Dynamic Authentication Technique Using Lip Movements

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Abstract--- Advancement of technology has conquered every strata of human society. In this technological era the protection of important data from being intercepted is growing difficult day by day. Bio-metric security stands to be one of the most secure form of authentication techniques. Such authentication can be seen in the regions with high security such as Defense, Research head-quarters, space-missions etc. Bio-metric authentication today ranges from face recognition to retina recognition. Which are all single stage authentication techniques and cannot be heavily relied upon seeing the current advancement of technology. This concept of multi stage authentication technique which uses a total of three different characteristics / traits for identification of humans not only increases the reliability by many folds but also aid's to the robustness of the system. The first two stages consist of Face recognition and lip pattern recognition, the third stage consists of authentication based on dynamic moments of lips. By tracing and capturing the successive movements of lips during speech, the corresponding words can be detected and can be checked with the data base to authenticate an individual. The captured images are represented as points on a two-dimensional flat manifold that enables us to efficiently define the pronunciation of each word and hence analyze or synthesize the motion of lips. With multiple level of image processing, it becomes possible to set the matching parameters to a very close value and hence it becomes extremely difficult for any other brute force or hacking techniques to break into our system.

Keywords: Face Recognition, lip ROI detection, Feature extraction, lip reading, syllable tracking, threshold analysis.

I. INTRODUCTION

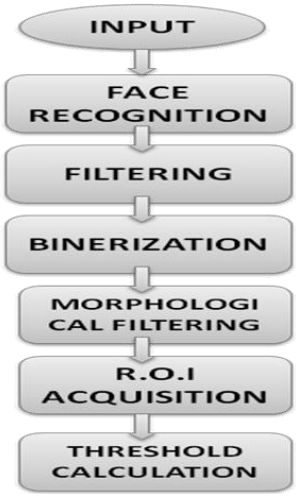

Fig. 1: Steps for detecting lip and calculating threshold based on same and using that for authentication

A large number of people need to be provided access to applications in varied context. New solutions are very much required for the advancement of human – computer interaction which can play a major role in integration of the information systems. Till date very less work has been done on automated lip reading area. Also majority work is based on color analysis, mouth parameters etc. We have developed a system which recognizes and converts the lip movement of an Individual into a pattern which can be used as a password for authentication in varied applications. This paper presents a secure, reliable and robust method for recognition of speech based commands without processing or evaluating of sound signals.

Multistage Silent Authentication System is mainly divided into three major steps: Face detection and tracking, Lip region detection, and converting the visual moments of the lips to a pattern for password authentication.

II. FACE DETECTION AND FACE TRACKING

The very first step of the system is to detect the face and to make real time tracking of the same, [1]Viola-Jones algorithm is used in order to detect the face from the whole picture frame. Viola-Jones algorithm involves the sum of image pixels within rectangular areas along.

Fig. 2: Tracked Face

The first part is to detect the face zone and make a useful face tracking; we used the "Viola-Jones" algorithm in order to detect the face zone from the whole picture. The Viola-Jones algorithm involves the sums of image pixels within rectangular areas along the image and also several iterations Until the strong classifier is found where each iteration the distribution of weights of weak classifier is recalculate, therefore may take a long period to operate. [2]Track the face location instead of applying the Viola-Jones algorithm for each frame, helps to avoid loss of time and unnecessary calculations.

The "Viola-Jones" algorithm detects the initial face zone

where, in the hue representation, the mass center is searched. The HSV (hue, saturation, and value) are common cylindrical-coordinate representations of points in an RGB color model, where the hue representation is the angle around the central vertical axis corresponds to each cylinder.

III. GABOR FILTERING

Elliptical Gabor filtering is used because of the fact that the shape of the lips is best suited to an ellipse [5]. And is defined as under:

$$G(x,y) = g(x',y')\exp\left(2\pi jF\sqrt{x^2+y^2}\right)$$

Where

$$(x',y') = (x\cos\theta + y\sin\theta, -x\sin\theta + y\cos\theta)$$

G and F is the spatial central frequency of the filter in the frequency domain.

G(x,y) is a 2-D Gaussian envelop as follows

$$g(x,y) = \left(\frac{1}{2\pi\sigma_x\sigma_y}\right)\exp\left[-\frac{1}{2}\left(\frac{x^2}{\sigma_x^2}+\frac{y^2}{\sigma_y^2}\right)\right]$$

A set of Gabor filters with different frequencies and orientations may be helpful for extracting useful features from an image'. Once the face is detected the next step is to filter the received images to convert them into a HSV. If we want to convert this into a binary form we have to first convert RGB to HSV. The gray scale images can be easily dealt with for localization process.

Because of the elliptical shape of lips, in appropriate frequency and scale factors, the EGF emphasizes the edge of lips. Therefore, these parameters are adjusted in a way that the lip and mouth region are apparently extracted.

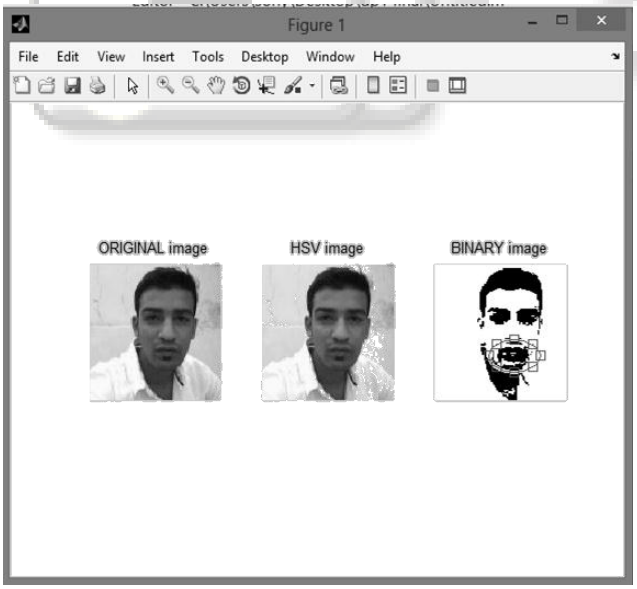

Fig. 3: Simulated Results of HSV and Binary Image.

IV. BINERIZATION

After performing EGF filtering on face image, binarization of image carried out. Here the binary image is a digital image that has only two possible values for each pixel [6]. Two colors used for a binary image are black and white though any two colors' can be used. The color used for the object(s) in the image is the foreground color while the rest of the image is the background color.

Binary images are also called bi-level or two-level. This means that each pixel is stored as a single bit (0 or 1). The names black-and-white, B&W,

Then on black and white image, post processing morphological operations is used to smooth the extracted binary mask and eliminate small erroneous blobs and holes. By determining mouth region, a rectangular.

V. MORPHOLOGICAL FILTERING & R.O.I. ACQUISITION

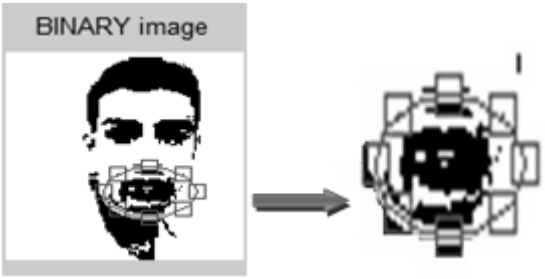

Fig. 4: Morphological Filtering and Then Applying R.O.I to Binary Image for Lip Feature Extraction

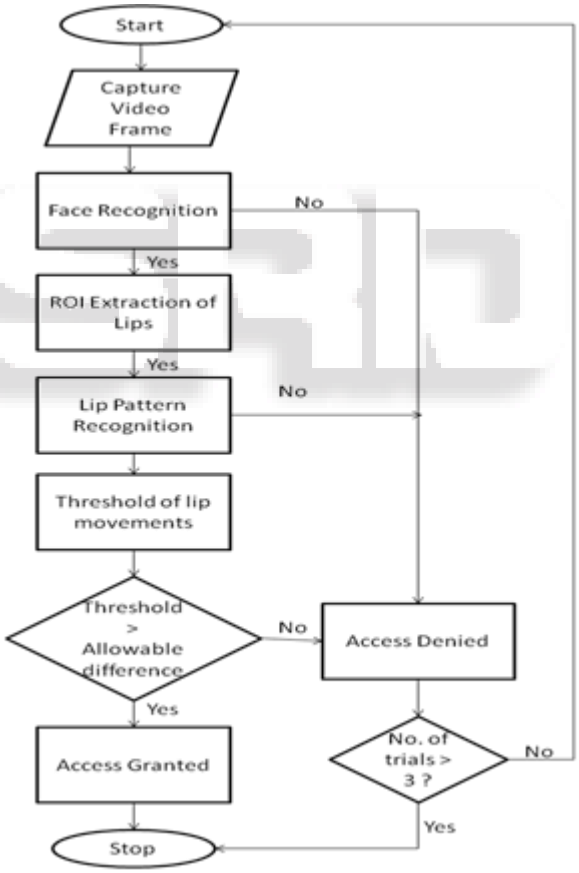

Fig. 5: Flow Diagram of the Whole System

Morphological filtering [5] will improve visibility and perceptibility of the lips which will ease the detection of the same. These will clean the image from various types of noise, enhancing contrast among adjacent regions or features at certain scales and retaining only lips in the complete frame, in other words we can say that it will act as a binary mask which will mask the remaining parts of the face only lip portion remains.

The next step is to extract the Region of Interest (R.O.I.) lips from the complete frame.

VI. CALCULATING THRESHOLD BASED ON LIP MOVEMENTS

After the lips have been successfully detected the next step is to convert the visual moments of the lips in a form of pattern that can be used for authentication.

The system that we devised for authentication purpose is calculating the no of frames (threshold) as under:

1) Calculate the no of frames between one lip touching frame to the next one. Note in case of live streaming the threshold should be kept bit large for more accurate results.
2) Now if the calculated threshold is beyond the actual threshold then access will be denied otherwise accepted.

VII. CONCLUSION

Here, we propose new concept of biometric authentication based on moments of lips where no voice is involved. Here face recognition and lip pattern recognition will serve as the preliminary rounds of authentication. Hence will aid to reliability of the system.

Based on these concepts various authentication systems and related technologies can be improvised to which differently abled (who cannot speak) person were an exception.

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