Face Detection and Recognition: A Review

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Abstract--In this research project, an energy efficient face detection technique for smart phones by combining the normalized cross correlation and generalized cross correlation is purposed. Normalized cross-correlation method is used for the template matching with image light level normalization hence minimize the lighting and exposure conditions in the image. This is typically done at every step by subtracting the mean and dividing by the standard deviation. Whereas, generalized cross-correlation adds a windowing (or filtering) function prior to the inverse transform. Its purpose is to improve the image quality depending on the specific characteristics of the images and noise. In our proposed algorithm, both of the normalized and generalized cross correlation is combined, which will cover all of the aspect covered by the both of the former candidate algorithms. Hence our algorithm will be able to tackle light variations, noise and other specific image characteristics. In addition, algorithm will be able to work with various shadow effects cause by various face angles.

Keywords: Normalized Generalized Cross correlation, Fault Tolerant Face detection, Cross Correlation, Skin Detection, Shape Detection

1. INTRODUCTION

Face detection is a technique what refer to the detection of the face automatically by digital camera. Face Recognition is a term used for recognition of a person automatically by computerized systems by taking a look at his/her face. Face detection is a popular feature used in biometrics, digital cameras and social tagging. [1]

Face detection and recognition has gained more research attentions in last some years. There are many good uses of this face detection and recognition feature: **1)** It can be used as biometric authentication; **2)** It can be used in digital camera for best picture contrast; **3)** It can be used for social tagging.

Biometrics are automatic methods of recognizing a person based on a physiological or behavioral characteristic. Major authentication methods used are as following: [2][5]. First is something of user's knowledge: Like passwords or PIN. Second is something user carries like smart card. Third is some biometric identity of user like finger print, finger vein, palm print, palm vein, face pattern, etc.

Face detection is an almost unique biometric identity. There are very few chances of having two similar faces. So it can be used in the biometric identity based authentications systems. For security hardening it can used in combination with smart card or key card. Face detection is very important feature in digital cameras and social tagging. In digital cameras, Face detection is used because it controls the contrast on face in the clicked picture and can also help to view the clearer face than the click without face detection. In social tagging, face tagging is used to tag the people in the picture or post. [1][3][4][6]

In existing face detection algorithms, various face detection algorithm methods use various face detection methods like knowledge-based method, feature invariant approaches, template matching method and appearance based methods. In this proposed algorithm template matching face detection method is purposed. Knowledge based methods uses the already programmed characteristics to detection the face, whereas appearance based method learn the face shapes by reading various training templates. Feature invariant method uses the object features for the feature detection in an image. Template based method uses the active template comparison, which provide the most accurate results in case of face detection.

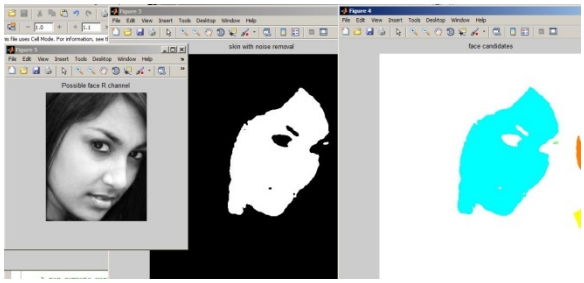

FIGURE 1: A general Face detection using skin colors

In signal processing or image processing, there are a number of methods for template matching are used for various purposes. In example of Google image search, the algorithm used is a image template matching algorithm. In

speaker detection application, there are various voice template matching algorithms are used for various properties of voice. All of these template matching techniques consist of various small feature code segments. These feature code segments may offer noise reduction, light normalization, computer vision anti blurring, feature extraction, feature analysis or feature detection.

Out of these all template matching features, the popular among all is cross correlation and there are various cross correlation algorithms used for the template matching. There are normalized cross-correlation and generalized cross-correlation. Normalized cross-correlation for image-processing applications in which the brightness of the image and template can vary due to lighting and exposure conditions, the images can be first normalized. This is typically done at every step by subtracting the mean and dividing by the standard deviation.

Image cross-correlation compares two image matrices based on various mathematical techniques. Cross correlation in images can be based upon various image characteristics like color patterns, color pixels, matrix coordinates, etc.

A generalized cross-correlation adds a windowing (or filtering) function prior to the inverse transform. Its purpose is to improve the estimation of the time delay, depending on the specific characteristics of the images and noise (broadband or narrowband interference, Gaussian noise, etc.). Since there are many different types of images and noise, there are many different window functions (eg.: SCOT, Ekhart, etc.) Each one is designed for specific problems. Understanding these differences is not trivial, nor is proper calculation of the window function. They are typically dealt with in graduate-level time delay estimation or sonar/radar courses in the signal processing.

2. LITERATURE SURVEY

C. Saravanan et. al have proposed an algorithm for Face Matching using Normalized Cross Correlation. They have used the template matching based approach for face detection. Zhiwei Zhang, Dong Yi, Zhen Lei and Li S.Z. have collectively works on a regularized transfer boosting method for face detection across spectrum. The authors have developed a technique to check the issue of multispectral face by using a combination of large scale visible face images and multispectral face images. Xinjun Ma et. al. have worked on a face detection algorithm based on modified skin-color model. The proposed algorithms works on the basis of skin-color hence uses digital image processing techniques based on color patterns. Zakaria Z. et. al. proposed Face detection using combination of Neural Network and Adaboost. By combining the two algorithms, they have reduced the false positive results drastically. El-Bakry H.M. et. al. have developed Fast principle component analysis for face detection algorithm using cross-correlation and image decomposition. They have developed and used the fast PCA technique to perform the principle of divide and conquer, in which they have divided the image into many sub-images and performed the computation on each sub-image separately. Willis P.A., Stauffer H.U., Hinrichs R.Z. and Davis H.F. have developed a rotatable source crossed molecular beans apparatus with pulsed ultraviolet/vacuum ultraviolet photoionization detection. Kyu-Dae Ban et. al. have proposed a algorithm for face image recognition using NCC (Normalized Cross Correlation). The solution is adaptable for the low resolutions images as well as ordinary or high resolution images. El-bakry and associates have developed a fast Neural Implementation of PCA for face detection. The algorithm is based on cross correlation in frequency domain between the test image and eigen values or weights.

FIGURE 2: A general face detection

3. PROBLEM FORMULATION

Face detection is a technique used in various applications. Most popular applications of face detection are digital cameras, smart phone cameras, social media, photo sharing, photo tagging, biometric, etc. Face detection fails in high or low light, different angles, etc. And face detection computations count affect the battery life of battery running devices.

4. PROBLEM STATEMENT

Face detection is an image processing technique which can be utilized in number of technologies. Face detection can be used for auto-focusing in the digital photography, person tagging on social networks, authentication systems, portal login, etc. Face detection techniques when used on smart phones for various software systems, consumes smart phone resources which directly affect the battery consumption. An effective and efficient face detection technique is required to be developed, which can be as effective as the other best techniques but energy efficient on the other hand, which helps user to preserve the battery power.

5. PROPOSED MODEL

In this research, an effective and energy efficient Face detection technique is purposed by improving existing face detection algorithms. This face detection algorithm must be effective, accurate and energy efficient. The new algorithm will adaptable to various image capturing conditions like lighting levels, head positions, different angles, expressions, etc. This algorithm would be designed using combinations of Normalized Cross Correlation, Generalized Cross Correlation or Generalized Normalized Cross Correlation. To make this algorithm energy efficient the mathematical computations has to be fine-tuned and limited. So It may require a new algorithmic structure which will limit the number of computations to achieve the face detection goal.

6. METHODOLOGY

At first stage, a detailed literature study would be conducted on the existing face detection and recognition techniques. Literature study will lead us towards refining the structure of the proposed algorithm. The literature for face detection and cross correlation would be studied and different aspects would be learnt from the perspective of face detection. Afterwards, the proposed algorithm will be implemented in the MATLAB simulator and a thorough performance analysis would be performed. Obtained results would be analyzed and compared with the existing techniques.

7. CONCLUSION

In this research project, a novel face detection algorithm for various variable factors in the images will be presented. An effective and energy efficient face detection technique is

purposed by combining the existing popular cross correlation algorithms, normalized cross correlation and generalized cross correlation. The proposed face detection algorithm is proposed for smart-phones hence, it must be energy efficient, accurate and fast. Normalized cross-correlation for image-processing applications in which the brightness of the image and template can vary due to lighting and exposure conditions, the images can be first normalized. This is typically done at every step by subtracting the mean and dividing by the standard deviation. Whereas, generalized cross-correlation adds a windowing (or filtering) function prior to the inverse transform. Its purpose is to improve the estimation of the time delay, depending on the specific characteristics of the images and noise. In proposed algorithm, both of the normalized and generalized cross correlation is combined, which will cover all of the aspect covered by the both of the former candidate algorithms. Hence our algorithm will be able to tackle light variations, noise and other specific image characteristics. In addition, algorithm will able to work with various shadow effects cause by various face angles.

8. FUTURE WORK

In the future, the algorithm design would be reviewed before starting the development of the algorithm in Matlab environment. The literature would be also reviewed and more papers, articles or books would be studied and if possible, more improvement in the design and then implement the algorithm in Matlab will be done. Then this algorithm would be thoroughly tested and analysed. Afterwards, the results would be compared with the existing algorithms and if required, improvements would be made in the algorithm code.

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