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EXPERIMENTAL STUDY ON ILLUMINATION NORMALIZATION METHODS FOR EFFECTIVE FACE IDENTIFICATION BY GENETIC ALGORITHM

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Abstract: In this research paper the three very important illumination normalization techniques discussed specifically Log About, Homomorphic filter and Wavelets for effective face Identification using Genetic Algorithm (GA). Their Performances are compared with one another with the standard face database

Keywords : Face Identification,Genetic Algorithm,Image Classification,Image Preprocessing ,Normalization

INTRODUCTION

The purpose of face Identification is to process input images in order to determine the locations of any faces in the image. Faces are complex objects and detecting them remains a challenging task for computer vision systems, despite the relative ease with which humans are able to do so. One of the major difficulties faced by face detection systems is challenging illumination conditions, such as low level lighting and shed shadows. This research paper reviews the state of the art detecting faces using evolutionary approach of genetic algorithm and explores methods of overcoming unpleasant illumination conditions. These methods can be broadly classified as invariant features, normalization and variation modeling. Illumination is considered one of the most difficult tasks for face Detection. Variations caused by pose, expression, occlusion or illumination is highly nonlinear, and making the detection task extremely complex. Well known contrast enhancement algorithms, such as histogram equalization, are global methods which do not consider important image details applied for face Detection [1]. Logarithm transformations enhance low gray levels and compress the high ones. They are useful for non-uniform illumination distribution and shadowed images; however they are not effective for high bright images [2].

Homomorphic filters enable active range compression and contrast enhancement simultaneously, but they are limited by image sizes of 2nx2n [2]. Shan et al. [3] investigated several illumination normalization methods and proposed novel solutions, such as Gamma Intensity Correction (GIC), Region-based strategy combining GIC with Histogram Equalization (HE) and Quotient Illumination Relighting (QIR) method. Chen et al. [4] employed a discrete cosine transform (DCT) to compensate for illumination variations in the logarithm domain. This method not requires any modeling steps and can be easily implemented in a real-time face identification system. In this research work a assessment between three methods from the literature, log About [2], homomorphic filter [5], and wavelet-based [1] to identify which technique is best for face Identification

LOG ABOUT

The Log About method proposed by Liu et al. [2] can be implemented by applying a high pass filter followed by a logarithm transformation described by

$$g(x, y) = a+\ln (f(x, y) +1)/b \ln c$$

Where f(x, y) is the original image, a, b and c are parameters which control the location and shape of the logarithmic distribution.

HOMOMORPHIC FILTER

In this method the original image is split vertically in two halves, generating two sub-images from the original one (figure 1). After wards the filter is applied in each sub image and the resultant sub-images are combined to form the whole image. This method was used a first order (n = 1) Butterworth High Pass filter with a cutoff frequency D0 = 0.25. Then, the original image is divided horizontally, and the same procedure is applied [5]. The two resultant images are grouped together in order to obtain the output image, given by:

IHMMOD(x, y) =1/2.[IHMV(x, y)+0.75IHMH(x, y)]

Where IHMV(X, Y) is the vertically divided image, after the application of homomorphic filter, and IHMH(x, y) is the horizontally divided image.

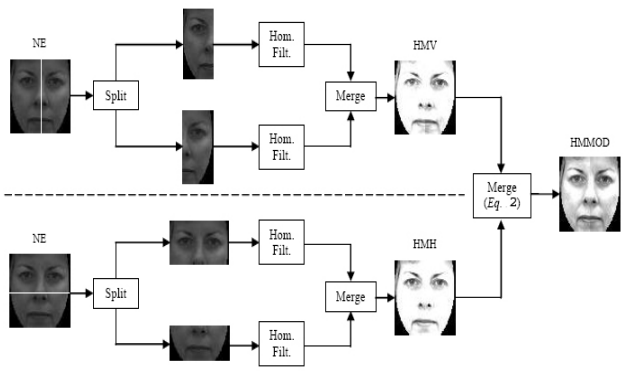

Figure1 Homomorphic filter variation

WAVELETS

In this method the image is decomposed in high (sub bands LH, HL and HH of figure 2) and low frequencies (LL2). Then histogram equalization is applied on the estimate coefficients (low frequency), and at the same time the details are enhanced (high frequency) by multiplying each element of the detail coefficient matrix by a scale factor (>1) [1].

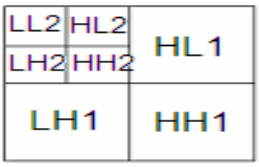

Figure 2: Multi resolution structure

The image is reconstructed from its estimate coefficients and details coefficients in all the three directions by using the inverse wavelet transform, resulting the normalized image.

FACE IDENTIFICATION THROUGH GENETIC ALGORITHM

This Face Identification system is based on visual information of the face from the template image and is commenced with the estimation of the face area in a given image. Facial features, such as eyes, nose, mouth, eyebrow, etc. are then localized from the face skeleton with the knowledge of the face geometry. Experimental findings demonstrates that this face identification system provides flourishing results for the images of persons which contain quite a high degree of variability in expression, pose and other facial details.

Steps involved in Face Identification System [8]

Initialization:

Generate an initial population with M chromosomes randomly.

Evaluation:

Evaluate the fitness function for each chromosome in the population.

Selection:

Use the roulette wheel selection procedure.

Cross Over:

Produce two off-springs from two chromosomes with better fitness function values.

Mutation:

Apply the conventional mutation operation to the population with a mutation rate P_M.

Termination Test:

If a predefined termination condition is satisfied, go to **Step 7**, else go to **Step 2**.

Preservation:

Keep the best chromosome.

End.

RESULTS &FINDINGS

To verify the efficiency of the selected methodologies. These Methods are tested with a standard face database, containing grayscale images of ten people, each one under, twenty different illumination variation constraints.

Table 1 Shows results obtained by applying each normalization methods and without using normalization.

Table 1 Recognition Rate for each method

Method	Recognition Rate
Without illumination normalization	77%
Homomorphic filter	79%
Log About	91%
Wavelet	96%

CONCLUSION

In these research work three illumination normalization methods performances was compared. The results and findings shows that with the illumination Normalization there is an effective improvement in the face identification recognition rate, the wavelet method generates the best result when compared with other methods, improving the recognition rate by 19%. This is due to the fact that face image resultant from wavelet processes has not only enhanced contrast but also with enhanced edges and provide the other required details that will facilitate further face Identification process [1].

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