Image Retrieval based on Content using Template Matching

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Abstract---The purpose of this paper is to introduce a faster and a more reliable approach to developing a Content Based Image Retrieval (CBIR) system. For developing such a system, we require a functional process that depends on certain features of the image. In this paper, we propose an algorithm which is solely based on Normalized Cross Correlation (NCC) and depends on the extracted template of the query image as its process feature. A template is basically a significant portion of the input query image and provides a measurement of the level to which the image considered should be either similar or identical to it. The calculation and comparison of the images is done by implementation of NCC and the output is interpreted by user defined threshold. Through this paper, we propose a complete system to analyze and implement the above functions using NCC as the base approach.

I. Introduction

Content based Image Retrieval System is basically a coordinated integration of an image capturing technique with an image matching technique. Also known as Query by Image Content (QBIC), it provides the facility of matching images based on the similarity of its content. A CBIR system is deemed efficient based on its essential process techniques. Every CBIR system will have same or similar functions, what differs is the implementation technique. For this, the system can be based on a certain feature of the image which can be color, texture, shape or, as in our case, "template". A template is basically a clip or segment of the query image used as a reference to the images in the database.

Image matching plays a significant role in the development of a CBIR system. For this, we use correlation. Correlation in image processing domain is a technique by which the similarity measure of two images can be predicted and calculated. It is of two types (1) Cross correlation and (2) Auto correlation. In our proposed implementation, we use cross correlation in normalized form i.e. Normalized Cross Correlation.

Thus, this paper intends to provide an approach to the development of a CBIR system based on Template Matching using NCC as its matching method. This is specifically done so as to simplify and produce accurate results. NCC algorithm is not stable when dealing with significant rotation and scaling changes but is tolerant to invariant brightness, contrast and illumination. Template matching is implemented using an approach where the template is repeatedly scaled as well as rotated to move it as a mask over the image extracted from the database. Thus, pairing the two approaches, we provide a new method to successfully develop Content based Image Retrieval System.

II. Proposed System

A. Working

A Content based Image Retrieval System requires focus on two major sections of the system i.e. user interface and core process. Our focus feature is the template of the given image.

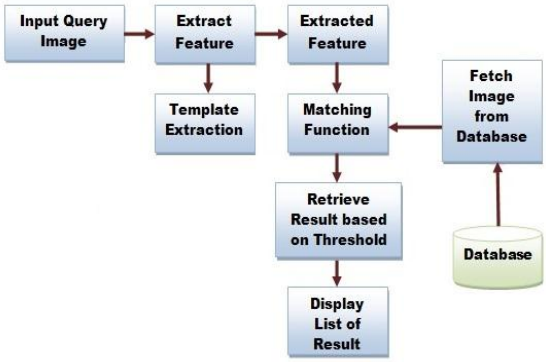

Fig. 1: Schematic block diagram of the proposed CBIR system

The block diagram depicted above provides a general view of the functionality of the proposed CBIR system. Template matching is the method adopted to gain a particular similarity measure while the threshold and comparison of the query image with that of images retrieved from the database is the functionality of the correlation function. Threshold is nothing but the limit provided by the user to decide the limit to which the two images under consideration should be similar. While designing such a system, emphasis should be given on the following operations:

- Feature Extraction

Feature extraction is basically a process point which scans and stores a specified property or part of the query image. In the given system, the feature to be extracted is nothing but the template itself.

- Similarity Function

Every CBIR system needs to put a considerable amount of emphasis on its Similarity function. This function will measure the degree to which the content of the images match each other. In our case, the similarity measurement is performed by a correlation function in normalized form (NCC).

- Image Representation

For every matching process, the image must be represented efficiently for the smooth functionality of the system. The representation of the images in the system basically means coding of the features extracted in the previous processes.

- Image Retrieval

Image Extraction and representation is followed by retrieval which translates the similarity measurement and calculation

into perceived results of matching according to concluded extracted features.

- User Interface

In the end, the user should be able to provide the specific query image and should be able to efficiently browse and search for images. This can only be done by a good interface.

III. Implementation Details

The implementation plan involves the use of the two significant processing approaches i.e. Template Matching and Normalized Cross Correlation.

A. Template Matching

A template is nothing but a part of the query image used as a measuring reference for calculating the match percent of the content of the image involved in the search. Template matching is the process which uses a template and produces similar matched results. Template matching is a technique which searches for areas in an image similar to (or identical to) the extracted template. The basic goal of this technique is to find a portion of the input image similar or identical to the template.

The technique is such that the template is slid over onto the compared image and at every position a measure is calculated. In this paper, we also propose a template matching technique such that for every position, the template is scaled as well as rotated in order to compensate the shortcomings of the matching algorithm i.e. NCC.

Implementation of this technique is carried out in the proposed system by using the template as a pixilated mask and rotated and scaled simultaneously while moving its position pixel by pixel.

B. NCC Algorithm

The main functional requirement of a particular CBIR system is to match the extracted features based on the content data the comparison image provides. In this paper, we propose a system which implements the extracted feature solely as a template while its similarity matching approach is nothing but a modified Correlation algorithm called Normalized Cross Correlation.

The function of the NCC algorithm is nothing but to obtain a metric for each position of the template onto the image retrieved from the database. This metric is then compared with a specified threshold and based on these values, we generate a similarity result.

Correlation is used as an efficient similarity measurement algorithm as it is not prone to errors due to variant properties such as illumination, contrast and brightness. Normalized Cross Correlation minimizes the sensitivity of the system to angle and size variations of the reference template. NCC functions and calculates a certain measurement of the level of similarity between the query image and the images stored in the system database. This measure is then compared with the threshold or limit and if the metric is greater than or equal to the threshold, the image is retrieved and displayed as a result.

As explained before, we emphasize on the functioning of template matching and NCC as a combined unit for the accurate retrieval of similar images. Template matching alone is not an accurate enough approach nor efficient. It is sensitive to variations in image features. Also, NCC is prone to errors following feature angle position and size. The proposed system is designed in such a way that each drawback is compensated with the advantage of the other. We further explain the design and working of our proposed Content Based Image Retrieval System with the following Data Flow Diagram:

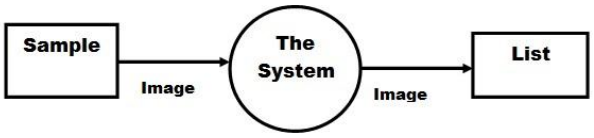

Fig.2: Level 0 DFD

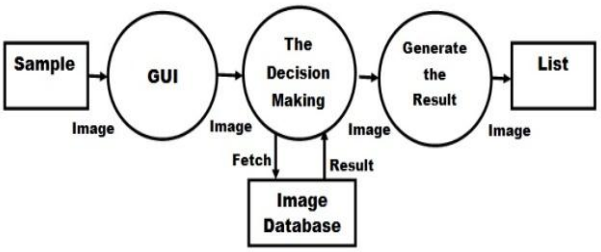

Fig. 3: Level 1 DFD

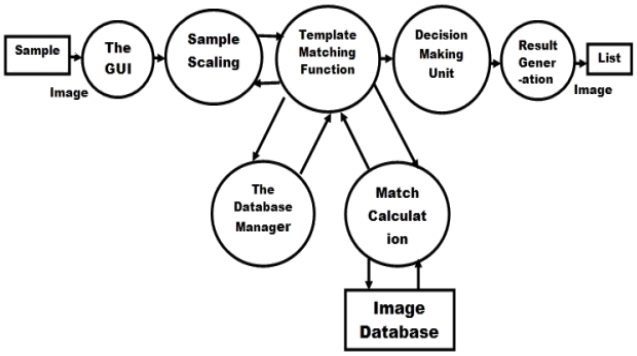

Fig. 4: Level 2 DFD

IV. Application

Content Based Image Retrieval being a current topic of interest, it is stil in its research phase. It provides its services in various fields such as Mug shot retreval, Etertainment industry, Forensic applications, Military applications and general image searching applications. It also has the potential to be further used in Social linking applications. An efficient CBIR system has the ability to provide various services related to Image Processing.

V. Conclusion & Future Scope

In conclusion, we can say that there are a varety of methods by which a CBIR syste can be deveoped. In this paper, we proposed a method for developing a CBIR system based on Template Matching and NCC approach. A CBIR system is only as good as its algorithm. We have seen template matching as an extraction approac and NCC as a similarity approach. We have also elaborated its functions and role as a whole. Finally, we see a complete functional diagra as to how to design the system.

The only thing constant in this world is change. There is always room for improvement or change in any

software and our system is no exception. GUI implementation can be put to a wider scope. Also, its processing tie can be taken into focus whilr implementation.

VI. ACKNOWLEDGEMENT

We wish to express our sincere gratitude to our principal Mr. Mohiuddin Ahmed, M. H. SabooSiddik College of Engineering, Mumbai, for providing the facilities to carry out the project work.

A special mention here to Prof. Z. A. Usmani (H.O.D., Computer Engineering Department, and MHSSCOE) for his valuable support. We are also thankful to all staff members of Computer Department, without whom the completion of this report would have been impossible.

This entire journey would not have been possible without the efforts put in by our guides, Mrs. Er. ShabanaTadvi. She has been a constant source of encouragement and guidance through the entire semester.

This acknowledgment would indeed be incomplete without rendering our sincere gratitude to our family. They have always been a pillar of strength and support in our past and current endeavors.

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