moment of the targeted region, as well as the feature vector describing the shape of the image.

Step 4: Normalise the feature vector of the shape and store in the database.

Step 5: Having similarity matching, the Euclidean distance of the two graphs' normalised eigenvectors is the similarity degree of two images. Assuming that the normalised eigenvectors of the two graphs are $(h_1^I, h_2^I, \cdots, h_7^i)$ and $(h_1^q, h_2^q, \cdots h_7^q)$; then, the Euclidian distance is the similarity of the two image shapes:

$$S_{im}(Q,I) = \sqrt{\sum_{i=1}^{n} (h_i^q - h_i^I)^2}$$

CONCLUSION

A university image demonstration learning system promotes learning autonomy and collaboration. It provides students with rich sports-learning resources, and allows them to learn independently where and when they wish to. Standardisation of the image demonstration system should further improve the quality and efficiency of physical education.

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