A Survey on Face Recognition Techniques

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Abstract
Face detection is a computer technology that determines the locations and sizes of human faces in arbitrary (digital) images. It detects facial features and ignores anything else, such as buildings, trees and bodies. Face detection can be regarded as a specific case of object-class detection. In object-class detection, the task is to find the locations and sizes of all objects in an image that belong to a given class. Examples include upper torsos, pedestrians, and cars. Face detection can be regarded as a more general case of face localization. These days face detection is current research area. The face detection is normally done using ANN, CBIR, LDA and PCA.
Keywords:- *ANN, CBIR, LDA and PCA*

I.INTRODUCTION

Early face-detection algorithms focused on the detection of frontal human faces, solve the more general and difficult problem of multi-view face detection. That is, the detection of faces that are either rotated along the axis from the face to the observer (in-plane rotation), or rotated along the vertical or left-right axis (out-of-plane rotation), or both. The algorithms take into account variations in the image or video by factors such as face appearance, lighting, and pose. Many algorithms implement the face-detection task as a binary pattern-classification task. That is, the content of a given part of an image is transformed into features, after which a classifier trained on example faces decides whether that particular region of the image is a face, or not. Often, a window-sliding technique is employed. That is, the classifier is used to classify the (usually square or rectangular) portions of an image, at all locations and scales, as either faces or non-faces (background pattern). Images with a plain or a static background are easy to process. Remove the background and only the faces will be left, assuming the image only contains a frontal face. Using skin color to find face segments is a vulnerable technique. The database may not contain all the skin colors possible. Lighting can also affect the results. Non-animate objects with the same color as skin can be picked up since the technique uses color segmentation. The advantages are the lack of restriction to orientation or size of faces and a good algorithm can handle complex backgrounds. [1].

A face model can contain the appearance, shape, and motion of faces. There are several shapes of faces. Some common ones are oval, rectangle, round, square, heart, and triangle. Motions include, but not limited to, blinking, raised eyebrows, flared nostrils, wrinkled forehead, and opened mouth. The face models will not be able to represent any person making any expression, but the technique does result in an acceptable degree of accuracy. [3] The models are passed over the image to find faces, however this technique works better with face tracking. Once the face is detected, the model is laid over the face and the system is able to track face movements.

II.TECHNIQUES OF FACE DETECTION

Methods for human face detection from color videos or images are to combine various methods of detecting color, shape, and texture. First, use a skin color model to single out objects of that color. Next, use face models to eliminate false detections from the color models and to extract facial features such as eyes, nose, and mouth.

LDA

Linear discriminant analysis (LDA) and the related Fisher's linear discriminant are methods used in statistics, pattern recognition and machine learning to find a linear combination of features which characterizes or separates two or more classes of objects or events. The resulting combination may be used as a linear classifier, or, more commonly, for dimensionality reduction before later classification.

LDA is closely related to ANOVA (analysis of variance) and regression analysis, which also attempt to express one dependent variable as a linear combination of other features or measurements.[1][2] In the other two methods however, the dependent variable is a numerical quantity, while for LDA it is a categorical variable (i.e. the class label). Logistic regression and probit regression are more similar to LDA, as they also explain a categorical variable. These other methods are preferable in applications where it is not reasonable to assume that

the independent variables are normally distributed, which is a fundamental assumption of the LDA method.
LDA is also closely related to principal component analysis (PCA) and factor analysis in that they both look for linear combinations of variables which best explain the data.[3] LDA explicitly attempts to model the difference between the classes of data. PCA on the other hand does not take into account any difference in class, and factor analysis builds the feature combinations based on differences rather than similarities. Discriminant analysis is also different from factor analysis in that it is not an interdependence technique: a distinction between independent variables and dependent variables (also called criterion variables) must be made.
LDA works when the measurements made on independent variables for each observation are continuous quantities. When dealing with categorical independent variables, the equivalent technique is discriminant correspondence analysis.[4][5]

EIGENFACE

Eigenfaces are a set of eigenvectors used in the computer vision problem of human face recognition. The approach of using eigenfaces for recognition was developed by Sirovich and Kirby (1987) and used by Matthew Turk and Alex Pentland in face classification. It is considered the first successful example of facial recognition technology.[citation needed] These eigenvectors are derived from the covariance matrix of the probability distribution of the high-dimensional vector space of possible faces of human beings.

Eigen Face Generation

A set of eigenfaces can be generated by performing a mathematical process called principal component analysis (PCA) on a large set of images depicting different human faces. Informally, eigenfaces can be considered a set of "standardized face ingredients", derived from statistical analysis of many pictures of faces. Any human face can be considered to be a combination of these standard faces. For example, one's face might be composed of the average face plus 10% from eigenface 1, 55% from eigenface 2, and even -3% from eigenface 3. Remarkably, it does not take many eigenfaces combined together to achieve a fair approximation of most faces. Also, because a person's face is not recorded by a digital photograph, but instead as just a list of values (one value for each eigenface in the database used), much less space is taken for each person's face.
The eigenfaces that are created will appear as light and dark areas that are arranged in a specific pattern. This pattern is how different features of a face are singled out to be evaluated and scored. There will be a pattern to evaluate symmetry, if there is any style of facial hair, where the hairline is, or evaluate the size of the nose or mouth. Other eigenfaces have patterns that are less simple to identify, and the image of the eigenface may look very little like a face.
The technique used in creating eigenfaces and using them for recognition is also used outside of facial recognition. This technique is also used for handwriting analysis, lip reading, voice recognition, sign language/hand gestures interpretation and medical imaging analysis. Therefore, some do not use the term eigenface, but prefer to use 'eigen image'.

IV.NEURAL NETWORK FACE DETECTION

Pattern recognition is a modern day machine intelligence problem with numerous applications in a wide field, including Face recognition, Character recognition, Speech recognition as well as other types of object recognition. The field of pattern recognition is still very much in it is infancy, although in recent years some of the barriers that hampered such automated pattern recognition systems have been lifted due to advances in computer hardware providing machines capable of faster and more complex computation.
Face recognition, although a trivial task for the human brain has proved to be extremely difficult to imitate artificially. It is commonly used in applications such as human-machine interfaces and automatic access control systems. Face recognition involves comparing an image with a database of stored faces in order to identify the individual in that input image. The related task of face detection has direct relevance to face recognition because images must be analyzed and faces identified, before they can be recognized. Detecting faces in an image can also help to focus the computational resources of the face recognition system, optimizing the systems speed and performance.
Face detection involves separating image windows into two classes; one containing faces (targets), and one containing the background (clutter). It is difficult because although commonalities exist between faces, they can vary considerably in terms of age, skin colour and facial expression. The problem is further complicated by differing lighting conditions, image qualities and geometries, as well as the possibility of partial occlusion and disguise. An ideal face detector would therefore be able to detect the presence of any face under any set of lighting conditions, upon any background. For basic pattern recognition systems, some of these effects can be avoided by assuming and ensuring a uniform background and fixed uniform lighting conditions. This assumption

is acceptable for some applications such as the automated separation of nuts from screws on a production line, where lighting conditions can be controlled, and the image background will be uniform. For many applications however, this is unsuitable, and systems must be designed to accurately classify images subject to a variety unpredictable conditions.

Each technique takes a slightly different approach to the face detection problem, and although most produce encouraging results, they are not without their limitations. The next section outlines the various approaches, and gives six examples of different face detection systems developed.

III.CBIR

Recent years increase in the size of digital image collections. This ever increasing amount of multimedia data creates a need for new sophisticated methods to retrieve the information one is looking for. The classical approach alone cannot keep up with the rapid growth of available data anymore. Thus content-based image retrieval attracted many researchers of various fields. There exist many systems for image retrieval meanwhile. Retrieval of Images from Image archive using Suitable features extracted from the content of Image is currently an active research area. The CBIR problem is identified because there is a need to retrieve the huge databases having images efficiently and effectively. For the purpose of content-based image retrieval (CBIR) an up-to-date comparison of state-of-the-art low-level color and texture feature extraction approach is discussed. In this paper we propose A New Approach for CBIR with interactive user feedback based image classification by Using Suitable Classifier.

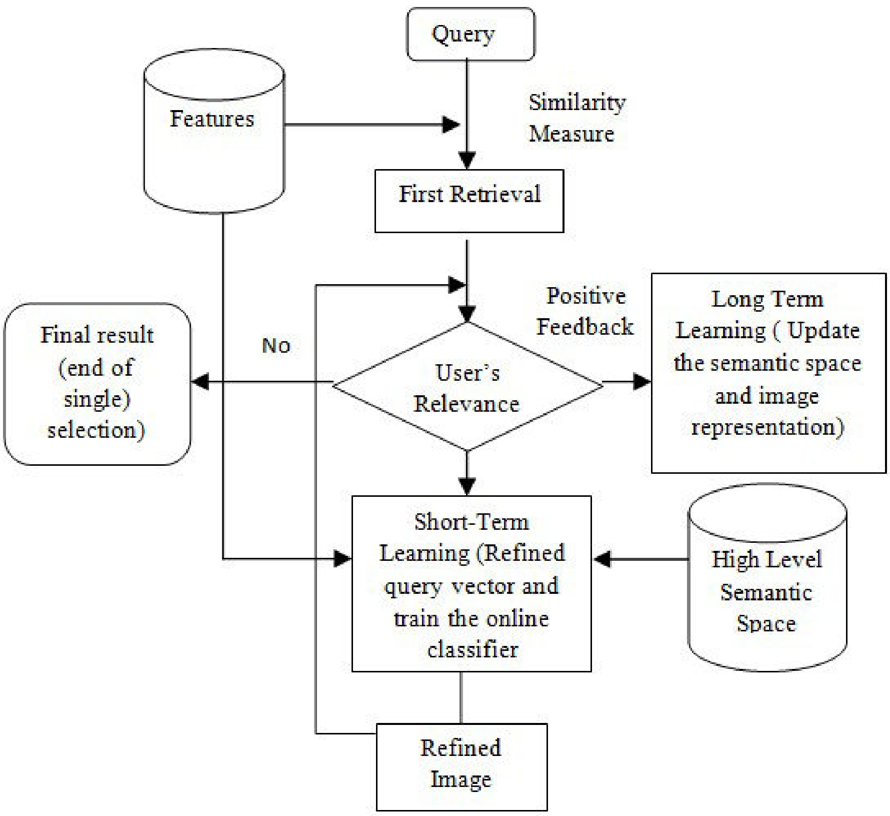

Figure.1- Image Retrieval Using Relevance Feedback

This Approach is applied to improve retrieval performance. Our aim is to select the most informative images with respect to the query image by ranking the retrieved images. This approach uses suitable feedback to repeatedly train the Histogram Intersection Kernel based Classifier. Proposed Approach retrieves mostly informative and correlated images. Figure 1 shows systematic retrieval process.

Color Feature

Color is the most popularly used features in image retrieval and indexing. On the other hand, due to its inherent nature of inaccuracy in description of the same semantic content by different color quantization and /or by the uncertainty of human perception, it is important to capture this inaccuracy when defining the features. We apply fuzzy logic to the traditional color histogram to help capture this uncertainty in color indexing [3], [2].In image retrieval systems color histogram is the most commonly used feature. The main reason is that it is independent of image size and orientation. Also it is one of the most straight-forward features utilized by humans for visual recognition and discrimination. Statistically, it denotes the joint probability of the intensities of the three color channels. Once the image is segmented, from each region the color histogram is extracted. The major statistical data that are extracted are histogram mean, standard deviation, and median for each color channel i.e. Red, Green, and Blue. So totally $3 \times 3 = 9$ features per segment are obtained. All the segments need not be considered, but only segments that are dominant may be considered. Because this would speed up the Calculation and may not significantly affect the end result.

Texture Feature

Texture is another important property of images. Various texture representations have been investigated in pattern recognition and computer vision. Basically, texture representation methods can be classified into two categories: structural and statistical. Structural methods, including morphological operator and adjacency graph, describe texture by identifying structural primitives and their placement rules. They tend to be most effective when applied to textures that are very regular. There is no precise definition for texture. However, one can define texture as the visual patterns that have properties of homogeneity that do not result from the presence of only a single color or intensity. Texture determination is ideally suited for medical image retrievals].In this work, computation of gray level co occurrence matrix is done and from which a number of statistical measures are derived. The autocorrelation function of an image is used to quantify the regularity and the coarseness of a texture. This function is defined for an image *I* as: The notion of texture generally refers to properties of homogeneity direction information.

Shape Feature

Shape is used as another feature in image retrieval. However, it is evident that Retrieval by shape is useful only in very restricted environments, which provide a good basis for segmentation (e.g. art items in front of a homogeneous background). Shape descriptors are diverse, e.g. turning angle functions, deformable templates, algebraic moments, and Fourier coefficients.

Combinations of Color, Texture, Shape

Features Similarity is based on visual characteristics such as dominant colors, shapes and textures. Many systems provide the possibility to Combine or select between one or more models. In a combination of color, texture and contour features is used. Extends the color histogram with textural information by weighting each Pixel's contribution with its Laplacian also provides several different techniques for image retrieval. These methods use the feedback from the user in order to automatically select or weight the different models, such that the requirements of the user are best fulfilled. Several systems perform segmentation and characterize each region by color, texture, and shape. As stated before these systems crucially depend on a good segmentation which is not always given. This can result in retrieval results which seem to have nothing in common with the query. Among various flowers the system returns an image that does not display a star-shaped object but for which the segmentation delivered a star-like region as an artificial boundary within a textured region. We therefore consider segmentation-based methods reliable only for applications that allow for a precise segmentation.

Similarity Computation

Similarity measurement is a key to CBIR algorithms. These algorithms search image database to find images similar to a given query, so, they should be able to evaluate the amount of similarities between images. Therefore, feature vectors, extracted from the database image and from the query, are often passed through the distance function d. The aim of any distance function (or similarity measure) is to calculate how close the feature vectors are to each other. There exist several common techniques for measuring the distance (dissimilarity) between two N-dimensional feature vector f and g. Each metric has some important characteristics related to an application.

Image Classification

It is processing techniques which apply quantitative methods to the values in a digital yield or remotely sensed scene to group pixels with similar digital number values into feature classes or categories Image classification and annotation are important problems in computer vision, but rarely considered together. Intuitively, annotations provide evidence for the class label, and the class label provides evidence for annotations. Image classification is conducted in three modes: supervised, unsupervised, and hybrid. General, a supervised classification requires the manual identification of known surface features within the imagery and then using a statistical package to determine the spectral signature of the identified feature. The spectral fingerprints of the identified features are then used to classify the rest of the image. An unsupervised classification scheme uses spatial statistics (e.g. the ISODATA algorithm) to classify the image into a predetermined number of categories (classes). These classes are statistically significant within the imagery, but may not represent actual surface features of interest. Hybrid classification uses both techniques to make the process more efficient and accurate. We can use SVM (Support Vector Machine) for classification. Support Vector Machine, an important machine learning technique has been used efficiently for variety of classification purposes like object based image analysis, hand written digit recognition, and image segmentation among others. SVM can be used efficiently as a binary classifier as well as multi class classifier purpose. A Support Vector Machine (SVM) performs classification by constructing an *N*-dimensional hyper plane that optimally separates the data into two categories. SVM models are closely related to neural networks. In fact, a SVM model using a sigmoid kernel function is equivalent to a two-layer, perceptron neural network. Support Vector Machine (SVM) models are a close cousin to classical multilayer perceptron neural networks. Using a kernel function, SVM‟s are an alternative training method for polynomial, radial basis function and multi-layer perceptron classifiers in which the weights of the network are found by solving a quadratic programming problem with linear constraints, rather than by solving a non-convex, unconstrained minimization problem as in standard neural network training. Linear SVM is the simplest type of SVM classifier which separates the points into two classes using a linear hyper plane that will maximize the margin between the positive and negative set. The concept of non linearity comes when the data points cannot be classified into two different classes using a simple hyper plane, rather a nonlinear curve is required. In this case, the data points are mapped non-linearly to a higher dimensional space so that they become linearly separable. Table-1 given explain comparison between image classification techniques.

Parameter	**Artificial neural network**	**Support vector machine**	**Fuzzy logic**	**Genetic algorithm**
Type of approach	Non parametric	Non parametric with binary classifier	Stochastic	Large time series data
Non linear decision boundaries	Efficient when the data have only few input variables	Efficient when the data have more input variables	Depends on prior knowledge for decision boundaries	Depends on the direction of decisions
Training speed	Network structure, momentum rate ,learning rate, converging criteria	Training data size, kernel parameter	Iterative application of the fuzzy integral.	Referring irrelevant and noise genes.
Accuracy	Depends on number of input classes.	Depends on selection of optimal hyper plane.	Selection of cutting threshold	Selection of genes.
General performance	Network structure	Kernel parameter	Fused fuzzy integral.	Feature selection.

Table 1. Comparision of image classification techniques

CONCLUSION & FUTURE WORK

As the research point of view any study is not enough that you can say perfect. This paper gives some interest in the following are for research. In these days the crime we should be care of our safety this field of research can held in this area. The two algorithms can be combining to find the batter results in respect to accuracy & broader classes.

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