FUZZY CLUSTER INDEX: AN ANGLE ORIENTED FACE RECOGNITION USING RSA

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Abstract: The major drawbacks in face recognition system influenced by the changes in illumination, pose and expression of the images. However, one possible solution is angle oriented approach. Several authors discussed angle oriented approaches including Euler rotations. In this paper, we proposed indexing to the cluster based fuzzy classification namely, clock-wise and anti-clock wise rotations. In each cluster various angles of the images are extracted using discrete cosine transforms (DCT) that invokes certain normalization techniques. Security is provided to the database and the input images are compared with encrypted database images using RSA algorithm. The similarity based fuzzy cluster validity is discussed. Finally, the experimental results are studied using unique relevance recall metric on both the rotations, clock wise and anti-clock wise.

Keywords: Angle oriented, Fuzzy cluster classification, Indexing, RSA algorithm and unique relevance recall.

1 INTRODUCTION

Chellappa et al., 1995 [1] discussed the categories of face recognition, which falls into two categories; feature based and Holistic approaches. Feature based face recognition relies on detection and characterization of the individual facial features like eyes, nose and mouth etc., and their geometrical relationships. On the other hand the holistic approach involves encoding of the entire facial image. Earlier works on these lines were proposed by various authors: Quality of cluster index based on study of decision tree is proposed by B.Rajasekhar et al., 2011[12]. Object-Based Image indexing and Retrieval in DCT domain using Clustering Techniques is suggested by Hossein Nezamabadi-pour and Saeid Saryazdi, 2004 [11]. Michael J.Swan and Dana H. Ballard, 1991[9] discussed the Color Indexing.

Ziad M.Hafed and Martin Levine 2001[16] proposed a holistic approach to face recognition, an affine transformation was used to correct for scale, position and orientation changes in faces. Ting Shan et al., 2006 [14] developed a face model which can be used to interpret facial features and synthesize realistic frontal face images when a single face novel image given. Jagan Mohan R.N.V., and Subbarao R.,2011 [5][6] proposed a new computational approach that is converting the input image to database image using angle orientation technique and developed an algorithm for face recognition system using DCT and studied K-Means Cluster Reliability.

The angle oriented technique is broadly classified into two classes as discussed in increasing the reliability of angle oriented face recognition using DCT, proposed by Jagan Mohan RNV et al., 2011-12 [5][6], which is used for identifying the feature images of the faces even though they are angle oriented. If the input image angle is

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not 90^0, the image is rotated through 90^0 and then normalization technique is applied such as geometric - illumination technique. Recognition of an image by using rotational axis is easy to achieve or recognize the face.

If input image rotates from horizontal axis to vertical axis the face rotates anti-clock wise and the face appears in which it is the same as the database pose, then the object is recognized. Similarly, if input image rotates from vertical axis to horizontal axis the face rotates clock wise and the face appears in which it is the same as the database pose, then the object is recognized. Therefore if input image is angle oriented, the pose is changed or angle is altered using rotational axis and then compared.

Conventional image database contains raw image data that cannot be directly used for retrieval. As and when input image data needs to be processed that satisfies certain properties which are derived on the images that are stored in the database image. These image properties are stored in feature database which is used for retrieval and grouping. Previous works on information retrieval system focused on search-by-query: Latha.Y.M et al., 2007 [9] "Content based color image retrieval via wavelet transform". The user sends a query, for the database is searched widely for they are neighboring and similar.

Different authors discussed the categories of the database system that operate on Indexing and Searching. Among these two categories the first step is indexing, each image of the database is represented using a set of image attributes by means of color, shape, texture and layout. Image features are extracted and stored in a graphical feature database. When user makes a query, a feature vector for the query is evaluated in the second category of the database system. Using a similarity measures database vectors and input image vectors are compared. If images are similar, query is returned to the user given a Similarity based Query Optimization using MapReduce is introduced by Dileep Kumar Kadali. et. al., 2012 [2].

By careful observation and thorough reference of above concepts, this paper systematized with the following sections; Classification of Fuzzy angle oriented cluster approaches are introduced in Section 1. Section 2 deals with Database security with Encryption using RSA.

Fuzzy Cluster Index with Security described in section 3. Various index methods are mentioned in Section 4. Finally, the experimental results on angle oriented cluster database are provided in section 5. Conclusion and Future Perspectives are given in Section 6.

1. Fuzzy Angle Oriented Cluster Classification: Mining Fuzzy Association Rules in Databases discussed by various authors including the handling of quantitative attributes [8] and Intrusion Detection System [7]. In our present discussion, we introduced the fuzzy classification technique on angle oriented cluster classifications.

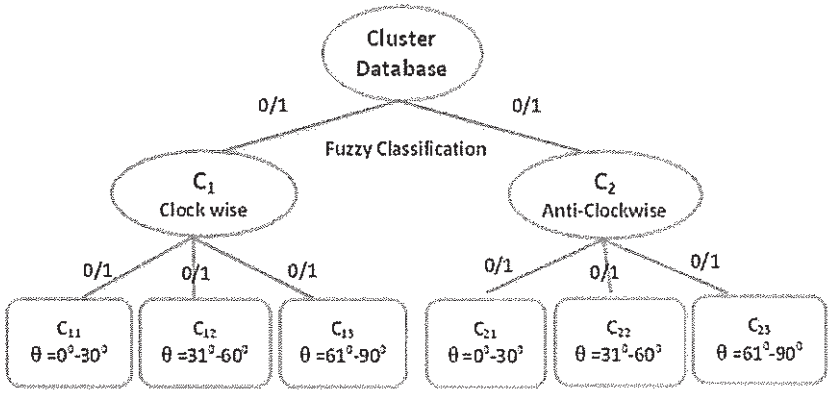

Figure 1.1: Fuzzy Decision Tree for Angle Oriented Cluster Database

Consider the dataset, I = {0^0, 30^0, 60^0, 90^0, 120^0, 180^0, 240^0, 360^0} that represents all the attributes appearing in input Training database. The training database set C = {0^0,30^0,60^0,90^0} contains all the possible items of the database I. The classification of clustering of database images using decision tree was discussed by Subbarao, R. et. al., 2012 [13]. Entire database of the images denoted by C which is the root node i.e., [0^0-90^0], divided into two groups namely, Clusters C_1 and C_2 representing internal nodes i.e., Clock wise and Anti Clock wise. The similar image object groups being rotated in the clock wise rotation belonging to the internal node, known as Cluster C_1. On the other hand, C_2 is a group of similar image objects rotates in Anti clock wise direction. Again the Cluster C_1 is Re-grouped into three terminal nodes C_{11} [0^0-30^0], C_{12} [31^0-60^0] and C_{13} [61^0-90^0] called nested clusters, and also, the cluster C_2 is re-grouped into three terminal nodes C_{21} [0^0-30^0], C_{22} [31^0-60^0], C_{23} [61^0-90^0] called nested clusters of C_2. Let θ be the angle of rotation in each cluster. Fuzzy sets and their corresponding membership functions have to be defined by domain experts, each of the fuzzy sets can be beheld as [0, 1] valued attribute, called fuzzy attribute. As we are aware of that any function f: X⟶ [0, 1] is called a fuzzy set, X is any non-empty set.

Let X= [0^0, 90^0]. Define f(x) = Sin x. A fuzzy rule can be expressed in the following form

$$F = \sum_{\theta=0^\circ}^{90^\circ} \sin\theta \qquad (1.1)$$

The fuzzy sets and their membership function as discussed by Krishnamoorthi, M. et. al., 2008 [7] and Kuok, et. al., 1998 [8].

The fuzzy sets for each cluster with an angle of range 30^0 can be represented as

$$\sum_{\theta=0^\circ}^{30^\circ} Sin\theta \ , \sum_{\theta=31^\circ}^{60^\circ} Sin\theta \ , \sum_{\theta=61^\circ}^{90^\circ} Sin\theta \qquad (1.2)$$

Finally, the fuzzy set (1.1) can be expressed as

$$F = \sum_{\theta=0^\circ}^{30^\circ} Sin\theta + \sum_{\theta=31^\circ}^{60^\circ} Sin\theta + \sum_{\theta=61^\circ}^{90^\circ} Sin\theta \qquad (1.3)$$

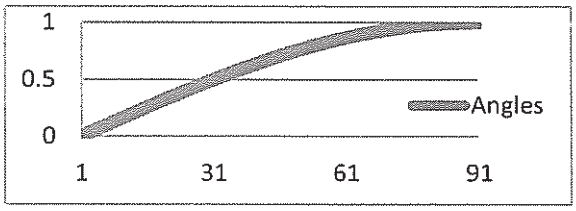

Fig1.2 Fuzzy Cluster profile

It is also verified through the above profile that between 0 and 1 of θ values, the fuzzy cluster depiction increases in between 0^0 and 90^0.

2. DATABASE SECURITY

Database security is essential for database management system which indicates sensitivity, importance of data and information of an organization. The data stored in a database management system plays a vital role in the business organization and is regarded as a corporate asset. Thus, it is very much essential to the organization, to secure the data properly with essential secrete keys for cipher text and to compare with the original data. The accession to the data in database security system is more complicated and time consuming so that, it is important for the database administrator to develop general policies, procedures and appropriate controls to protect the existing database. For the last two decades not much change was taken place in this regard. Encryption is used for data transit over a communication channel from sender to receiver. The common database security using encryption/decryption process is given in figure2.1. The user authentication methods for database systems improved due to the threat posed by exploitation of the web applications or normal applications.

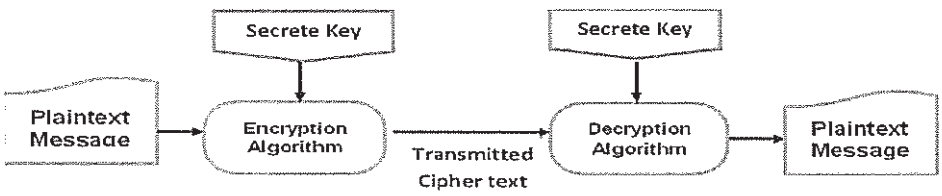

Figure: 2.1. Security using encryption/decryption process

Encryption is the process of transmit the information as plaintext using an algorithm namely cipher, to make it hide for everyone except individuals owning special knowledge, usually referred to as a key. The result of the process is encrypted information in cryptography, referred as cipher text. In many situations, the term encryption also implicitly refers to the reverse process; decryption. The general procedure (or principle) is to provide security to the database of the organization given in flowchart 2.2. The primary goals in database security are to prevent i). Loss of availability ii). Loss of Data Integrity iii). Loss of Confidentiality or Secrecy iv). Loss of Privacy, Theft and Fraud and v). Accidental losses.

Figure: 2.2. Flow chart for Database Security Principles

2.1. Encryption using RSA: In the present paper, we introduced RSA public encryption to angle oriented cluster based face recognition system. It is well-known public key algorithm. A block cipher which falls between the plain text and cipher text and are integers between 0 to n-1 for a given n. The sender and receiver must know the values of n and e (Encryption), and only the receiver knows the value of d (Decryption).

1. Select two prime numbers, x and y.
2. Calculate n=x*y
3. Calculate ϕ (n) = (x-1) (y-1).
4. Select e such that e is relatively prime to ϕ (n) and less than ϕ (n); gcd (ϕ (n), e) =1
5. Define d such that de mod ϕ (n) = 1 and d < ϕ (n).
6. Finally, the ensuing keys are public key, PU = {e, n} and private key PR = {d, n}.

3. FUZZY CLUSTER INDEX WITH SECURITY FOR ANGLE ORIENTATION

The Concept of indexing and security was developed by several authors at various database security systems. In the image indexing algorithm complete reformation of DCT coefficients is represented in color, shape and texture features which are compressed as proposed by Nezamabadi-pour, H.et.al., 2004 [11]. Feng et al., [ ] provided an indexing approach by direct extraction of statistic parameters in DCT domain to combine the nature of texture and shape into an integrated feature. An image indexing algorithm is able to extract content from JPEG compressed domain, introduced by Jiang et al [3]. In this section, we can choose an angle orientation based image indexes with the help of encrypted based security for each nested cluster. The importance of index is to retrieve the database image with the help of security to an input image clearly and accurately within the short period, according to the pose of input image.

As mentioned in section 1 regarding the cluster classification and respective angle in each cluster that θ assumes. Cluster C_1 has three nested clusters; each nested cluster has 30 indexes. If the encrypted based angle oriented image indexes are matching with the database of the root node C with the help of RSA, the database image retrieves accurately. Similarly the same process can be adapted to the nested clusters C_{21}, C_{22}, and C_{23} that are represented for anti-clock wise rotation root node C_2 of C. Therefore the index plays a key role to retrieve the database images.

4. SIMILARITY BASED FUZZY CLUSTER VALIDITY INDEX

In section 3, several clusters in clock wise and anti-clock wise directions are encrypted with different indexes. To identify the validity and efficiency several external evaluation clustering methods are introduced in this section. Evaluation of clustering results may also be referred to as cluster validation. Rajasekhar, B. et. al. 2011[12], studied 'Quality of Cluster Index based on Study of Decision Tree'. These types of evaluation methods compute how close the clustering is to the predefined standard classes. Two indexing methods namely, Jaccard and Tanimatto are considered to study the similarity of indexed fuzzy clusters. These methods are

used to quantifying the similarity between the two clusters C_1 and C_2 i.e., Clock wise and Anti-clock wise directed clusters. These coefficients take values between 0 and 1 for jaccard and in between -1/3 and 1 for Tanimatto.

The index formulae are

$$\text{Jaccard Index} \quad J(X,Y) = \frac{(X \cap Y)}{(X \cup Y)} \tag{4.1}$$

$$\textit{Tanimatto Index} \quad T(X,Y) = \frac{X.Y}{||X||^2+||Y||^2-X.Y} \tag{4.2}$$

5. EXPERIMENTAL RESULTS

The experimental results are obtained for both clock wise and anti-clockwise rotations for various clusters. The methods jaccard and Tanimatto are used for indexing and the Unique Relevance Recall (URR) metric suggested by Kowalski, G.J. and Maybury, M. T. (2008) is used to compare the systems clock wise and anti-clock wise clusters. It measures the number of relevant items (required angle of the image) retrieved by one cluster that are not retrieved by the other. The Unique Relevance Recall metric is given by

$$\textbf{Unique Relevance Recall} = \frac{\textit{Number Unique Relevant}}{\textit{Number Relevant}} \tag{5.1}$$

The unique relevance recall metric is used for efficiency of the face recognition in all types of clusters.

5.1. Anti-Clock Wise Rotations: The methods Tanimatto and Jaccard are used for face matching. The mean recognition values for both the methods in all the three clusters c_{11}, c_{12} and c_{13} are calculated and the corresponding profiles for each of the three clusters are depicted in figures 5.1, 5.2 and 5.3 respectively.

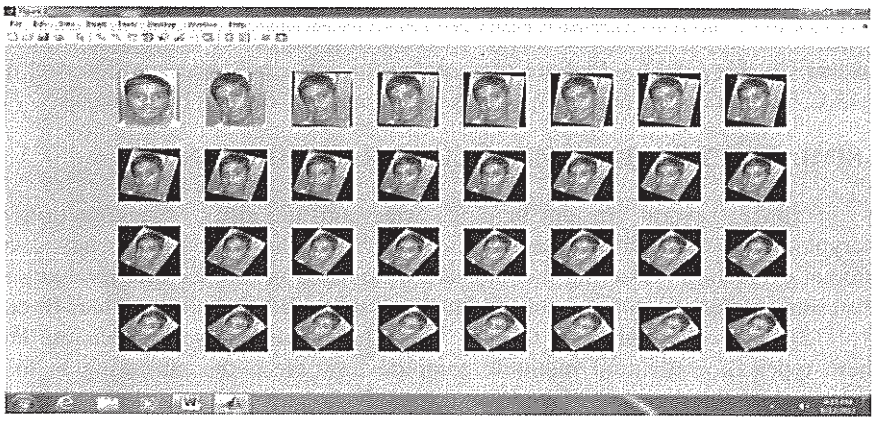

Fig:5.1:Recognition of Images in Anti-Clock wise Rotation

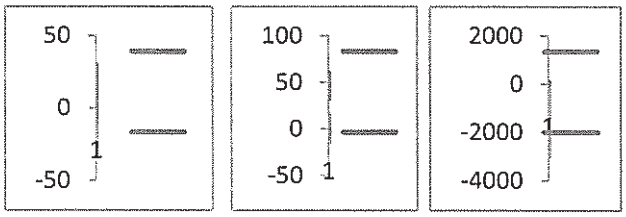

Fig:5.1.1 C_{11} (0^0-30^0) *Fig:5.1.2 C_{12} (30^0-60^0)* *Fig:5.1.3 C_{13} (60^0-90^0)*

It is noticed that only two images are not recognized in Cluster C_{11} while using jaccard method.In all the remaining cases the recognization is 100%.

5.2.Clock-Wise Rotations: As in the anti Clock wise rotation, the experimental results are calculated in clock wise direction also. The image recognition in Tanimatto is 100% for all the clusters, 90% and 98% of recognition is observed in clusters C21, C22 respectively. Also a cluster C2 occupies 100% recognition.

Fig:5.2:Recognition of Images in Clock wise Rotation

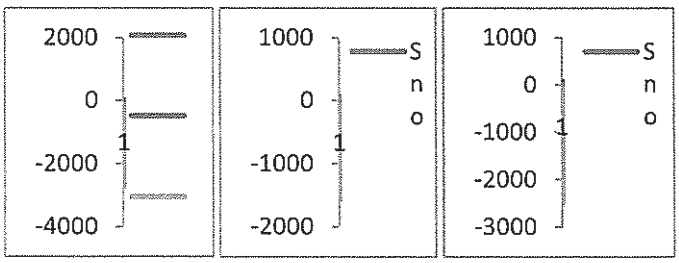

Fig:5.2.1 C_{21} (0^0-30^0) *Fig:5.2.2 C_{22} (30^0-60^0)* *Fig:5.2.3 C_{23} (60^0-90^0)*

6. CONCLUSION

The concept of face recognition is studied through Fuzzy cluster classification on the basis of rotation of images both clock-wise and anti-clock wise directions.

From the above experimental results one can conclude that Tanimatto method has good amount of recognition when compare with Jaccard approach. It is also observed that the unique relevance recall rate for image retrieval is high for Tanimatto.

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