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Face Detection and Recognition in Smartphones

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Abstract: *In this paper, various algorithms have been referred for face detection and recognition for security purpose in smartphones. Different types of algorithms such as template matching, color code segmentation using K-mean clustering algorithm, etc. for face detection and KLT for face recognition have been used. In any of the face recognition system the first step is face detection. The mentioned algorithms have first been constructed in MATLAB and then later it is implemented in SMARTPHONES phones. After the implementation of the mentioned algorithms, we have recognized certain pros and cons while implementing the face recognition system on a mobile phone with limited hardware capabilities.The level of processing power of mobile phones have been steadily increasing over the past few years .And it has now reached an extent at which there are mobile phones that could run big applications with Relative success. Applications with facial detention and recognition capabilities has also been advancing Over the same period of time to a point where successful facial recognition could be implemented with Considerable less amount processing power. Due to these two advancement it has now become possible to run facial recognition application on Mobile phones. Facial recognition which is the process of identifying specific people in a digital image By comparing and analyzing patterns [6] is now possible on mobile phones. This project would be Developing a mobile application capable of performing facial detection and recognition*

Keywords: Preschool Education, Cognitive Development

I. INTRODUCTION

Face Recognition have become a new way for secure authentication for mobile phones. As mobile phones are becoming increasingly powerful, security of the data stored in mobile phones is a topic of concern; the data can be email addresses, sensitive and important documents, etc. Although, the current phones have password protection to provide security, a face recognition scheme is much more secure and flexible. In the face recognition feature, only by looking at the screen one can unlock their phone screen. Although figure print is the most used way of authentication in mobile phones, face detection is rapidly gaining popularity and acceptance. In this paper, we will focus on few algorithms such as color segmentation combined with template matching for face detection and KLT algorithm for face recognition. As we know that, face detection and face recognition mechanism depends on Biometrics system. Biometric is a measurable and unique characteristic of human being. It can determine both Physiological and Behavioral characteristics of human being. A person's identity can be recognized and verified through this. The Physiological biometric depends on the data obtained by the direct measurements of a part of human body whereas the behavioral biometrics is based on the action of human. Some of the physiological biometrics is facial recognition, finger-scan, retina-scan, iris-scan, hand-scan, etc. And the different technologies related to behavioral biometrics are voice-scan, signaturescan, keystroke-scan, etc. The field of face detection and recognition has attracted a lot of attention in recent times[1], this can be attributed to the large range of applications that it could be used for varying from access control, surveillance and security, personnel profiling and biometrics. But even though considerable amount of man hours as well as resources have already been devoted to the field, it is still a very attractive field to venture into since most of the work done are computer based application while this project would be implement on a mobile phone which has much has resource available to it as compared to conventional computers.

II. LITERATURE SURVEY

Facial recognition has been one of the powerful applications as it has progressed the structure and amalgamation of efficient machine learning algorithms to recognize and verify faces. This finds applications in multiple interfaces suchas

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multi-factor authentication parameters[3], human recognition and verification, authorization, etc. The feature extraction scenarios are mainly used in the tracking of features for other applications, recognizing the emotional state of humans, etc.[4] An example is presented by [3], who has experimented with three-factor authentication wherein the single sign-on token is issued after ensuring password, pin and facial recognition systems match against the user. Following the same example, [5]have also implemented fingerprint, iris, and pin verification for the smartphone user as a method of handling authentication mechanism. The ease of access is in regard to not requiring any special mechanisms to verify the user as the camera will easily capture an image which is further processed for features and verified against the valid match. Another significant application for facial

recognition is highlighted by [6], where they have tracked the human emotions to interact with the robot using the Lanade-Lucas-Tomasi algorithm. Advances in facial recognition technology have garnered more interest from social sites to understand their customers better, Deepface[7] was constructed on Facebook's internal dataset to understand and train over its own profile image dataset using deep learning methods. The objectives of performing facial recognition is different for each use case, it consists of various ends that can be created in ambiguous models. [8]predicted hire ability of professional male candidates with potential features including features for classification.

III. FACE RECOGNITION

Face Recognition has become a new method of secure authentication for mobile phones. One can unlock their Smartphone by simply looking at it. Figure 4 For recognition process few algorithms are used such as VIOLA JONES ALORITHM and KLT algorithm. The reference for both this algorithm has been taken from Comparison between viola-jones and klt algorithms and error correction of viola-jones algorithm by Mohammad Ashraful Islam md.Anin Naeem, md. Nazmul Hasan which was published in International Journal of Computer Engineering and Applications, Volume XI, issued on 5th May 17.

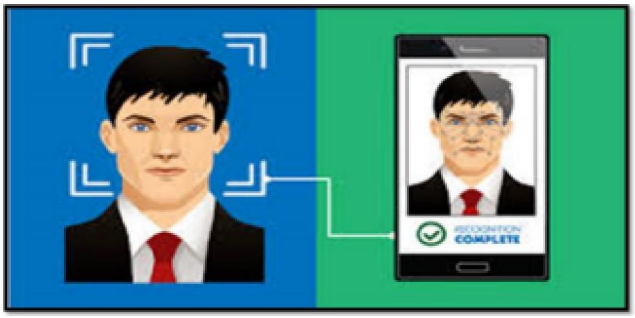

Figure: Face Recognition

A. VIOLA JONES ALGORITHM

This is a first object detection framework which was developed by Michael Jones and Paul Viola and this algorithm is already been implemented in OpenCV in the act of cvHaarDetectObjects() which is used for basically face detection as per the Comparison between viola-jones and klt algorithms and error correction of viola-jones algorithm by Mohammad Ashraful Islam md.Anin Naeem, md. Nazmul Hasan published in International Journal of Computer Engineering and Applications.

Here, the main motive is to detect face from a picture or image. A human can do this task easily but for a device like computer or a robot always needs some information's. In the case of Viola-Jones, to do this task it needs appropriate front view against the camera and the face should not be bending to any other sideways.

B. KLT ALGORITHM Kanade-

Lucas-Tomasi or KLT algorithm measures the components or points of a frame and also detects the same points in another frame and then measures the movement of the points from previous frame to the present frame. This technique is planned because the other techniques are expensive and KLT is so much speedy than other techniques. KLT is basically used for face tracking rather than face detection. Moving objects can be tracked by tracking the particular points in a frame and finding the points in another frame. KLT algorithm is simply used for tracking the faces

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sequentially from frame to frame. Detailing of KLT algorithm is provided in the research paper of Mohammad Ashraful Islam, Md. Anin Naeem and Md. Nazmul Hasan.

IV. IMPLEMENTATION

STEPS IN FACE RECOGNITION

Face recognition is Computer/Mobile based digital technology and is been an active research area from the last few years. To detect faces in an image various techniques were proposed. Here we have referred to template matching algorithm and color code segmentation using k-mean algorithm for face detection and KLT algorithm and Viola-Jones algorithm for face recognition. The following block diagram which is referred from Face recognition in mobile phones by Guillaume Dave, Xing Chao, and Kishore Sriadibhatla shows the major steps in face recognition algorithm.

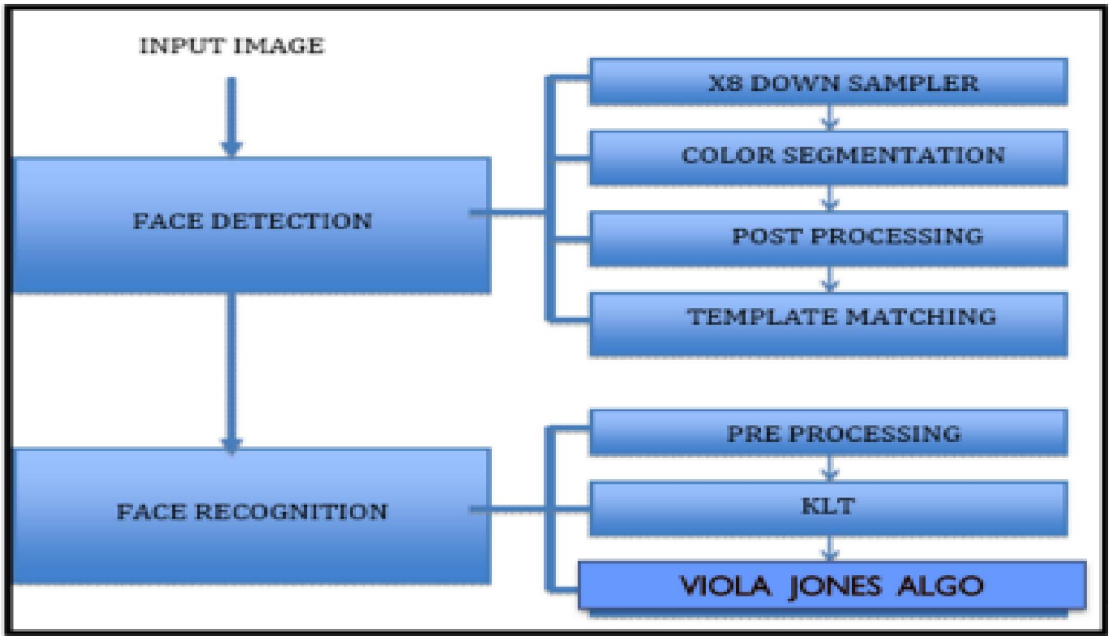
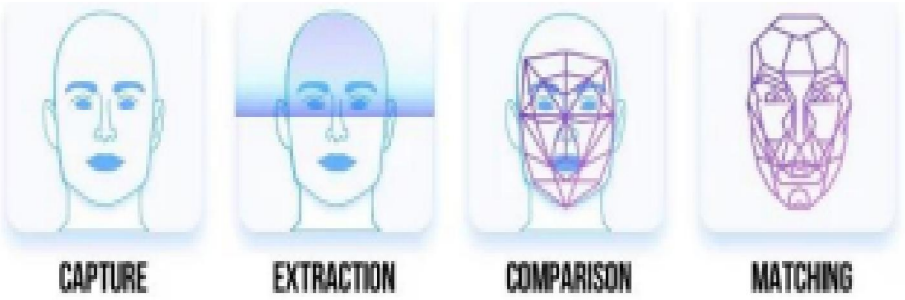


Figure: Block diagram of the Face Recognition system

B. Facial Recognition in Smartphones Facial recognition is becoming the de-facto standard for unlocking phones and gradual elimination of fingerprint sensors in smartphones.

The steps it includes are as follows:



All identification or authentication technologies operate using the following four stages:

A. CAPTURE: A behavioral or physical sample is captured by the system during enrollment.

B. EXTRACTION: A template is created by extracting the unique data from the sample that is being captured and stored within the phones database.

C. COMPARISON: Now, a new sample is compared with the template.

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D. MATCH/NON-MATCH: Here, the system decides if the features which are extracted from the new samples are a match or non-match.

FACE DETECTION

X8DOWN SAMPLER

The first step in our face recognition algorithm is the face detection. We used color segmentation, morphological processing and template matching algorithms for the face detection. If the user takes the photo correctly, we can make the following assumptions:

• The face is centered and takes a big part of the image, since the photo is shot closely
• The illumination conditions are correct
• The user is facing the camera

So the face detection needs not to use the most performing algorithm; we rather want an algorithm that can perform well and fast in the cited conditions.

In consequence, we decided to use the following for face detection:

1) Use color segmentation to find skin pixels.
2) Use morphological operations to eliminate isolated pixels (false acceptances in 1
3) Use template matching to extract only the face, which we will use for face recognition.

COLOR SEGMENTATION

Detection of skin color in color images is a very popular and useful technique for face detection. In the skin color detection process, each pixel was classified as skin or nonskin based on its color components values. To reduce the computation time, we first down sample the image by a factor of 8. This is done without pre-filtering to avoid the extra computation required; the aliasing introduced is negligible. Scale-by-max color balancing is also performed to reduce the effects of illumination variations. Scale-by-max was chosen over gray-world because it can be done in the gamma pre-distorted world and the gray-world assumption is not quite true for face pictures.

In the literature, the color segmentation can be done in many different ways, with some very advanced methods to process the images in extreme illumination conditions or with a cluttered background. Here we looked for a simple rule to detect the skin pixels as fast as possible. Two methods in particular were explored.

First we can work in the RGB space to avoid any calculation. We modified a rule from [2]:

A pixel with color values (R, G, B) is classified as skin if: -

- R > 95 and G > 40 and B > 20 and
- R > G and R > B and
- R-G > 15

This algorithm performed well in general, but we wanted to explore other options, in particular because the speed of the RGB classifier was slower than expected. Other widely used color segmentation methods are based on Cr or Hue classifiers. We tested various rules for Hue, but the classification can be too strict or on the contrary too loose for some lighting conditions.

MORPHOLOGICAL IMAGE PROCESSING

After color segmentation, a mask of non-skin pixels is obtained. However this mask is not perfect: some sparse non-skin pixels are still visible while some parts of the face can be masked (see fig. 3). Morphological image processing is thus a good way to eliminate the non-skin visible pixels and regroup the skin pixels: First, erosion is performed to remove sparse non-skin pixels. Second, dilation is performed with a larger disk to regroup the skin regions and smooth their contours. The disk diameter is bigger when scale-by-max was used because more skin pixels have been misclassified. Below is a sample output of the color segmentation and morphological processing stages.

TEMPLATE MATCHING

After a color segmented image is obtained, template matching is used as a final step in the face detection process. Template matching is a process of locating an object represented by a template T(x,y) in an input image I(x,y) by cross-

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correlating the input with the template. Crosscorrelation is implemented in the frequency domain using (FFT and IFFT) as it is computationally more efficient.

V. METHODOLOGY

Face Recognition System

Face detection separates the area of the face from the image background. Face detection's purpose is to focus in a smaller image area for analysis, rather than analyzing the whole image.

Face feature extraction is used to extract such information from the face image, which helps differentiate between faces of different individuals and is robust to photometric and geometric changes. The extracted face features are used to verify the identity of the face.

Face recognition occurs when the extracted face features are compared to the saved data of one or more faces in the database. This module's output is "yes" or "no" for 1:1 verification; otherwise, when doing a 1:N identification, the output is the face's identity.

The purpose of this work is the development of an application that does authentication based on face recognition in Android mobile devices. Face recognition is not a problem belonging only to the field of computer vision. It is a relevant topic in pattern recognition, neural networks, computer graphics, image processing and psychology.

The three main problems that face recognition aims to solve are [15]:

Verification (authentication): Am I who I pretend to be? The face recognition system decides whether the face in the acquired image belongs to the identity the person pretends to have.

Identification (recognition): Who am I? The face recognition system matches the face from the acquired image with the face models saved in the database.

Watch list: Are they looking for me? The acquired image is compared to the face models of people in the watch list saved in the database. If the face in the image belongs to a person in the watch list, that individual is identified.

Pose variation: The ideal situation for face detection would be in cases where all the input images contain faces in frontal pose. However, this is hardly realizable in practice. Furthermore, pose variation affects face detection algorithms' performance.

Obscuring face features: The presence of elements such as glasses, a hat or a beard is another challenge for face detection.

Face gestures: Face features change by a considerable amount as a result of different face gestures.

Factors of the environment where the image is acquired: Different cameras and different environmental conditions can greatly affect the image quality, thus also affecting the visibility of the face in the image

The images FaceAuth gets from the camera of the mobile device are not normalized, in the sense that they do not only contain faces. These images also contain other objects that, in the case of our face recognition system, represent noise data.

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