Model For Reducing Semantic Gaps In Content Based Image Retrieval For SAR Images

Harpreet Kaur[#], Kiran Jyoti[*]

[#]*M.Tech of Computer Science*
[#]*GNDEC, Ludhiana, India*

[*]*Assistant Professor in IT Deptt.*
[*]*GNDEC , Ludhiana, India*

Abstract : **Synthetic Aperture Radar (SAR) is an important domain which uses remote sensing strategies and used in a variety of fields. Synthetic Aperture Radar (SAR) provides high resolution imaginary. Various content based image retrieval systems (CBIR) have been developed. But systems for specific domain or application are rare. So, in this research we have designed a content based image retrieval system for Synthetic Aperture Radar (SAR) images. We have done expensive work on building an algorithm that annotates Synthetic Aperture RADAR (SAR) images. For achieving this we have used Multi Range Thresholding technique to get the segments or regions which are specific to Synthetic Aperture RADAR (SAR) domain like soil, river, sea, rock, lake and glacier etc. This research focus on human dialect and linguistic descriptors for image retrieval to retrieve the most accurate image. Our results of queries shows higher value of Recall and Precision and confirm that the proposed framework effectively improves the performance of image retrieval applications.**

Keywords : **Content Based Image Retrieval System (CBIR), Synthetic Aperture Radar (SAR), Multi Range Thresholding Method, Annotation, Feature Extraction, Ground Truths**

I. INTRODUCTION

Image Retrieval is the science of locating images from a large database or image sequences that fulfill a specified image need. And the relationship between queries, images, meaning, and relevance is considered as a foundation for image retrieval system. Image Retrieval is important in all domains/applications such as Antisocial Elements, Forces, Protected property, Construction Engineering, Ornamentations and rag trade, Press and advertising, Treatment of injuries and diseases, Spatial data management and analysis and Cultural heritage research for efficient services. Various content based image retrieval systems (CBIR) have been developed.

But in Synthetic Aperture Radar (SAR) image retrieval, it is most difficult task because retrieval systems mostly retrieve images based on information embedded in images either in form of text/Metadata associated with the image or with the primitive features of an image. Text based method is not valid because different users use different keywords and these keywords can be incomplete to identify complicated image features. Primitive features are considered as valid upto some extent. These features such as color, shape and texture find images by matching the image signature of query image with the image signatures of database images. But again, this leads to the creation of gap between the features of a Synthetic Aperture Radar (SAR) image being stored in a database and what is expected while executing human dialect and human linguistic descriptors based query such as “Discover areas of ice". To remove these drawbacks and to retrieve the semantic images from Synthetic Aperture Radar (SAR) database, we present an approach which uses the combination of color characteristics and text annotation. It also uses the multi range Thresholding method to classify objects in the image.

II. CONTENT BASED IMAGE RETRIEVAL (CBIR)

Content based image retrieval (CBIR) system retrieve the images that matches the user query by analyzing the visual contents of the images in the database. Content basically refers to unique descriptors like color, texture and shape of the image. When a query is made these unique features are extracted to find the exact match to the features queries by the user.

Text-based image retrieval and content-based image retrieval are the two techniques adopted for search and retrieval in an image database. Text Based techniques can be traced back to 1970s[1]. In this approach Metadata such as Keywords are used to search and retrieve images from the database. But this approach is not considered as valid because different users can use different keywords for annotations [1]. This method can be subjective and incomplete because it cannot specify complicated image features perfectly. Moreover, it requires humans to personally describe every image in the database. This is tedious for very large databases [1]. Content Based image retrieval technique was adopted in the early 1990 to overcome the above drawbacks[4]. Content Based Image Retrieval is also called Visual Image retrieval.

Content-based retrieval uses the color, texture and shape features of images to represent and access the images [4] because of their unique properties. These features are objective and can be easily derived from the image without the need of any external knowledge base [5]. During processing, first of all the CBIR system derive these basic features like color , texture and shape for query image or text and then it match these basic features with all the images stored in the database after driving basic features for them also. The search is based on the similarity rather than on exact match [11]. During similarity operation, the system assign some index value to rank the images/objects according to their similarity level. Then display the results according to ranking value[7] .

III. PROBLEM FORMULATION

After conducting systematic review of Content Based Image Retrieval systems, it has been found that less work has been done based on domain specific Content Based Image retrieval. As they require specific treatment in their design and architecture specific domain. To develop these systems we need experts and knowledge for particular domains. Therefore, lack of such people also hinders the growth of domain specific content based image retrieval (CBIR) and worst is the case for evaluation of such systems. Moreover, the focus is normally on extraction of color, texture or numeric value features and relate it to the human readable keywords and phrases. However, little work has been done to attach meaning which is specific to particular domain.

Therefore, We focused our research on the Synthetic Aperture Radar (SAR) images retrieval. There is need to retrieve synthetic aperture radar information based on the user query. The query may include all possible descriptors of such images. Therefore, in our research we have build a system which is close to human dialect and linguistic descriptors and also reduce the semantic gap between the features of a Synthetic Aperture Radar (SAR) image being stored in a database and what is expected by the user. e.g. Find images having Commercial Building. Discover areas of 20 inch ice

IV. PROPOSED ARCHITECTURE

Our research focused on the Synthetic Aperture Radar (SAR) images retrieval. The proposed system is close to human dialect and linguistic descriptors, reduce the semantic gap between the features of a Synthetic Aperture Radar (SAR) image being stored in a database and what is expected by the user and retrieve images based on the user query. The query may include all possible descriptors of such images. This method uses the multi range thresholding method to identify objects in an image. It also uses the classification technique, which classify the images into different semantic groups. With the help of this multi range Thresholding method and classification scheme our algorithm retrieves the images which are most semantic to the user query. This method contains the following steps or modules. In this proposed system, dataset development is our first step. Then images collected from different sources are compressed and resized in the preprocessing phase of the retrieval process to make the storage and retrieval process easy and efficient.

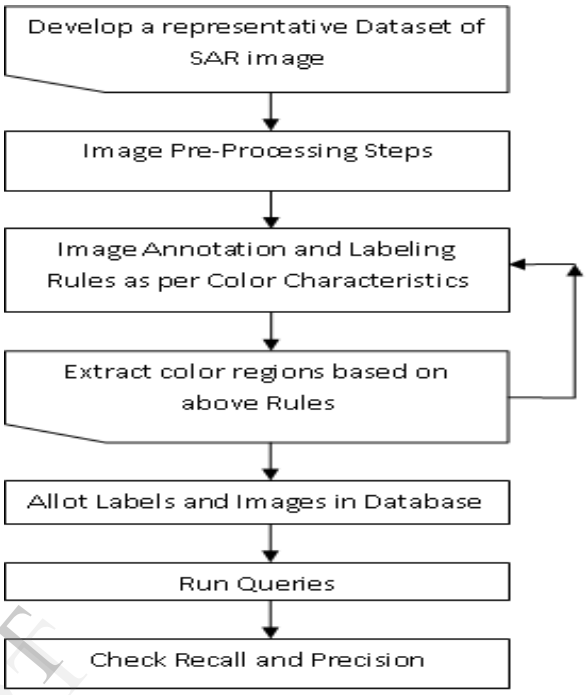

Figure 1 Steps or Modules of SAR image Retrieval

Image annotation technique is used to assign metadata in form of keywords to a digital SAR image. It uses multiclass image classification with a large number of multi range Thresholding classes, as large as Synthetic Aperture RADAR (SAR) objects. Synthetic Aperture RADAR (SAR) objects consist of Black, Blue, Brown, Cyan, Green, Magenta, Purple, Red, White, Gray, Yellow and Orange color for labeling classification. These visual categories reduce semantic gap and meet high level human perception and allowing the effective image retrieval strategies. Our retrieval process, retrieve the image signature from the image and then according to that assign the one colour pixels to one of the categories. As the feature extraction is the basis of content-based image retrieval. Colour, Texture and shape features are considered as primitive features to retrieve the image content. Color is considered as the important feature to recognize the images according to human perceptions. Our research, uses the Multi range thresholding algorithm for the extraction of colored regions from the image. Images are retrieved from the SAR database using labels associated with them. In the proposed algorithm multi range thresholding algorithm extracts the features from the image and then classifies the images into different semantic groups. It also assigns the labels to each image according to the object in the image.

Classification algorithm describe the different semantic classes according to the 12 colors such as Black, Blue, Brown, Cyan, Green, Magenta, Purple, Red, White, Gray, Yellow and Orange. When the user can enter the query in the form of Text such as "Find images having rock", then the retrieval system check the labels and then map these labels to the images in the.

V. ALGORITHMS

1. Algorithm for Query by Text

Step (1) For each query entered by user
Step (2) For each image in SAR Database
Step (3) Get Annotation Labeling for each color*
Step (4) Find Images having objects similar to query
Step (5) End For
Step (6) End For

2. Algorithm to retrieve pixel values and Annotation Labeling

Step (1) Let colorlist is the set representing different colors to classify SAR Objects
Step (2) For each image in Database
Step (3) If Image is RGB
Step (4) Read Image
Step(5) For each color in colorlist
Step (6) Find all color pixel segments using Multi Thresholding Algorithm*
Step (7) If pixelcolor belong to colorlist color and pixelcolor ratio $\geq 2\%$
Step (8) Annotate Images with Specification according to color ratio and pattern
Step (9) Store Annotation data
Step (10) End If
Step (11) End For
Step (12) End If\
Step (13) End For

3. Algorithm to extract colors using Multi Thresholding Algorithm

Step (1) Let RGB is the discrete set of prints representing an image.
Step (2) For each Image in Database
Step (3) If Image is RGB then
Step (4) For each RGB [1×3] vector of colors
Step (5) Initialize Result array
Step (6) For each color in colorlist
Step (7) Linear 3D interpolation of 3D vectors
Step (8) End For
Step (9) End For
Step (10) End if
Step (11) End For

VI. RESULTS AND DISCUSSIONS

Many methods are available for measuring the performance of image retrieval systems. The performance of Synthetic Aperture Radar (SAR) Image retrieval system is measured using two retrieval statistics Precision (Image) and recall (Image) . The values are calculated using Eq. (1) and (2) . We have conducted 21 tests on 275 images for different categories such as "Rock", "Soil", "Forest", "Lake" and so on.

1. Precision: Precision is defined as the fraction of images which are relevant and retrieved by the CBIR system. It measures the quality of system. Mathematically, Precision is the ratio of number of relevant images retrieved by CBIR system to the total number of images retrieved by the CBIR system.

$$\text{Precision} = \frac{\text{Number of Relevant Images Retrieved by System}}{\text{Total number of Images Retrieved by System}} \quad (1)$$

Precision (Image) Graph :

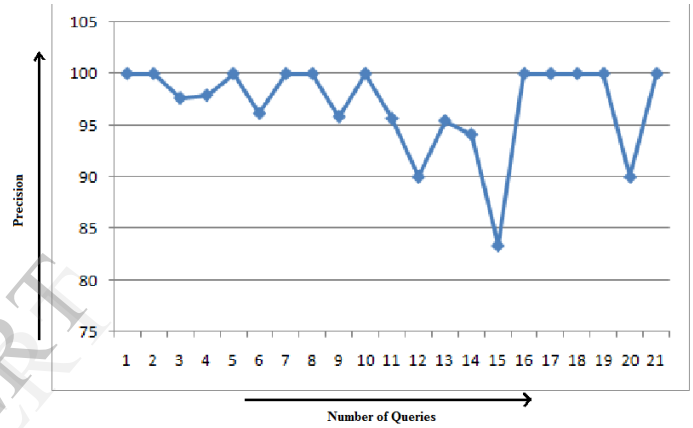

Figure 2 Precision (Image) Graph where Precision varies from 83 to 100 percentage

2. Recall: Recall is defined as the fraction of relevant images that are retrieved by the CBIR system. It measures the quantity or completeness of system. Mathematically, Recall is the ratio of number of relevant images retrieved by the system to the total number of relevant images existing in the database.

$$\text{Recall} = \frac{\text{Number of Relevant Images Retrieved by the System}}{\text{Total number of Relevant Images Existing in the Database}} \quad (2)$$

Recall (images), Precision (Images) values are calculated for the different queries and their results are shown in the following table:

Recall (Image) Graph:

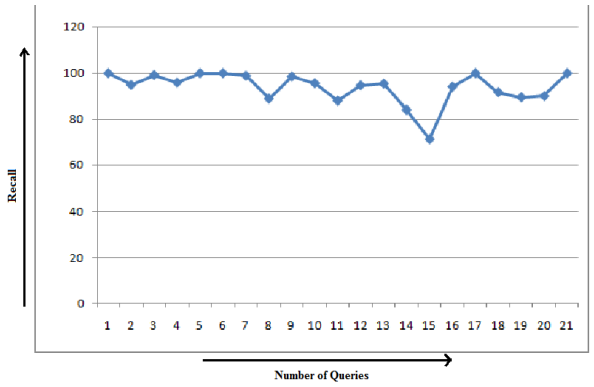

Figure 3 Recall (Image) Graph Graph where Recall varies from 71 to 100 percentage

As it is difficult to obtain high recall with high precision through only low level features in SAR domain. It also cannot be achieved through manual tagging. We have achieved it through combination of both, color retrieval and image annotation. So this combined approach gives high recall and high precision and give better results.

VII. CONCLUSIONS

The semiautomatic Image retrieval system for Synthetic Aperture Radar (SAR) images is developed in the present research work. This system will retrieve the images according to user query. Images are retrieved from the database with the combination of color feature extraction and annotation method. In the proposed system, image features are extracted using Multi Range Thresholding Method and then semiautomatic annotation algorithm is used in the creation of ground truths for the object. Ground Truth is a keyword vocabulary based on the requirements of the Synthetic Aperture Radar Domain and then this vocabulary is used in the manual annotation of images, which reduce the semantic gap in the retrieval process and retrieve the images according to human linguistic descriptors. The proposed technique considers all the relevant aspects of Satellite Images. The performance of Synthetic Aperture Radar (SAR) image retrieval system is evaluated in terms of Precision (Image) and Recall (Image). The statistics calculated show the effectiveness of the proposed system over traditional image retrieval systems.

VIII. FUTURE SCOPE

The present thesis work point to following directions of research that are likely to be needed to further enhance the scope of the system.

- Better semantically enriched descriptions need to be developed by understanding specific domain requirements and information seeking behavior such as metallurgy.
- The adaptability of the retrieval system can be further enhanced by using a 'Text and Image' query system as compared to a text-only query system.
- As Semiautomatic Annotation method is time consuming, promising new automatic annotation methods needs to be developed.
- Future work also includes the extension of the proposed framework to support usable human interfaces to CBIR systems.
- Compact storage architectures need to be developed for large image databases.
- CBIR system for Synthetic Aperture Radar, which can recognize Soil and Rock clearly, need to be developed. As the present system cannot able to distinguish it clearly .
- Future work can also extended to search the different parameters according to percentage area. For example, "Find images having 40% water ".

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