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ANALYSIS OF EXISTING METHODS OF SEARCHING IMAGES IN DATABASES

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The difficulty of solving recognition problems is primarily related to a person's perception of the world around him. Geometric distortions, changes in brightness, local and background noise are some of the most common problems of perception. Calculating the features that allow you to search for images in databases is an unresolved issue [1-3].

Contrary to fairly effective methods of solving recognition problems, to date there is no universal method; there are a large number of solutions for individual classes of images in a given area [4, 5]. Thus, the tasks of recognition at the present stage are solved only locally and remain relevant.

Many methods have been developed to solve the problem of searching for images in databases, but those based on the features of the image itself, such as finding special points and their numerical description, have become widespread [6-8]. Based only on the collection of such data in digital format, you can allow your computer to work with visual images like a human.

Images and information about the object (name, creation date, and description) are entered into the database, and the SQL query language is used to search and view the data, which allows you to search and sort the results according to certain criteria. Search engines mainly use the method of textual description of images by a human operator [9] (in which the query is given by keywords and thus reduces to the task of searching databases containing text, the disadvantages of this method are the growing amount of multimedia data which makes it almost impossible operator description of all recorded data) and Chang's method [10] (based on the description for indexing and structuring the contents of video databases from the image content itself, the content is a set of visual features drawn from the image), where the query in a certain space of signs on a given degree of similarity.

The variety of applications, user goals, and query methods determine the architecture of a content search engine. Attempts have been made to classify systems according to these criteria. Thus, it was proposed to divide the sources of video data archives into subject-oriented and universal areas. The subject-oriented area is characterized by restrictions and a similar set of data belonging to a particular subject area, as well as minor changes in the conditions of image registration, which makes it possible to obtain a characteristic description of images [11-14].

Image collections from the subject-oriented area include medical and satellite images, scanned fingerprints, trademarks, and more. Video data archives from universal areas are characterized by thematic interpretation of images obtained, perhaps, in terms of geometric parametric distortions, under different lighting conditions and interference. Choosing an

adequate feature space and degree of similarity to “understand” images is an extremely difficult task [15]. For example, the following can be used to query: sample image (search is performed across the field of view of the image or by areas of interest, in most cases the query image must be provided by the user or can be selected from an ensemble of cluster images); sketch (the user, using the service graphic editor, gives priority-sketch of the query object based on the shape of objects, color characteristics and their spatial location), numerical characteristics of low-level features, where the user specifies visual primitives that must contain images; keywords (limited to WEB video data collections that take into account media tags that frame media resources with descriptions (such as Google and AltaVista search engines) and database annotation systems) and combined (based on query combination sample image with keywords). There are three types of search [16]:

- Search for an association in which the user has no clear goal at the beginning of the search, except to find interesting images, the search consists of queries that allow you to view the contents of the database, the system itself must contain feedback elements, the search goal is set by sketch, image -sample or keywords, and the result of the query is a family of images sorted by relevance to the object of the query, or a hierarchy of images presented as a tree;

- Search by category, the user's goal is to find the desired image class with subsequent navigation in its content, the search system of this type must be interactive, the query is given by one or more images, keywords, or sketches, and the search result is organized and visualized in clusters, ideally corresponding to conceptual classes of images;

- Targeted search, when the user has a clear idea of the purpose of the search, the query is given by image-prototype. The search is carried out either in the collections of subject-oriented areas or in the archives of universal areas, in order to find duplicates. Systems of this type can control the choice of characteristic descriptions and similarity measures and have additional capabilities to explain search results, for example, to visualize the numerical characteristics of similarity.

There is a special standard for the description of multimedia data – MPEG, which uses an extended version of XML and consists of the following basic elements: feature descriptor, description scheme and definition description language, MPEG-7 descriptors – sets of low-level features that characterize color, texture, and shape [7].

To increase the degree of “understanding” of images when searching, it is better to use local characteristic descriptions [1]. This need is underlined by the fact that images contain several objects that differ significantly from each other in visual content, in this case, comparing images with global features can lead to gross errors, and thus a very important step in overcoming semantic break is the ability of the search engine to perform queries at the object level.

Analysis of modern search engines and review articles show that the JSEG algorithm and graph segmentation method is more often used [17]. The visual description of any image in this case consists of a set of local characteristic descriptions, color, outline, etc. Features of color are often considered: dominant color, moments, histogram, wavelets, and textures – Gabor filter.

Existing approaches to comparing feature descriptions of a set of domains are divided into an independent search for the largest match (for each query image area, the most similar image area is searched from the database, the total value of similarity is determined by the weighted sum of the obtained values) and the comparison “one-to-one”.

A “one-to-one” comparison differs from an independent search for the greatest match in that it does not allow multiple “linking” areas. The order of selection of areas is determined by their size and relative location. This approach is implemented in Windsurf, Cortina, and Istorama systems. But the scope of “one-to-one” comparison methods is limited to image collections for which there are highly efficient segmentation algorithms; “many-to-many” comparison reduces the dependence of comparison on the quality of segmentation algorithms, and more specifically on the level of detail [8-10].

A common trend for image retrieval methods in databases is the desire to eliminate semantic conflict, which leads to increasing computational complexity of image processing methods and distance calculation operations, so, the operation of comparing images at the regional level using EMD metrics, which requires solving the transport problem, several orders of magnitude more time-consuming than the operation of calculating the Euclidean distance between two global feature descriptions. Therefore, when creating an efficient index structure for databases containing images, it is necessary to focus on methods that provide the least number of distance calculation operations.

Therefore, image search engines are required to exclude as many objects as possible to allow for interactive viewing and refinement. Metric indexing methods are a more promising approach to reducing the number of distance calculation operations at the stage of query execution in comparison with the methods of spatial indexing [1].

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