

Content-Based Image Retrieval Based on Error Diffusion Block Truncation Coding

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ABSTRACT:

This paper presents a new approach to index color images using the features extracted from the error diffusion block truncation coding (EDBTC). The EDBTC produces two color quantizes and a bitmap image, which is further processed using vector quantization (VQ) to generate the image feature descriptor. Herein two features are introduced, namely, color histogram feature (CHF) and bit pattern histogram feature (BHF), to measure the similarity between a query image and the target image in database. The CHF and BHF are computed from the VQ-indexed color quantize and VQ-indexed bitmap image, respectively. The distance computed from CHF and BHF can be utilized to measure the similarity between two images. As documented in the experimental result, the proposed indexing method outperforms the former block truncation coding based image indexing and the other existing image retrieval schemes with natural and textural data sets. Thus, the proposed EDBTC is not only examined with good capability for image compression but also offers an effective way to index images for the content-based image retrieval system.

Keywords: *CBIR, EDBTC, GLCM*

I.INTRODUCTION

Block Truncation Coding was presented by Delp and Mitchell in 1979. The image is divided into non-overlapped blocks, by the algorithm, each pixel in a block is substituted by its high mean or low mean. This results in a simple and efficient image compression algorithm. The BTC has a very limited compression ratio; hence the quality of image decreases rapidly on the compression ratio being increased. Many new methods are being addressed in the literature to improve the computational complexity, compression ratio, and image quality of the BTC. Digital Halftoning is the technology of converting a continuous tone image into a two tone image. A continuous tone image and a halftoning image are very similar that exploits the lowpass nature of the Human Visual System (HVS) and is as perceived by an image capturing device. There are various types of halftoning techniques, [1] including ordered dithering, error diffusion, iteration-based, and dot diffusion. Considering these techniques the ordered dithering provides good image quality and lowest computational complexity Image Retrieval Systems are employed on image collection in an image database. Image Retrieval Systems will retrieve a set of images that meets the user demand. That is Image Retrieval Systems must employ an efficient way to Access, Browse, Retrieve similar images in real time. The basic idea is to use metadata on an image like Captioning, Keywords, and Descriptions. Image Retrieval Systems is based on annotation words like text based used by Google Inc, Attribute based Image Retrieval Systems developed in SQL. The downside of these Image Retrieval Systems is its Laborious, Time consuming, Expensive. Content Based Image Retrieval system uses computer vision techniques to the image retrieval problem that is searching for digital images in large image databases. Content-based means the search analyzes the contents of the image predominantly color, shape, texture, edge pattern, contour or

any other potential detail derived from the candidate image. Content-Based Image Retrieval on compressed images in a database is the need of the hour. The basic objective of any Image compression technique is to represent an image with a smaller number of bits without the degradation of the visual quality of decomposed image. The image compression techniques are classified into two broad categories, the Lossy compression technique, and Loss-less compression technique. In lossless compression, there is no difference between the reconstructed image and original image at each pixel. But in lossy compression, the reconstructed image contains degradations relative to the original image. The quality of compressed image is better in lossless compression techniques is compromised on the compression ratio which is less whereas lossy compression techniques provide only acceptable image quality with Fig .Ihigher compression ratio. Block Truncation Coding is a lossy image compression technique.

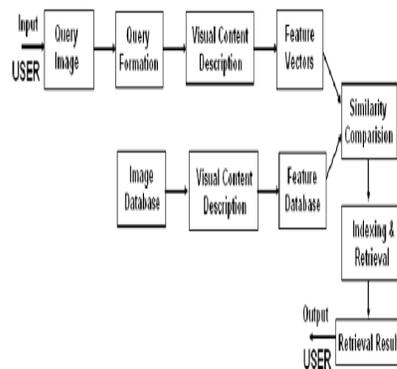


Fig 1. Block diagram of CBIR system

DIRECT BINARY SEARCH BLOCK TRUNCATION CODING

The Human-visual-system Peak Single-to-Noise Ratio (HPSNR) is employed in this study for image quality estimation. The previous extreme values, maximum and minimum in each block, used in halftoning-based BTCs [2] induce unpleasant impulse noises. In addition, the blocking effect and false contour are somewhat enhanced with these extreme values. To solve this problem, the extreme values should be adaptively scaled with a parameter α . Many indices have been tested, and it is found that the entropy (E) defined below, correlates to the parameter α .

$$E = -\sum_i \text{Log}(p_i) \times p_i \quad (1)$$

Pi denotes the occurrence probability of the ithe symbol, the grayscale value from 0 to 255. The Entropy E reflects the fluctuations in a sub-image. The parameter α can be considered as a function of entropy, as denoted $\alpha(E)$.

II. LITERATURE REVIEW:

The desired image in the huge image database. The CBIR employs the image features of visual content to represent and index the image in the database. These features can be color, texture, shape, etc. The feature choice depends on the user's preference or is decided by the expertsystem.fig 2. Shows flow chart of the system.

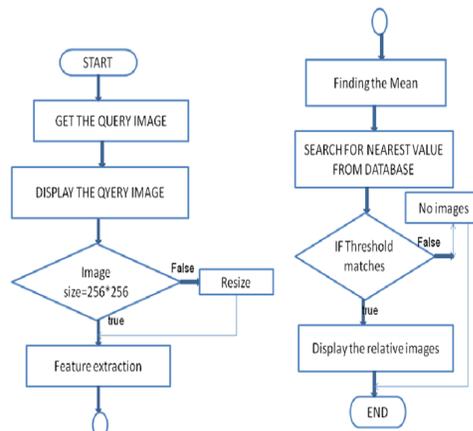


Fig 2. Working process of CBIR

Finding a single best representative feature of an image is very difficult because of the fact that the photographer may take several images under different conditions such as different lighting sources, various view angles, different illumination changes, etc. fig 2. Developing an effective and efficient image feature descriptor becomes a challenging task for CBIR system to achieve a high image retrieval performance. Many attempts and researches have been devoted to improving the retrieval accuracy in the CBIR system. One of these efforts is employing an image feature descriptor derived from the compressed data stream for CBIR task. As opposite to the classical approaches which extract an image descriptor from the original image, this image retrieval scheme directly generates image feature from the compressed data stream without firstly performing the decoding process. This type of image retrieval aims at reducing the computation time in feature extraction/generation since most of the multimedia contents and images are already converted into the compressed format before they are recorded in any storage devices. A new CBIR system has been propose in which the image feature descriptor is simply derived from the compressed data stream. This new approach indexes the color images using the feature descriptor extracted from the Error-Diffusion Block Truncation Coding (EDBTC). The EDBTC is an improved version of Block Truncation Coding (BTC) [2] which is an efficient image compression technique. The EDBTC has been demonstrated to yield a promising result on several image processing applications such as image compression, image watermarking, inverse halftoning, data hiding [5],[6],[7], image security, halftone image classification, CBIR system, etc [3],[8]. The EDBTC produces two color quantizers and a single bitmap image on the encoding stage. In the CBIR system, an image feature descriptor is directly derived from the EDBTC color quantizers and bitmap image in the compressed domain by involving the Vector Quantization (VQ). The two features are generated by the CBIR system, namely Color Histogram Feature (CHF) and Bit Pattern Histogram Feature (BHF), to measure the similarity criterion between a query image and a set target images stored in the database. The CHF and BHF are computed from the VQ-indexed color quantizer and VQ-indexed bitmap image, respectively. The similarity distance computed from CHF and BHF can be further utilized for performing the similarity matching between two images. As reported in, the image retrieval with EDBTC feature offers lower feature dimensionality compared to the former BTC-based image retrieval scheme, and at the same time, outperforms the former BTC-based CBIR system. The image retrieval system with EDBTC feature also performs better compared to the former competing schemes on natural and textural images. Triggered by efficiency and successfulness of the image retrieval system using EDBTC feature, we propose to develop a new way to further improve the EDBTC image retrieval performance for this book chapter. Some extensions for the EDBTC image retrieval system proposed for this book chapter can be highlighted as follows: 1) extending the EDBTC image feature descriptor for the other color space, 2) proposing a new feature descriptor by combining the two color quantizer to further reduce the feature dimensionality, 3) investigating the effect of different similarity distance for overall image retrieval performance, 4) examining suitable similarity weighting constants to achieve the highest image retrieval performance, and 5) performing image retrieval and classification over various natural and textural image databases in the grayscale and color space.

III.METHODOLOGY

An image retrieval system is a computer system for browsing, searching and retrieving images from a large database of digital images. Most traditional and common methods of image retrieval utilize some method of adding metadata such as captioning, keywords, or descriptions to the images so that retrieval can be performed over the annotation words. Manual image annotation is time-consuming, laborious and expensive; to address this, there has been a large amount of research done on automatic image annotation. Additionally, the increase in social web applications and the semantic web have inspired the development of several web-based image annotation tools.

The first microcomputer-based image database retrieval system was developed at MIT, in the 1980s, by BanireddyPrasaad, Amar Gupta, Hoo-min Toong, and Stuart Madnick.

A.SEARCH METHODS

Image search is a specialized data search used to find images. To search for images, a user may provide query terms such as keyword, image file/link, or click on some image, and the system will return images "similar" to the query. The similarity used for search criteria could be meta tags, color distribution in images, region/shape attributes, etc.

- Image meta search - search of images based on associated metadata such as keywords, text, etc.
- Content-based image retrieval (CBIR) – the application of computer vision to the image retrieval. CBIR aims at avoiding the use of textual descriptions and instead retrieves images based on similarities in their contents (textures, colors, shapes etc.) to a user-supplied query image or user-specified image features.
- List of CBIR Engines - list of engines which search for images based image visual content such as color, texture, shape/object, etc.

Data Scope

It is crucial to understand the scope and nature of image data in order to determine the complexity of image search system design. The design is also largely influenced by factors such as the diversity of user-base and expected user traffic for a search system. Along with this dimension, search data can be classified into the following categories:

- Archives - usually contain large volumes of structured or semi-structured homogeneous data pertaining to specific topics.
- Domain-Specific Collection - this is a homogeneous collection providing access to controlled users with very specific objectives. Examples of such a collection are biomedical and satellite image databases.
- Enterprise Collection - a heterogeneous collection of images that is accessible to users within an organization's intranet. Pictures may be stored in many different locations.
- Personal Collection - usually consists of a largely homogeneous collection and is generally small in size, accessible primarily to its owner, and usually stored on a local storage media.
- Web - World Wide Web images are accessible to everyone with an Internet connection. These image collections are semi-structured, non-homogeneous and massive in volume, and are usually stored in large disk arrays.

B.CONTENT-BASED IMAGE RETRIEVAL

Content-based image retrieval (CBIR), also known as query by image content (QBIC) and content-based visual information retrieval (CBVIR) is the application of computer vision techniques to the image retrieval

problem, that is, the problem of searching for digital images in large databases. (see this survey for a recent scientific overview of the CBIR field)

"Content-based" means that the search will analyze the actual contents of the image rather than the metadata such as keywords, tags, and/or descriptions associated with the image. The term 'content' in this context might refer to colors, shapes, textures, or any other information that can be derived from the image itself. CBIR is desirable because most web-based image search engines rely purely on metadata and this produces a lot of garbage in the results. Also having humans manually enter keywords for images in a large database can be inefficient, expensive and may not capture every keyword that describes the image. Thus a system that can filter images based on their content would provide better indexing and return more accurate results.

The term Content-Based Image Retrieval (CBIR) seems to have originated in 1992 when it was used by T. Kato to describe experiments into automatic retrieval of images from a database, based on the colors and shapes present. Since then, the term has been used to describe the process of retrieving desired images from a large collection on the basis of syntactical image features. The techniques, tools, and algorithms that are used originate from fields such as statistics, pattern recognition, signal processing, and computer vision.

Technical progress

There is a growing interest in CBIR because of the limitations inherent in metadata-based systems, as well as the large range of possible uses for efficient image retrieval. Textual information about images can be easily searched using existing technology but requires humans to personally describe every image in the database. This is impractical for very large databases, or for images that are generated automatically, e.g. from surveillance cameras. It is also possible to miss images that use different synonyms in their descriptions. Systems based on categorizing images in semantic classes like "cat" as a subclass of "animal" avoid this problem but still face the same scaling issues.

Potential uses for CBIR include: Art collections, Photograph archives, Retail catalogs, Medical diagnosis, Crime prevention, The military, Intellectual property, Architectural and engineering design, Geographical information and remote sensing systems, CBIR software systems, University of Washington FIDS Demo, CIRES: Content Based Image Retrieval System, LTU-Corbis Visual Search, Cortina , Octagon, Windsurf, See CBIR engines for other examples of publicly available and accessible CBIR systems.

CBIR techniques

Many CBIR systems have been developed, but the problem of retrieving images on the basis of their pixel content remains largely unsolved.

Query techniques

Different implementations of CBIR make use of different types of user queries.

Query by example

Query by example is a query technique that involves providing the CBIR system with an example image that it will then base its search upon. The underlying search algorithms may vary depending on the application, but result images should all share common elements with the provided example.

Options for providing example images to the system include:

- A preexisting image may be supplied by the user or chosen from a random set.
- The user draws a rough approximation of the image they are looking for, for example with blobs of color or general shapes.

This query technique removes the difficulties that can arise when trying to describe images with words.

Semantic retrieval

The ideal CBIR system from a user perspective would involve what is referred to as semantic retrieval, where the user makes a request like "find pictures of dogs" or even "find pictures of Abraham Lincoln". This type of open-ended task is very difficult for computers to perform - pictures of chihuahuas and Great Danes look very different, and Lincoln may not always be facing the camera or in the same pose. Current CBIR systems therefore generally make use of lower-level features like texture, color, and shape, although some systems take advantage of very common higher-level features like faces (see facial recognition system). Not every CBIR system is generic. Some systems are designed for a specific domain, e.g. shape matching can be used for finding parts inside a CAD-CAM database.

Other query methods

Other query methods include browsing for example images, navigating customized/hierarchical categories, querying by image region (rather than the entire image), querying by multiple example images, querying by visual sketch, querying by direct specification of image features, a

nd multimodal queries (e.g. combining touch, voice, etc.).

CBIR systems can also make use of relevance feedback, where the user progressively refines the search results by marking images in the results as "relevant", "not relevant", or "neutral" to the search query, then repeating the search with the new information.

C. CONTENT COMPARISON USING IMAGE DISTANCE MEASURES

The most common method for comparing two images in content-based image retrieval (typically an example image and an image from the database) is using an image distance measure. An image distance measure compares the similarity of two images in various dimensions such as color, texture, shape, and others. For example, a distance of 0 signifies an exact match with the query, with respect to the dimensions that were considered. As one may intuitively gather, a value greater than 0 indicates various degrees of similarities between the images. Search results then can be sorted based on their distance to the queried image.

Color

Computing distance measures based on color similarity is achieved by computing a color histogram for each image that identifies the proportion of pixels within an image holding specific values (that humans express as colors). Current research is attempting to segment color proportion by region and by the spatial relationship among several color regions. Examining images based on the colors they contain is one of the most widely used techniques because it does not depend on image size or orientation. Color searches will usually involve comparing color histograms, though this is not the only technique in practice.

Texture

Texture measures look for visual patterns in images and how they are spatially defined. Textures are represented by texels which are then placed into a number of sets, depending on how many textures are

detected in the image. These sets not only define the texture but also where in the image the texture is located.

The texture is a difficult concept to represent. The identification of specific textures in an image is achieved primarily by modeling texture as a two-dimensional gray-level variation. The relative brightness of pairs of pixels is computed such that degree of contrast, regularity, coarseness, and directionality may be estimated (Tamura, Mori & Yamawaki, 1978). However, the problem is in identifying patterns of co-pixel variation and associating them with particular classes of textures such as silk, or rough.

Shape

The shape does not refer to the shape of an image but to the shape of a particular region that is being sought out. Shapes will often be determined first applying segmentation or edge detection to an image. Other methods like [Tushabe and Wilkinson 2008] use shape filters to identify given shapes of an image. In some case, accurate shape detection will require human intervention because methods like segmentation are very difficult to completely automate. Some software producers are trying to push CBIR based applications into the filtering and law enforcement markets for the purpose of identifying and censoring images with skintones and shapes that could indicate the presence of nudity, with controversial results.

GLCM

Grey-Level Co-occurrence Matrix texture measurements have been the workhorse of image texture since they were proposed by Haralick in the 1970s. Too many image analysis, they are a button you push in the software that yields a band whose use improves classification - or not. The original works are necessarily condensed and mathematical, making the process difficult to understand for the student or front-line image analyst. This GLCM texture tutorial was developed to help such people, and it has been used extensively worldwide since 1999.

This document concerns some of the most commonly used texture measures, those derived from the Grey Level Co-occurrence Matrix (GLCM). The essence is understanding the calculations and how to do them. This involves

- Defining a Grey Level Co-occurrence Matrix (GLCM)
- Creating a GLCM
- Using it to calculate texture in the exercises.
- Understanding how calculations are used to build up a texture image
- Viewing examples of the texture images created with various input parameters

IV. IMPLEMENTATION

Applications are mainly In music, In cryptography, In medicine, In politics, In religion, In sports, In technology, In transportation, In education, In the military, In other fields. Error Diffusion Block Truncation Coding [4] for Color Image This section introduces an EDBTC image compression for the color image. Herein, the compression is presented for RGB color image. However, this method can be extended to the other color spaces such as YCbCr, or the other color channels. In a simple way, the EDBTC compresses an image patch in RGB color space into a new representation, i.e. two color quantizer of the same size as a single color pixel and its corresponding bitmap image of the same size as original image patch. The two EDBTC color quantizers are simply set with the min and max pixel values found in an image patch. On the other hand, the EDBTC employs the error kernel to generate a bitmap image. The EDBTC method produces better image quality compared to that of the classical BTC approach as it has been reported and deeply investigated.

The EDBTC produces a single bitmap image $bm(x, y)$ of the same size as image patch by incorporating error kernel. In this chapter, we employ Floyd-Steinberg error kernel for generating a bitmap image. For

performing the EDBTC thresholding, we firstly compute the minimum, maximum, and mean value of the inter-band average pixels as follows in fig 3.

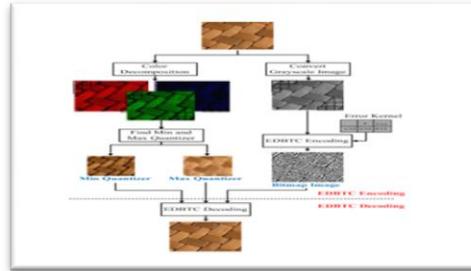


Fig 3. Schematic diagram of EDBTC processing for color image

where q_{min} and q_{max} are the EDBTC min and max quantizer, respectively. The EDBTC encoder module sends the two color quantizer and bitmap image into decoder side via transmission channel. For decoding this EDBTC data stream, the decoder simply replaces the bitmap image of having value 1 with the max quantizer, vice versa.

V. RESULTS

The step by step execution of the program is given below. Figure 4 is basic GUI page to acquire an input image. in figure 5 image is loaded. In figure 6 input image is browsed. In figure 7 image is selected from data base. In figure 8 features of input image is calculated. In figure 9 similar type of feature images are extracted.

STEP 1: Basic GUI page

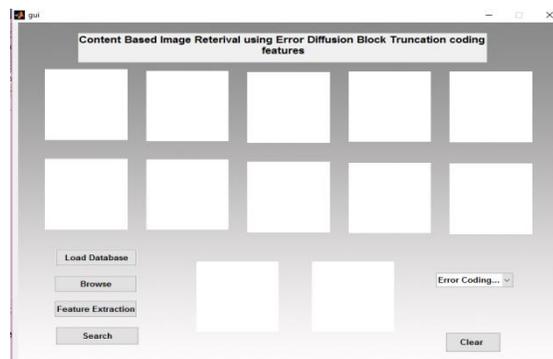


Fig 4. Basic GUI page

STEP 2: Database is loaded successfully.

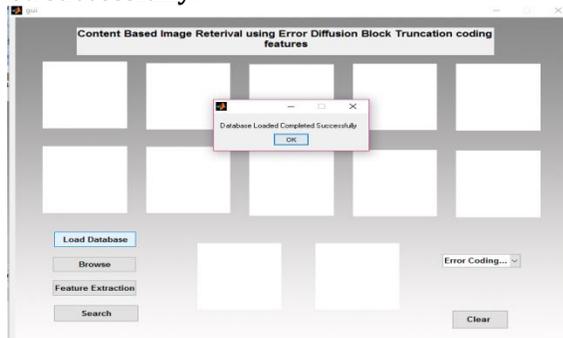


Fig 5. Database is loaded

STEP 3: Browsing of input image

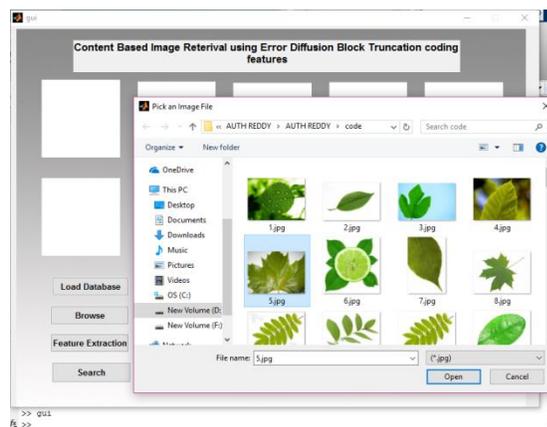


Fig 6. Browsing of input image

STEP 4: Input image is selected

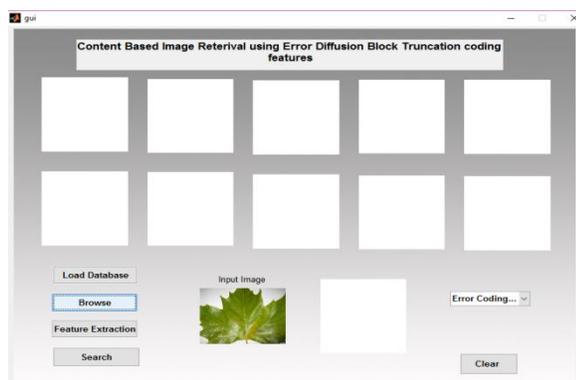


Fig 7. Input image is selected

STEP 5: Features of input image are extracted

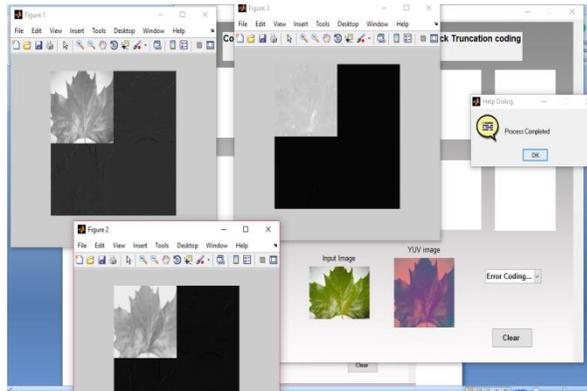


Fig 8. Features of input image are extracted

STEP 6: Similar images are extracted from database with same features of input image

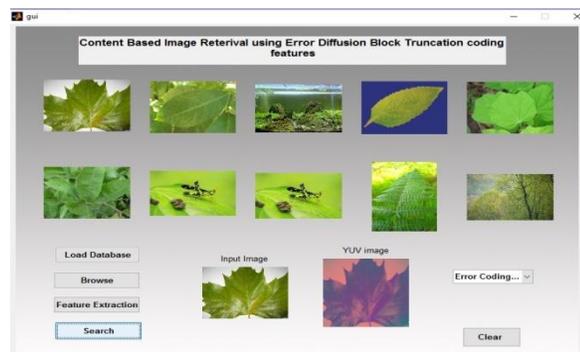


Fig 9. Similar images are extracted from database with same features of input image

VI. CONCLUSION

A new method is proposed in this study for color image indexing by exploiting the simplicity of the EDBTC method. A feature descriptor obtained from a color image is constructed from the EDBTC encoded data (two representative quantizers and its bitmap image) by incorporating the VQ. The CHF effectively represents the color distribution within an image, while the BHF characterizes the image edge and texture. The experimental results demonstrate that the proposed method is not only superior to the former BTC-based image indexing schemes, but also the former existing methods in the literature related to the content-based image retrieval. To achieve a higher retrieval accuracy, another feature can be added into the EDBTC indexing scheme with the other color spaces such as YCbCr, Hue-Saturation-Intensity, lab, etc. An extension of the EDBTC image retrieval system can be brought to index video by considering the video as a sequence of images. This strategy shall consider the temporal information of the video sequence to meet the user requirement in the CBIR context. The percent efficiency is 75%, which can be increased to 90 – 95% with the content-based technique. To achieve a higher retrieval accuracy, another feature can be added into the EDBTC scheme with other techniques. An extension of the EDBTC image retrieval system can be brought to index video considering the video as a sequence of images.

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