Pattern Keys Investigation for Content-Based Image Retrieval System

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Abstract – An approach to search images from a database by structural features got from the three stages clustering algorithm is considered. Image key forming investigation for visual pattern processing is presented.

Keywords – clustering, content-based image retrieval, structural properties, visual pattern.

I. INTRODUCTION

The existent universal content-based image retrieval (CBIR) systems attribute to one of three categories depending on approach of extracting features: a histogram, coloured location, and region-based. A successful categorization of images will greatly enhance the performance of CBIR systems through filtering out images from irrelevant classes during matching.

II. CBIR PROBLEM

In general, the content-based image retrieval problem is to create a image set that are relevant to the user’s image-request, arranged in order of decreasing relevance, and the need to choose the optimum between the minimization and maximization of relevance images [1, 2].

We describe a mathematical model of the image search and introduce some basic concepts:

1. The set $P$ of all images in a database, consisting of $n$ images classes:

   $$ P = \{P_1, P_2, ..., P_n\} = \{\{p_{11}, p_{12}, ..., p_{1n}\}, \{p_{21}, p_{22}, ..., p_{2n}\}, ..., \{p_{n1}, p_{n2}, ..., p_{nn}\}\} \quad (1) $$

2. $I$ set with corresponding images indices:

   $$ I = \{I_1, I_2, ..., I_n\} = \{\{i_{11}, i_{12}, ..., i_{1n}\}, ..., \{i_{n1}, i_{n2}, ..., i_{nn}\}\} \quad (2) $$

Each index represents a set with image keys number $g$, where each key is a set of $r$ image features:

   $$ i = \{i^1, ..., i^g\} = \{\{k_1^1, k_1^2, ..., k_1^r\}, ..., \{k_g^1, k_g^2, ..., k_g^r\}\} \quad (3) $$

3. Input user’s image-query $p_u$, belongs to a $P_u$ class:

   An optimization problem is to find images set $P_{res}$ by the user’s image query $p_u$:

   $$ P_{res}(p_u) = \{\{p_{11}(i_1), ..., p_{1n}(i_1)\}, ..., \{p_{n1}(i_1), ..., p_{nn}(i_1)\}\} \quad (4) $$

that satisfies the following conditions:

   - $d(i_u(p_u),i(p)) \rightarrow \text{min}$, $f(P_{res},P) \rightarrow \text{max}$, $p \in P$, $i \in I$, \quad (5)

   - $d(i_u(p_u),i(p)) \rightarrow \text{min}$, $q, s \rightarrow \text{max}$, $i \rightarrow \text{min}$, \quad (6)

where: $d$ – a distance function between the key features of an image query $p_u$ and image $p$ in the database; $f$ – a similarity function (relevance) of classes $P_1$, ..., $P_n$ result set on the $P_{res}$-class image query $p_u$; $v$ – number of resulting classes image; $q, s$ – the number of images in each result class; $t$ – the receipt time of the result set; $p(i)$ (or $P(I)$) – in general, means of obtaining $p$ (or image group $P$) from the database by an index $i$ (group index $I$); $i(P)$ (or $I(P)$) – generally means getting index $i$ (or building new if absence in the repository indexes) (group index $I$) for the image $p$ (image group $P$).

III. PATTERN KEYS INVESTIGATION

For image indexing investigation a set $A$ with $3 \times 8 = 24$ pattern features and set $B$ with $3 \times 8 + 2 = 26$ pattern features were took:

   $$ A = A\{BI_{CR}(C, XY), BI_{CR}(CR, XY), BI_{CR}(IA, XY)\} \quad (7) $$

   $$ B = B\{CR, IA, C_{d}(XY), CR_{d}(XY), IA_{d}(XY)\} \quad (8) $$

Fig.1 illustrates classification result for 3 semantic groups: dinosaurs, flowers, busses and animals (lions + elephants).

IV. CONCLUSION

An approach to solving content-based image retrieval problem using 4-D structural features obtained as a clustering result, allowing comparison with other approaches to improve the search images quality is developed.

New three-stages clustering algorithm based on the classical hierarchical agglomerative algorithm, which unlike the know methods, is adaptive to the characteristic images features when looking at database is designed and developed.

REFERENCES
