Real time Eye Tracking for Password Authentication Using Eye Blink

Suhas A Bhyrate[1], Deeksha K [2], FirdouseAkhtar[3], NavyaShree S.L [4]

Assistant Professor, Department of Information Science & Engineering, Atria Institute of Technology, Bangalore India[1]

Student, Department of Information Science & Engineering, Atria Institute of Technology, Bangalore India [2,3,4]

Abstract— **Existing system includes entering Passwords physically which could be vulnerable and pins are universally used for validation and security. This paper includes avoiding frauds happening in bank and other safety zones. Specially designed for physically disabled to input passwords without having to physically input the pin. Certain algorithms are included to improve efficiency and enhance security. This is done via eye movements or eye blinks. Eye trackers provide better security compared to any other methods. This paper presents the real time application for gaze-based pin entry and eye detection and tracking for PIN identification using smart camera.**

I. INTRODUCTION

Eye trackers are considered as the tool which helps to compute the visual activities. It makes physically disabled people are able to interact with computers using their eyes. Firstly it captures the insight of the retina and the cornea of the eyes, commonly called as "red eye". Personal identification numbers are often used in user authentication method for many applications such as managing the money in ATM, approving electronic transaction, unlocking personal devices and opening doors [1]. Many applications uses PIN's for authentication in public setting a common attack is to record user's PIN entry.

All these security problems have been recognized from long time and researchers have come up with many different strategies to minimize the possibility of PIN entry observation. One such proposed alternate PIN entry method requires the user to input some information, which is derived from a combination of the actual PIN [1].

Interaction of computers is not only limited to keywords and printers. There are many kinds of pointing devices such as touch sensitive surfaces, high resolutin displays, microphones and speakers. Few people interact with computer round the clock for their work. Generally, the

interaction is through keyboard and mouse or both using hands, Eyes are a good applicant because they move anyway when interaction with computers. Eye moments can save interaction in particular hand based interaction.

Real time Eye Detection:

A. Smart Camera

The main component of eye tracking system is Logitech C170 smart camera or web camera with nice resolution. The main use of this camera is on board data capture, processing and storage. The users were asked to read texts and their gaze would be captured. In this particular application the viewer gazes at the digits of digital keypad. The camera is located above the virtual keypad. The system starts with capturing the images and converting it to grey scale image. First either system's camera or an external camera captures the images and transmits to laptop for image processing which is based on python with open cv. We will have to obtain positon of eye ball and define eye blink. The eye blink and movement works as the cursor control on the laptop screen and is used for entering command.

B. Personal identification number entry

Gaze based password or pin entry requires the user to enter pin or password by looking at the virtual keypad. The user will have to look at each digit or character for few seconds and blink for few seconds before moving to the next. While the user is viewing the pin digits on the keypad the camera captures the image of eye in sequential frames, computes the eye center location using certain image processing algorithms [7]. The eye tracking is stopped when pin entry is done.

C. Eye Blink Detection

To detect the eye blink, the number of black pixel in the pupil area is measured. The change from high to low of the dark pixel is designed for the eye blink detection. The eye movement and blink were used to controlled user interface for smart eye tracking system. The movement of the cursor will be moved following eye movement [6].

D. Algorithms

Until the user stop, the camera will be programmed to track the eye motion. It must select and save the template before real time eye tracking begins. **Figure 1**shows the flowchart for the real time eye tracking algorithms.

The Flowchart of Figure is explained below:

Step 1: Image Acquisition: It captures the raw image automatically by using smart camera.

Step 2: Image Preprocessing: The captured raw image is converted to a grey scale image, automatically by the camera.

Step 3: Face and Eye Detection: Initially the user's face and eye detected by Haar Cascade Algorithm using template matching.

The template matching, a template from the S is compared with the given image using a matching

compared with the given image using a matching metric. The matching metric provides a measure of similarity between the two templates. This similarity is converted into a numerical value as a score of the template match. A score of 1000 means an exact match with the tested template [2].

Step 4: Draw Facial Landmark: After template match. It marks the points on face to detect the face and eye position using Facial Landmark Recognition Algorithm. Facial Landmark Recognition Algorithm marks 5 or 68 points on face.

Step 5: Edge Detection: To find points around the ellipse or circle of the eye, an Edge detection technique is applied to new region i,e Region Of Interest (ROI).

Step 6: If at least 3 points or 4 points are found, the circle or ellipse will be drawn otherwise it skips the current frame.

Step 7: If the ellipse/circle of the eye is drawn, then the co-ordinates of the center of the eye will be calculated in the camera's processor and saved for future.

Implementation:

i) Haar cascade algorithm:

This algorithm helps in Edge feature detection in the eye region.The selected area is compared with positive and negative images ifthe area is detected as positive then the selected area is considered as an eye region or else it will consider it as negative.

It has four types

- Haar feature selection
- Creating integral image
- Adaboost training
- Cascading classifiers

Haar feature selection:

This is digital image feature which is helpful in object recognition.Firstly the algorithm should be trained with lots of positive and negative images to train theclassifier. Then the feature is taken out from the image.The eye region in the face

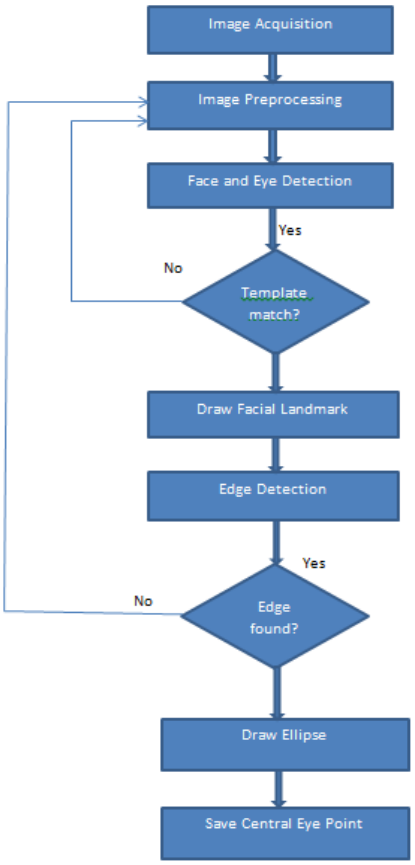


Figure 1: Flowchart for the real time eye tracking algorithm

is determined by using the edge feature detection since the eye region is darker than the other region when compared to nose and cheeks.

Creating integral image:

Integral images are those images in which the pixel value at any *(x,y)* location is the sum of the all pixel values present before the current pixel.

Adaboost training:

This process selects only those features known to improve the diving power of the model, reducing dimensionality and potentiality improving execution time as irrelevant features need not be computed. During this process, specific size is moved over the image and for each subsection of the image the haar features are calculated.

Cascading classifiers:

It consists of collection of depositary, where each storage is an ensemble of week learners. The week learners are simple classifiers called decision stumps. Each stage is trained using a technique called boosting. Boosting provides the ability to train a highly accurate classifier by taking a weighted average of the decisions made by the weak learners.

ii)Facial landmark recognition:

This algorithm helps to detect key facial structures in the image. When the user input the window location where the face and eye region is found. The overall points or markings on face would be 68 points and over eye it would be 6 points (because we need eye region specifically for password authentication).

This algorithm will locate the key facial structures with specific (x, y) co-ordinates.

i. Start with 1 for first (x, y) co-ordinate

ii. End with 68 with the last (x, y) co-ordinate.

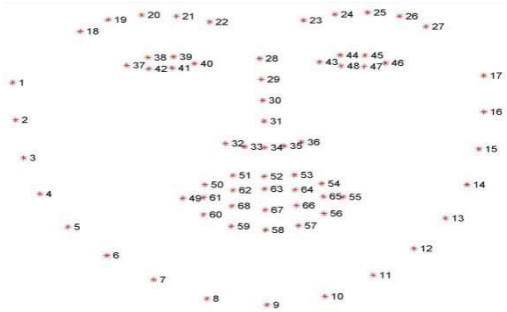


Figure 2: Facial marks drawn of face and eye region

iii) Canny Edge Detection:

Canny edge detection is a multi-step algorithm that can detect edges with noise quelled at the same time. itsmooths the image by using a Gaussian filter to quell the noise and undesired details.

The Process of Canny edge detection algorithm can be broken down to 5 different steps:

1. Apply Gaussian filter to smooth the image to quell the noise.
2. Find the intensity gradients of the image
3. Apply non-maximum suppression to get rid of retaliation of edge detection

4. Apply double threshold to determine potential edges
5. Track edge by hysteresis: Finalize the detection of edges by quelling all the other parts that are weak and not connected to strong edges.

I. To calculate the gaze ratio

1. Input the pixel values of the eye region.

2. Get only the eye region

3 .Divide each eye region into left and right part

4. Convert the eye image into gray scale.

5. Get the number of white pixels on both side i.e., on the left side and right side of each eye.

6. **To Calculate the Gaze Ratio:**

i) Gaze Ratio of left eye =

Number of white pixels on right side

Number of white pixels on right side

ii) Gaze Ratio of right eye =

Number of white pixels on right side

Number of white pixels on left side

iii) Gaze Ratio =

Gaze Ratio of left eye +Gaze Ratio of right eye/2

7. If Gaze Ratio <= 0.9 then select the right keyboard

Else

8. Then select the left keyboard

When the keyboard is displayed the eye blinking is calculated to update the password.

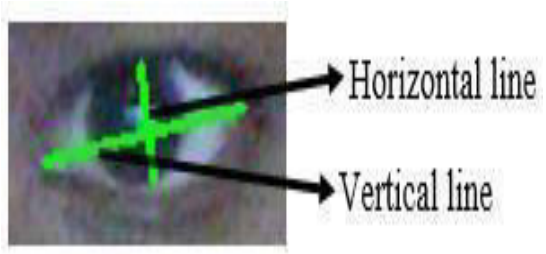
Algorithm:

I. Tocalculate the Blinking Ratio

1. Input is the co-ordinate values of the eye region

2. Obtain the horizontal and vertical of left eye:

i) Calculate the midpoint of 37^{th}, 38^{th}co-ordinate and 40^{th}, 41^{st}coordinate.
ii) Join the points to the vertical line.
iii) Join the $36^{th}$and 39^{th}point to get the horizontal line.



3. Obtain the horizontal and vertical of righteye:

i) Calculate the midpoint of 43^{rd}, 44^{th}co-ordinate and 45^{th}, 46^{st}coordinate.
ii) Join the points to the vertical line.
iii) Join the $42^{th}$and 47^{th}point to get the horizontal line.

4. Calculate the Blinking Ratio:

i) Blinking Ratio of left eye:

Blinking ratio of left eye =

Length of the horizontal line

Length of vertical line

ii) Blinking Ratio of right eye.

Blinking ratio of right eye =

Length of the horizontal line

Length of vertical line

iii) Blinking ratio =

Blinking ratio of left eye + blinking ratio of right eye /2

5. Initialize the Blinking frames to zero

6. If Blinking ratio >=5

Increase the blinking frames value by one

Else

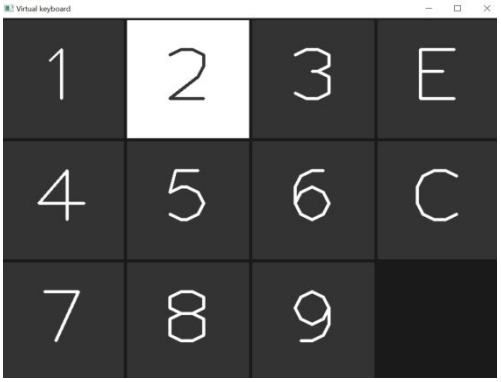
Do nothing

7. If Blinking frames ==6

Then update the letter as password

Figure 3: vertical and horizontal lines drawn over eye region

Figure 4: Co ordinate drawn over eye



Results:

A. Eye Detection and Eye Tracking:

Figure 5 shows how it will capture the digits when a person blinks a eye during pin entry. Every person will have unique password, to enter the password just blink on a particular number on virtual keypad. For example if a password as 3 digit unique password that person should blink 3 times on a particular number as per his unique Password. If a person has blinked on wrong pin number he can blink on 'C' to clear the Pin numbers.

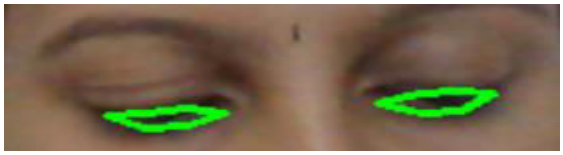


Figure 5 shows how it will capture the digits when a person blinks an eye during pin entry

Conclusion:

A smart-camera based eye-tracking system has been incorporated into a new application for gaze-based PIN identification. The system has been successfully tested with a nine-digit keypad, and can be extended to character and digit combination password entry. Stray data points in the scatter plots are generally associated with blinks of the eyes between digits . The stability of uses gaze will affect the accuracy of detected pins,

and must be accounted for. Currently the pin identification is accomplished after real time eye tracking and blinking technique. Future work includes incoperating the pin identification algorithm into the real time frame work for all in one password identification system. In addition gaze based password entry can extended to mobile devices, security zones, doors and other camera based systems.

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