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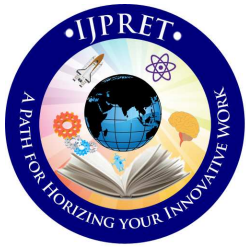

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A PATH FOR HORIZING YOUR INNOVATIVE WORK

FACE DETECTION WITH SKIN COLOR & FEATURES & RECOGNIZATION USING GENETIC ALGORITHM

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Abstract

Face recognition in video has gained wide attention as a covert method for surveillance to enhance security in variety of application domains (e.g., airports, traffic, Terrorist attack).A video contains temporal information as well as multiple instances of a face, so it is expected to lead to better face recognition performance compared to still face images. However, faces appearing in a video have substantial variations in pose and lighting. We propose a face recognition system that identifies faces in video. The system utilizes the rich information in video. The description of the proposed method and preliminary results are provided.

1. Introduction

Humans make use of face as an important clue for identifying people. This makes automatic face recognition very crucial from the point of view of a wide range of commercial and law enforcement applications. Although significant work has been done the current systems are still not close to the human perceptual system [3]. Traditionally, face recognition research has been limited to recognizing faces from still images. Most of these approaches discount the inherent 3-D structure of the face and therefore are very susceptible to pose changes [5]. One way to overcome this is to generate 3-D models using multiple still images or video and then use them while testing any probe image. Even if the resolution of the images/video is high (which is usually not the case), the face model generated by the known techniques is usually far from perfect which makes this approach often not practical for face recognition. Recently, methods based on multiple images/video sequences that do not involve creating an explicit 3-D model have been suggested. Such an approach is supported by many psychophysics works like, where authors argue that a 3-D object is represented as a set of 2-D images in our brains. Leaving out the algorithms based on simple voting, most of these methods make use of either the natural variability in a face or the information present in the temporal variation of face. In, book all recognize a face from a sequence of rotating head images by computing the Euclidean distances between trajectories formed by face sequences in PCA feature space. The Mutual Sub-space Method (MSM) considers the angle between input and reference subspaces formed by the principal components of the image sequences as the measure of similarity [12]. This approach discounts the inherent temporal coherence present in a face sequence that might be crucial for recognition. Face recognition is cast as a statistical hypothesis testing problem, where a set of images is classified using the Kullback-Leibler divergence between the estimated density of the probe set and that of gallery sets [14]. This method is based on the underlying assumption that face recognition can be performed by matching distributions. However, two such distributions for the

same subject might look very different depending on the range of poses and expressions covered by the two sets. Moreover, this approach is sensitive to illumination changes.

2. Literature Review:

Liu learn temporal statistics of a face from a video using adaptive Hidden Markov Models to perform video-based face recognition [20]. Kernel principal angles, applied on the original image space and a feature space, are used as the measure of similarity between two video sequences. Zhou proposes a tracking-and-recognition approach by resolving uncertainties in tracking and recognition simultaneously in a probabilistic framework. Lee in their recent work, represent each person by a low-dimensional appearance manifold, approximated by piece-wise linear subspaces. They present a maximum a posteriori formulation for recognizing faces in test video sequences by integrating the likelihood that the input image comes from a particular pose manifold and the transition probability to this manifold from the previous frame [19]. Among the methods mentioned, Lee method seems to be the one most capable of handling large 2-D and 3-D rotations.

3. Proposed Methodology:

The Proposed Method Consist of following steps

1. Image Capture from webcam
2. Image enhancement.
3. Neural Network Training using Genetic algorithm (In Training Phase Only).
4. Check for an input face is human or not using skin color extraction & features detection approach
5. Test an Image using Neural Network Based genetic algorithm approach.
6. Display Result.

Image Enhancement:

Image enhancement is the **improvement of digital image quality** without knowledge about the source of degradation. These operations could be performed using linear operations in either the frequency or the spatial domain. Here is a trick that can speed up operations substantially, and serves as an example for both point and neighborhood processing in a binary image:

we number the pixels in a 3×3 neighborhood like:

5	6	7
4	8	0
3	2	1

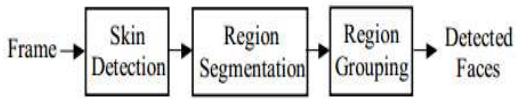
And denote the binary values (0, 1) by b_i (i = 0, 8); we then concatenate the bits into a 9-bit word, like $b_8b_7b_6b_5b_4b_3b_2b_1b_0$. This leaves us with a 9-bit revalue for each pixel, hence a new image (an 8-bit image with b_8 taken from the original binary image will also do). The new image corresponds to the result of a convolution of the binary image, with a 3×3 matrix containing as coefficients the powers of two. This neighbor image can then be passed through a look-up table to perform erosions, dilations, noise cleaning, skeletonization, etc.

Neural Network Training using Genetic algorithm: The training of feed-forward Neural Networks (NNs) by back propagation (BP) is much time-consuming and complex task of great importance. To overcome this problem, we apply Genetic Algorithm (GA) to determine parameters of NN automatically and propose efficient GA which reduces its iterative computation time for enhancing the training capacity of NN. Proposed GA is based on steady-state model among continuous generation model and used the modified tournament selection, as well as special survival condition. To show the validity of the proposed method, we compare with conventional and the survival-based GA using mathematical optimization problems and set covering problem. In addition, we estimate the performance of training the layered feed forward NN with GA. Genetic algorithms are often thought of, discussed and implemented using binary strings, or bit strings. Each gene or bit represents the expression of a state. If the bit is turned on, then the gene corresponding to that bit can be said to be "expressed". In this application a bit represents the state of either a variable being included ("1") or not included ("0") in the final solution. Genetic algorithms sometimes require the use of special operators in order to simulate the evolutionary processes which they emulate.

The most common operators are crossover and mutation. The crossover operator takes two parent chromosomes and combines them to produce an offspring. A common form of crossover operator is uniform crossover. In uniform crossover, if a specific gene is turned on in both parents, then it will be turned on in the offspring. If a gene is turned on in only one of the parents, then it may be turned on in the offspring. Uniform crossover was used in this project. The mutation operator is applied independently but immediately following the crossover operator. A mutation is a random change of a gene in a chromosome, and is applied according to a preset mutation rate. A survival rate that determines what percentage of the population i.e. the fittest members would survive into the next generation was employed. Because the computational cost of building and training neural network models from scratch can be high, another feature employed in this work was to guarantee that when a new offspring is generated it does not duplicate any chromosome currently in the population or which has been previously built and tested.

Skin Color Extraction & Features Detection:

The majority of existing methods have in common the de-correlation of luminance from the considered color channels. Luminance is underestimated since it is seen as the least contributing color component to skin color detection. Here we use a new color space which contains error signals derived from differentiating the grayscale map and the non-red encoded grayscale version.



The advantages of the approach are the reduction of space dimensionality from 3D, RGB, to 1D space advocating its unfussiness and the construction of a rapid classifier necessary for real time applications. The proposed method generates a 1D space map without prior knowledge of the host image.

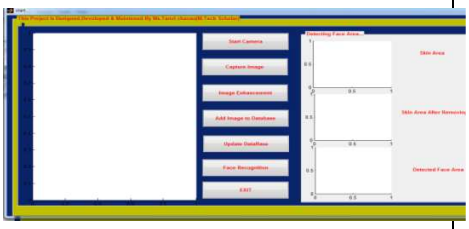
```
R > 95 AND G > 40 AND B > 20 AND
max{R, G, B} – min{R, G, B} >15 AND
|R – G| > 15 AND
R > G AND R > B
OR
R > 220 AND G > 210 AND B > 170 AND
|R – G| <= 15 AND
R > B AND G > B
```

Features Detection

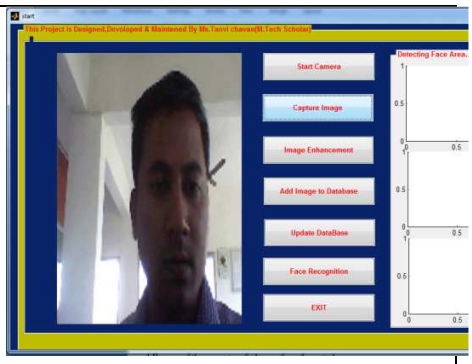
To locate the face region, we first identify the hair region that appears darker. Then the face region can be determined by growing the region with the similar color sampled below the hair region. The original image is then converted to a binary image where pixels with color values larger than a pre-defined threshold are set to 1, and other pixels are set to 0. On this binary image, pixels with value 1 are accumulated both horizontally and vertically. Then the following rules are applied to locate feature points.

1. Because of the symmetry of a human face, the central peak of the vertical projection represents the line passing through the nose and the mouth.
2. After finding the nose-mouth line, the left and right peaks are located to find the left and right eyes, respectively.
3. From the horizontal projection, if the first peak occurs at the beginning of face region, it is the hair region's bottom line, so that next peak would be the brow line. Otherwise, the first peak represents the brow line, the next peak is the eye line, and the next 2 is the nose line.
4. The cross sections of the vertical and the horizontal projection are therefore the feature points. Positions of the feature points are further refined. For examples, at the location of left eye we search for then left most corner.

Project GUI:

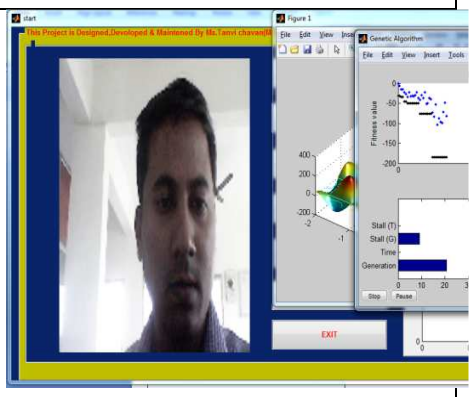


Main GUI



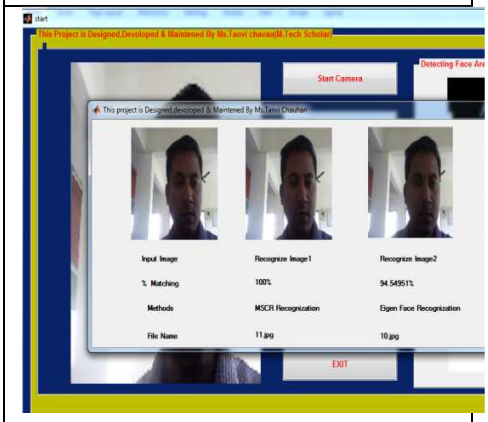
Web Cam Image Captured

Image Enhancement



Neural Network Training with Genetic Algorithm

Skin Color & Features Detection in an Input Image



Matched Result Images

Result Analysis:

METHOD	Error rate (%)	Trianing Time	Classification Time
PDBNN	4.0	20min	<0.1s
SOM+CN	3.8	4hours	<0.5s
Top-down HMM	13.0	n/a	n/a
Pseudo-2d HMM	5.0	n/a	240s
Eigenface	10.0	n/a	n/a
n-tuple	14.0	0.9s	0.025s
cont n-tuple	2.7	0.9s	0.33s
cont n-tuple*	4.2	30min	0.025s
1-nearest-neighbour	3.7	0s	1s

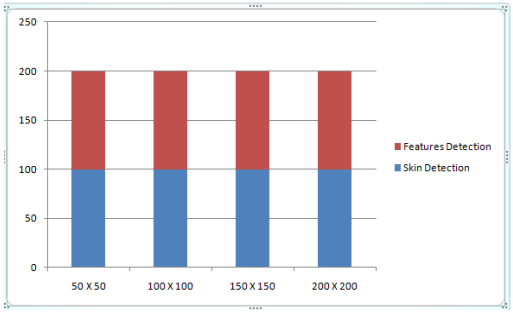
Existing Methods Results

Sr.No	Image Type	Size	Skin Detected	Accuracy of Detection(skin)	Features Detected	Accuracy of Detection(Features)
1	RGB	50X 50	Yes	100%	yes	100 %
2	RGB	100 X 100	Yes	100%	yes	100 %
3	RGB	150 X 150	Yes	100%	yes	100 %
4	RGB	200 X 200	Yes	100%	yes	100 %
5	RGB	250 X 250	Yes	100%	yes	100 %
6	RGB	300 X 300	Yes	100%	yes	100 %
7	RGB	350 X 350	Yes	100%	yes	100 %

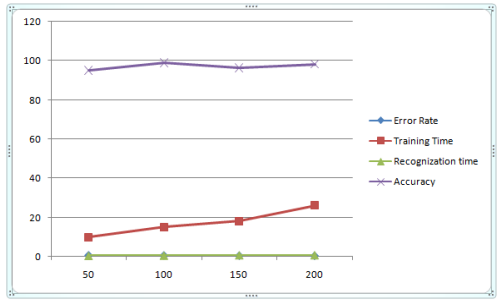
Skin Color Detection & Features Detection Result

Sr.No	Neural Network Training Time	Error Rate	No of Images	Size of an Image	Recognization Time	Accuracy (%)
1	10 Sec	0.67	50	200 X 200	0.32 Sec	95%
2	15 Sec	0.60	100	200 X 200	0.50 Sec	99%
3	18 Sec	0.47	150	200 X 200	0.67 Sec	96.43%
4	26 Sec	0.38	200	200 X 200	0.73 Sec	98.32%

Project Face Recognization Results



Skin detection & Face features Extraction Chart representation



Comparative Study

Conclusion:

We have used a specific method for generating features vector of the whole face in an image, by first detecting face regions using the color of skin which presents a robust overlooked in different background, accessory and clothing. It is a fast algorithm for extracting human faces in color images and easy to implement. GA is then applied to perform the recognition task. This solution was implemented using Matlab environment. Results indicate that the proposed method achieves good results.

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