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A Novel Content Based Medical Image Retrieval using SURF Features

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Abstract

Objective: Content Based Image Retrieval (CBIR) has been one of the most vivid research areas in the field of computer vision over the last 10 years. In the medical field, images especially digital images are produced in ever–increasing quantities and used for diagnostics and therapy. Content Based Medical Image Retrieval is an important tool for doctors in their daily activity. **Findings:** This work describes a method for medical images annotation based on the SURF (Speeded up Robust Features) features. The proposed technique effectively uses most of the information from image is backbone of an efficient Content Based Image Retrieval system for medical databases. In this work the SURF features are used to improve the retrieval accuracy. **Methods:** The method applies the SURF algorithm in the detection, description, extracting references images and matching feature points in the image respectively. In the process of feature point matching, the false matching points are eliminated through this algorithm. **Applications:** SURF is fast and robust interest point detector which is used in many computer vision applications. The experimental evaluation is carried out for lung images using SURF features and proposed method provides better outcome.

Keywords: Content Based Medical Image Retrieval, Copy-Move, Lung Images, SURF Features

1. Introduction

Medical domain images are used for therapy and diagnostic even though the images differ in their structures. In reality, there will be thousands of images in medical lab. of huge hospitals to be managed each year. Managing these images manually is a difficult and very time consuming task as well as expensive one since the images will be different from person to person. So, there is a need for automatic technique to manage those medical images in large repositories.

Content Based Image Retrieval provides a searching technique through certain criteria's i.e. shape, texture and color composition. CBIR is the upcoming computer vision application which is used in large database for searching images. In the medical field, CBIR will be very effective for retrieving the images from the database.

Based on the image resemblance, CBIR system will separate the different regions of an image and decides the similarity among the two images using distance calculation of different regions. The retrieved images will be used for diagnosing purpose. But this CBIR suffers drawbacks for average users interfaces are too tough so the results quality is low. Time consuming for particular query is also unsatisfactory for certain users. The idea is to develop a new prototype of Content Based Image Retrieval. So the paper proposes a system called Content Based Medical Image Retrieval. This method is based on finding the similarity of feature vectors through low level features. This work uses SURF feature algorithm to retrieval the medical images.

SURF acts as a feature detector for computer oriented visual applications. As SURF does not consider gradient images for the computation rather it is based on 2D and first order Haar wavelet responses[1]. This makes the SURF to prove its robustness. The rest of the work is organized

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as follows: Section 2 discusses about the related concepts, Section 3 describes about the proposed methodology for medical image retrieval, Section 4 evaluates the proposed methodology and Section 5 concludes the work.

2. Literature Survey

In general, the reference image is obtained from the image database according to the request provided. The retrieved image can be used for the diagnosis[2]. An evaluation about the capabilities and the intervals is involved in Content Based Medical Image Retrieval. The authors discus their views on bringing the importance on modality both on images and text developed the system at National Library of Medicine[3].

The survey on various Content Based Image Retrieval methods is in accordance with radiology. They have formed an approach that could be used in radiology which already exists for non medical systems[4]. The prototype for Content Based Image Retrieval system works as a multi tiered for tiny images. The approach even retrieves the tiny images from the database even for many diseases[5]. The author[6] provided the implementation for conducting user tests that aids Content Based Image Retrieval for accessing the patient medical information.

Several methods[7] were suggested for Medical Image Retrieval through features considered locally through patches and key points for the images using SIFT descriptor. Suggested the importance of access concepts[8] for the methods based on text in retrieving the information in the medical domain. The authors[9] proposed a content based framework for the heterogeneous environment. The proposed framework aids to retrieve the medical images and computer aided diagnosis systems.

An approach has been proposed[10] in which SURF uses color feature as an add-on and produces a major difference in the information retrieval accuracy. Review is done about the new approach methods of Vector of Locally Aggregated Descriptors[11]. This approach combines local image descriptor with SURF features for obtaining the aggregate results in the image retrieval. An approach[12] has been proposed with a different in variant SURF algorithm which reduces the drawbacks of SURF. The proposed approach combines the feature of ASIFT and SURF and results in reducing the drawbacks of SURF.

The performance[13] of Scale Invariant Feature Transform (SIFT) and Speeded up Robust Features (SURF) on various classification datasets proposes an algorithm[14] for segmenting and retrieving the images. The approach uses SURF through the features locally and constraints of geometry. The approach gives the novel way of retrieving the images effectively and efficiently. The authors have[15] proposed an approach on Finger-Knuckle-Print (FKP) which is based on recognition system. The approach uses local information for the image retrieval.

The problem in finding the accuracy for the segmentation was suggested by[16] by using Random walker and watershed algorithm. The proposed approach considers the given image as a graph and the foreground and background seed's are defined by the user. The proposed approach has found the accuracy with the minimum seed values.

The Detection of Ground glass pattern in Lung Disease was suggested by[17] which is based on High Resolution Computed Tomography (HRCT). The proposed approach uses Gabor filter bank algorithm. It helps in extracting the information from the images.

3. Research Methodology

This section gives the brief explanation of the proposed method for retrieving the medical images using SURF features.

3.1 Medical Image Retrieval System

In general, most hospitals will maintain the patient images and reports through computerized systems. The stored records will be reviewed and accessed by experts. The patient's integrated reports will be accessed by the experts for processing the diagnosis, composing the end report and storing it in the database[18]. The users can also use the computerized systems to view their records but they cannot change the information stored in the database.

3.2 SURF Feature Extraction

In the proposed methodology, we have used Speeded up Robust Feature (SURF) which is faster than other algorithms. The algorithm uses a descriptor based on certain properties and the complexities are further narrowed down when compared to other algorithms. The proposed prototype undergoes several phases like orientation, extraction and the phases are carried out through SURF descriptors. Once theses phases are completed then it is clustered as centroids and the histograms are generated.

The architecture of the proposed approach is given in Figure 1. We have conducted an experiment in simulated environment using lung images.

After generating the histograms, the next step is to form a region to select the appropriate orientation and then extract the SURF descriptor. The proposed approach brings the important points and the descriptor from the given training set of lung images. These images are in two dimensional, it is essential to convert into a single dimensional for the image retrieval. So the proposed approach uses a Bag of Words (BoW). Then the centroids are formed from the formed clusters. Finally the histograms are prepared as per the created centroids for the images Hence, this will be evaluated in comparison to existing SURF Histogram approach in terms of correct detection of test lung images.

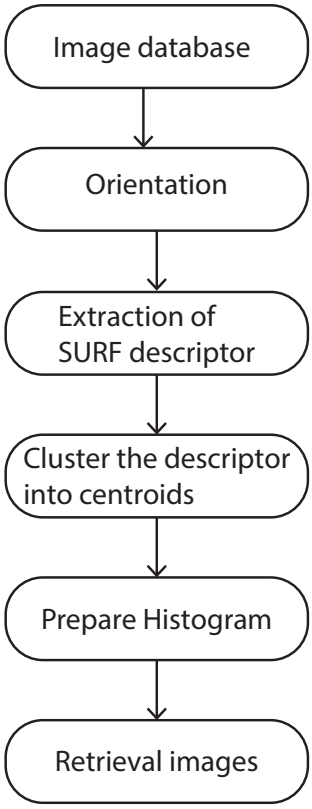


Figure 1. Process diagram.

4. Experimental Results

The experiments are conducted on the 50 images which are collected from Research Institute Coimbatore. Then the proposed SURF algorithm is applied to the gathered image. This will help to retrieve the lung images accurately and predict the disease whether it is present or not. The proposed method is evaluated using precision, recall and F-measure.

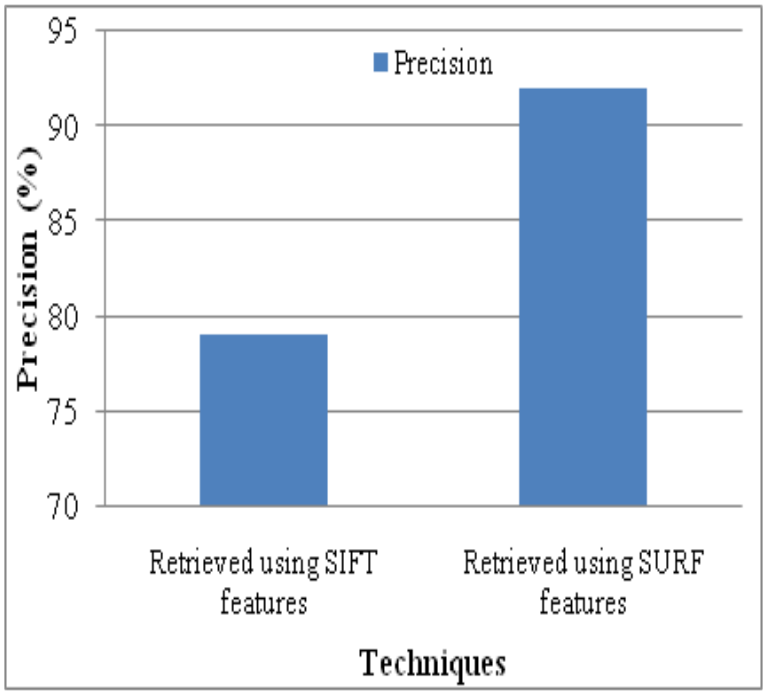


Figure 2. Precision for SURF features.

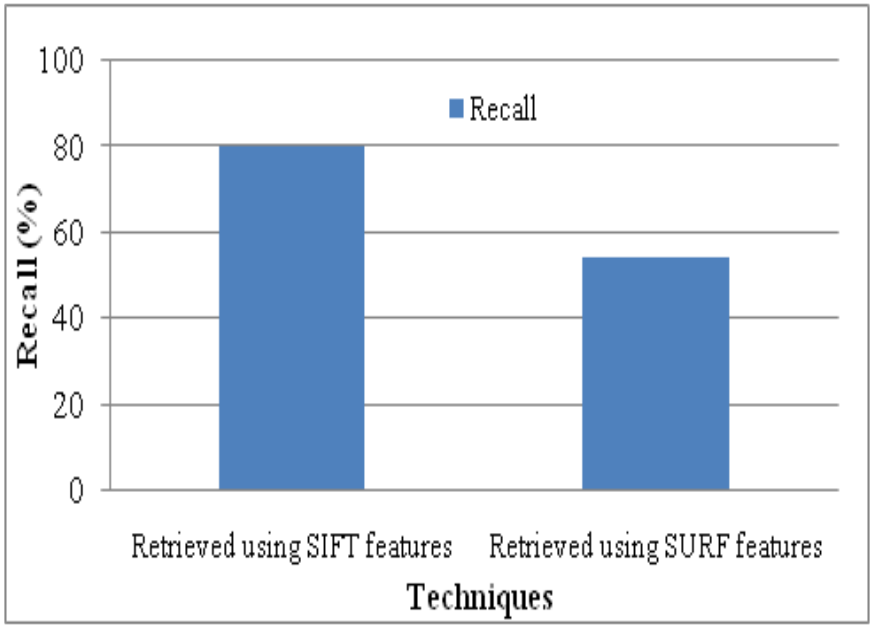


Figure 3. Recall for SURF features.

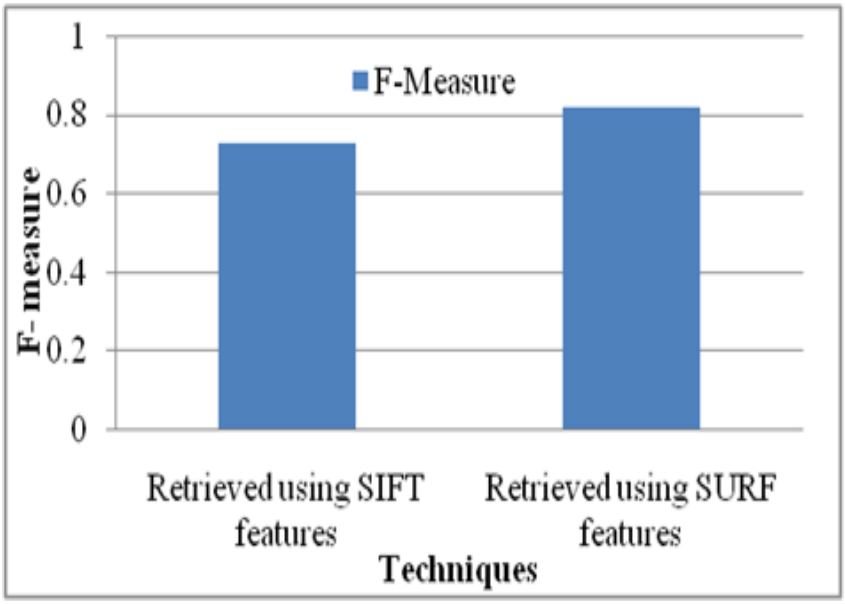


Figure 4. F-measure for SURF features.

$$\text{Precision} = \frac{\text{No of relevant images retrived}}{\text{Total No.of images retrived}} x100$$

$$\text{Recall} = \frac{\text{No of relevant images retrived}}{\text{Total No.of images that are relevant}} x100$$

$$\text{F measure} = 2\frac{\text{precision .recall}}{\text{precision} + \text{recall}}$$

Table 1: Precision and Recall

Techniques	Precision (%)	Recall (%)
Retrieved using SIFT features	79	80
Retrieved using SURF features	92	54

Table 1 shows the calculation for precision and recall values for the proposed SURF technique. The precision for the proposed SURF features is higher than the preceding method and the recall value is contradictory of the precision value. Figures 2 and 3 shows the precision and recall for proposed method.

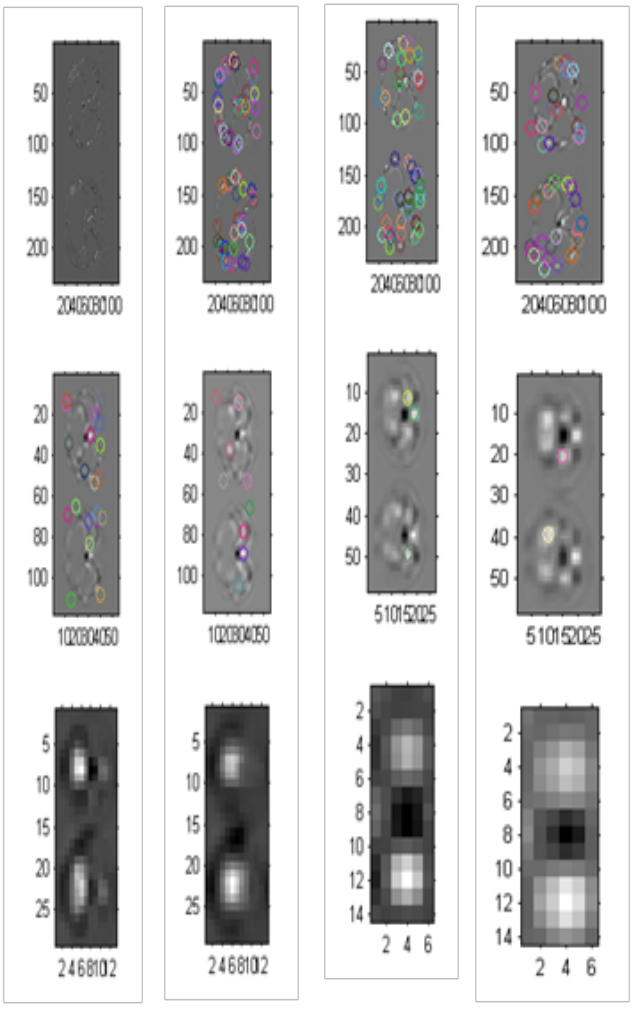
Table 2: F measure

Techniques	F measure
Retrieved using SIFT features	0.73
Retrieved using SURF features	0.82

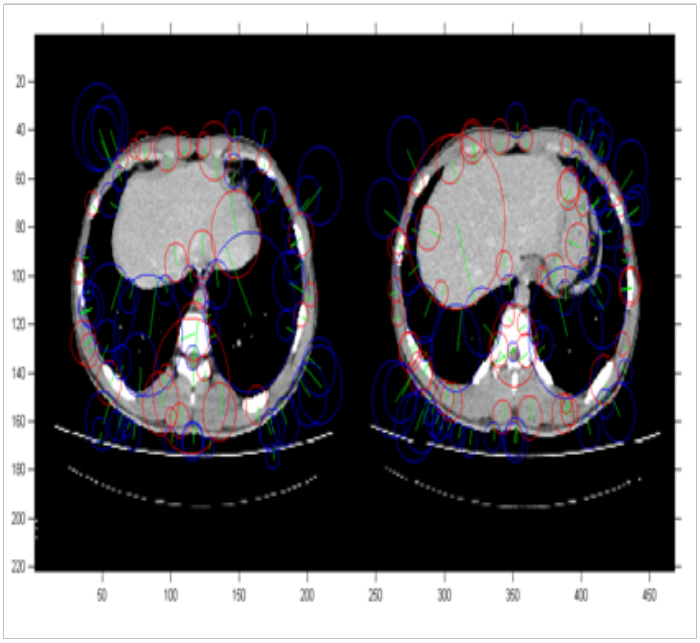
In Table 2, the F-measure value for the proposed method is shown. The proposed SURF feature has a high F-measure value when compared to SIFT feature. The graphical representation is shown in Figure 4.

Figure 5 shows the lung image extraction using SURF features. Proposed SURF algorithm retrieves the lung images accurately. Figure 5(a) shows the input query image of the lungs. Figure 5(b) describes the matching points of the image; if the ranges are increased the matching points will also be increased. The output of the image is shown in Figure 5(c) and surf features are highlighted using the color in the image. This method is applied to another image which is depicted in Figure 6 below.

5(a.) Input query image 1.



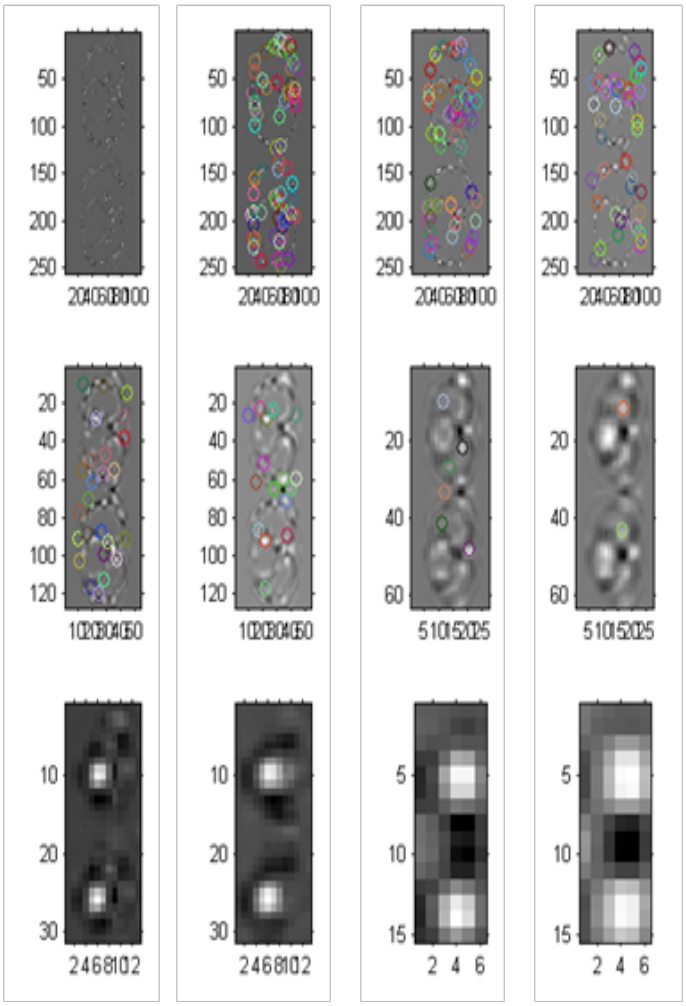
5(b) Matching points of the image 1.



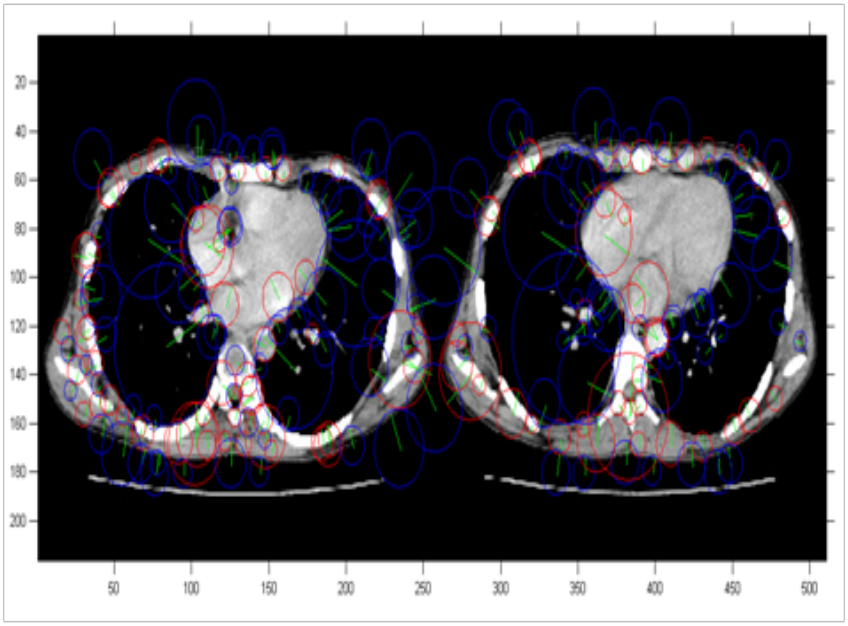
5(c). Output of the image 1.

Figure 5. Extraction of lung image 1 using SURF features.

6(a). Input query image 2.



6(b). Matching points of the image 2.



6(c). Output of the image 2..

Figure 6. Extraction of lung image 2 using SURF features.

5. Conclusion

Content Based Medical Image Retrieval (CBMIR) provides the efficient way for retrieving images from the databases. The proposed method uses SURF algorithm to increase the efficiency of image retrieval. The experiments are carried out in simulated environment and observed the reliability and robustness of the implemented system. The results have proven its accuracy, reliability and robustness when compared with its counterparts. In near future, the work can be extended for image enhancement.

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