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AN ANDROID APPLICATION FOR FACE RECOGNITION BASED AUTHENTICATION ON INCOMING CALL

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Abstract

This paper presents an application to authenticate incoming call receiver, based on robust and fast face recognition engine. The application allows registering and verifying subjects by storing and comparing their biometric information respectively. Application restricts the user to receive incoming call unless it verifies the proposed entity, if the entity is authentic then call will be received else application will reject the call automatically. All the processing is done in mobile device.

Face recognition is based on Local Binary Patterns (LBP) features, which have shown to be a powerful and computationally efficient feature extractor. The algorithm constitutes the engine of a new face recognition based user authentication for incoming call application. In terms of convenience, a higher degree of user-friendliness can be achieved if the biometric authentication is transparent, which means that the authentication can be done without explicit user actions. The current application runs on Android O.S., having been tested in mobile platform, demonstrating the feasibility of the proposed approach.

Index Terms— Face recognition, mobile computing, Android, incoming call.

Introduction

The process of verifying a person's identity, also called authentication, plays an important role in various areas of everyday life. Any situation with user interaction where the identity is required needs a means to verify the claimed identity. One of the more obvious and commonly known application areas for identity verifying technologies, i.e. authentication, is the Logical Access Control to computer systems, where authenticity is normally established by confirming aclaimed identity with a secret password or PIN code.Traditional methods of confirming the identity of an unknown person rely either upon some secret knowledge (such as a PIN or password) or upon an object the person possesses (such as a key or card). But testing for secret knowledge or the possession of special objects can only confirm the knowledge or presence, and not, that the rightful owner is present. In fact, both could be stolen. Conversely, biometric technology is capable of establishing a much closer relationship between the user's identity and a particular body, through its unique features or behavior.

Biometric verification performs comparison of biometric template with the one it has on records. Face recognition is one of the techniques used in biometric verification. While performing face recognition on mobile platform it does not only suffer from the same problems of a computer based system, such as illumination, occlusion and pose variations, but is also limited by other factors: Limited Processing Power, Limited Memory [1]. To implement face recognition based authentication for incoming calls on mobile, existing algorithms suffers from recognition time and Accuracy Tradeoff i.e. increasing robustness will increase the time of recognition.

To implement Real Time Recognition i.e. recognition must be performed within few seconds to support incoming call authentication and to make application robust under different illumination conditions. We use Retina illumination normalization [8] followed by simple, but robust and efficient face recognition algorithm for implementation in mobile devices. It is based on Local Binary Patterns (LBP) features [3], which have shown to be a powerful and computationally efficient feature extractor. Then Chi-square based classification method is used for Authentication.

The algorithm constitutes engine of a new face authentication for incoming call application. It restrictsuser to receive call unless proposed entity's face is not verified with registered entity's face image. The implementation is made for the Google Android platform, using OpenCV libraries for image processing. It is important to take into account that all

the processing is done in the mobile domain, without the need of any external computation.

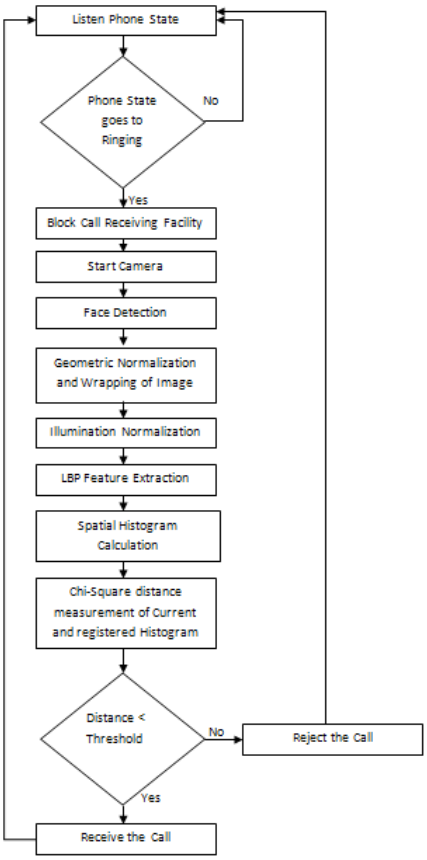


Figure 1.Flow Chart for Authentication on Incoming Call

An authentication method based on face recognition is designed for restricting access of incoming call for un-authorized entity. It will take the image of person (who wants to be registered as an authorized entity) during the registration process, once the registration is complete, it will monitor the entity while call receiving. Therefore the user can not receive the call unless the application will grant him as an authorized entity. For this purpose application has to monitor the call status and as the call status goes to incoming call, application has to restrict the receiving of call and take a photo of claimed entity by the same camera of mobile on which the call is coming. Once the image is captured, it will go through the matching process between capturedimage and registered image, if the match is successful then call can be received by the entity, else call will be ended. Flow chart of authentication process is shown in Figure 1.

The paper is organized as follows. The implemented facerecognition algorithm is presented in Section 2. In Section 3we make an analysis of recognition process and describes the application of incoming call authentication. Testing is done in Section 4. Finally, some conclusions are given in Section 5.

Face Recognition Algorithm

This section briefly explains different parts of theprocessing chain. Android SDK (Java) which is intended for the GUI, camera access and Android NDK (C++) intended for the image processingoperations have been used for computing operations.

First we need to capture the image and detect the face in it. Face detection is done by using method provided in Android SDK. To prevent errors due to misalignments,rotation or scale differences, a warping processis applied. The normalization is based on the eye positionslocated in the previously detected face. Cropping is done to extract face from the image. The final size of the normalized face image is 105×120.

To make the application illumination invariant, Retina modeling is used which consists on a nonlinearlight adaptation and a Difference of Gaussian (DoG)filter to remove illumination variation.

Local Binary Patterns (LBP) is used to extract the image features. We use the radius 1 and neighbor 8 in LBP feature extraction. To calculate the spatial histogram of LBP image, 60×70 sized window is used with 5 overlapping areas.

The classificationis based on chi-square distance measurement of histogram values [4].
Results presented in [2] show that the combination of Retinaillumination normalization and LBP features obtains goodrecognition rates in FERET database and YaleB database(98% and 100% respectively). Furthermore, this method obtainssimilar results than Local Gabor Binary Pattern Histogram Sequence (LGBPHS) [5], but with much lower complexity(computation time), so it seems a good starting pointfor mobile face recognition implementation [6].

Incoming Call Authentication Application

Based on the face recognition system described above, wepropose an incoming call authentication application. Theaim of the application is to restrict access of incoming call to unauthorized entity.Application is divided into four

modulesRegistration Module, Verification Module, Call Monitoring Module and Decision Taking Module. Figure 2 demonstrates architecture of application.

Registration Module: It takes the image from the camera, detects the face in that image, if face is detected then crops that face and makes an image which is then rescaled to a fix size image. Final size of normalized image is 105×120. After performing the wrapping process on the image, retina modeling is applied on the image to make it illumination invariant. Output image of retina processing is used to find the local binary pattern (LBP) image which is then used to find spatial histogram of LBP image. Resulting histogram is stored for further evaluation and decision making.

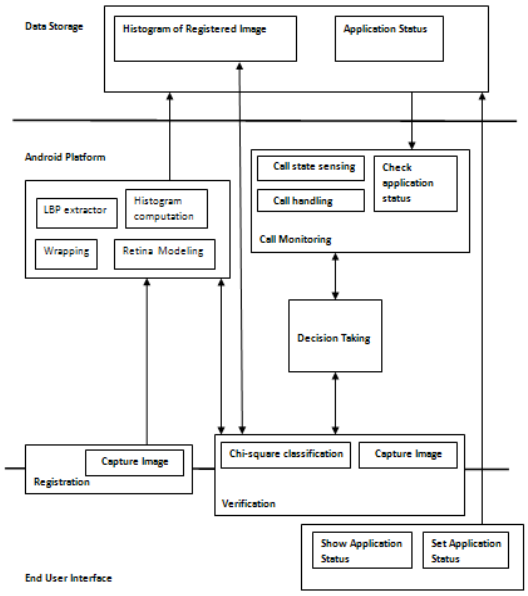


Figure 2.Application Architecture

Verification Module: It takes the image from the camera and performs face detection, cropping of image, wrapping of image, retina modeling, LBP computation and spatial histogram calculation of LBP image. After calculating histogram of proposed entity's image it performs matching operation between current histogram and histogram of registered person by calculating chi square value. If the value is above threshold then image is considered as mismatch else image is considered as successful match.

Call Monitoring Module: It performs continuous sensing of call state and when call state becomes ringing i.e. incoming call is detected, itoverrides the basic call handling module of android and starts the Decision Taking Module. Overriding the basic call handling module restricts the user to receive the call before face authentication.

Decision Taking Module: It starts Verification Module to find the result. Verification Module returns successful match or mismatch. If it gets successful match then it removes the restriction to receive the call applied by Call Monitoring Module and receives the call. In case of mismatch it terminates the incoming call.

Testing

Table 1 shows parameters to perform testing on the application.

Camera image	
Size	640×480 pixels
Colour representation	RGB
Wrapped image	
Size	105×120
LBP image	
Size	105×120
Radius	1
Neighbours	8
Spatial histogram	
Number of patterns	12
Window size	60×70
Overlap area	5

Table 1.Testing parameters

Maximum acceptable difference of chi square values (Threshold) should be less than 100 for successful match.When the user enables authentication tool then application starts monitoring the incoming call and restricts the user to receive the call unless proposed entity's face is not matched, shown in Figure 3.

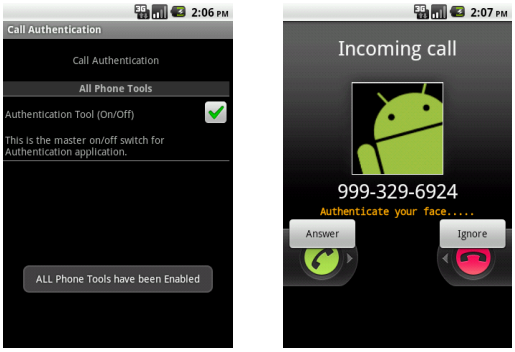
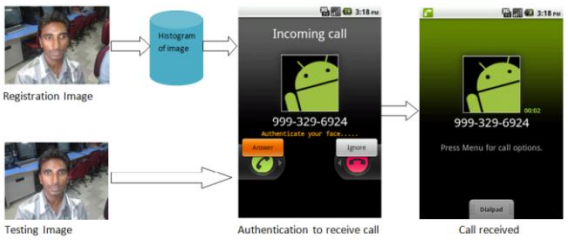


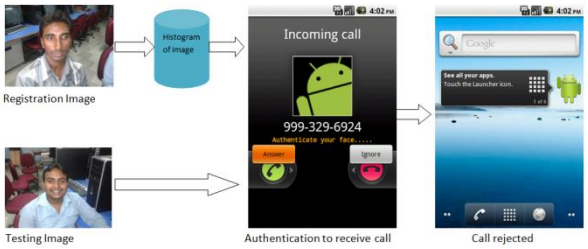
Figure 3.Enable Call Authentication

When incoming call is detected, application takes proposed entity's image and processes it to find the spatial histogram of image which is then used to find chi square value with registered image's histogram. If chi square value is less than threshold

then call is received, shown in Figure 4 (a) else call will be rejected, shown in Figure 4 (b).



(a) **Call Receiving**



(b) **Call Rejection**

Figure 4.Incoming Call Authentication

Conclusion and Further Work

An overview of face recognition on mobile device and the method to implement illumination invariant face recognition to perform authentication in limited time constraint are given. The combination of Retina Modeling, LBP(Local Binary Pattern) and Chi-square based classification method acts as a solution for providing robust and fast face recognition application to support real time authentication.

In the proposed approach, important parameters namely response time, and accuracy are considered to determine acceptability of application. The proposed method enables the user to receive the incoming call by authenticating face; it provides the freedom to capture images in various illumination conditions.

Results of the system are analyzed to test the call rejection and call acceptance conditions in various domains.

In future, method to block the cell phone if authentication fails can be implemented. When proposed entity fails to verify its identity then cell phone should be locked and it will unlock itself only ifthe application verifies authenticated person, meanwhile cell phone also sends its gps location to the registered person's email id.

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