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Gaze based Smart Eye Tracking System for Password Authentication

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ABSTRACT: Personal identification numbers (PIN) are widely used as safety measures especially to provide authentication and security since 90's. PIN requires user to physically input the PIN entry possibly leading to the password hacking via shoulder surfing or thermal tracking. PIN authentication using eye blink technique on the other hand doesn't leave any foot print behind, thereby provides a much better password authentication mechanism. Gaze-based authentication refers to finding the eye location across sequential image frames, and tracking eye center over time. Password authentication will be done using Morse code, where numbers will be represented as dots and dashes. This paper presents a real-time application for gaze-based PIN entry, eye detection and tracking for PIN identification using a smart camera.

KEYWORDS: Gaze based authentication, Eye blink PIN entry, Facial landmark, Morse code

I. INTRODUCTION

Throughout history technology has been the driving force of change. From movable type, to television, to the Internet, technology has been embraced and incorporated into our daily lives. Within the constructs of civilized society, the vast rewards of technological innovations have far outweighed the negatives. With the improved technology comes different ways in which we can make our lives better and more efficient.

The goal of any general security authentication system is to be user friendly, fast and safe for general public using conventional knowledge based mechanisms like passwords. But, these conventional methods are vulnerable leading to attacks like shoulder surfing and thermal tracking. Usable security is concerned with the study of how security information should be handled in the system, both at the user interface and in the back-end process, without discarding consideration for resources and costs. Balancing usability and security to achieve optimal result has been defined by the principle of psychological acceptability. According to this principle, a security mechanism should not make accessing a resource, or taking some other action, more difficult than it would be if the security mechanism were not present. This means that a security mechanism should add as little as possible to the difficulty of the user's performing some action. Here the perception of "difficult" should account for the abilities, knowledge and mental models of the system users. In essence, for security to be more usable, it has to be less noticeable. This paper considers all those factors and tries to achieve a result that is easily attainable by any user that interacts with our system. Currently there are not a lot of amenities for disabled people in the world which helps them to be incorporated in the normal society. Our system hopes to lessen that burden on them and makes sure that they are more integrated with the society

II. RELATED WORK

Real time Eye Tracking for Password Authentication [1] proposes a authentication process where a real time application for gaze-based PIN entry, eye detection and tracking for PIN identification using a smart camera. This process leaves no traces of physical footprints behind, therefore offering one of the most secure way to authenticate the password.

| | | |
|---|---|---|
| 1 | 2 | 3 |
| 4 | 5 | 6 |
| 7 | 8 | 9 |

Fig 1: Digital keypad for gaze based authentication

Quantitative Analysis of Tennis Experts Eye Movement Skill [2] proposes measurement the eye movements of an actual expert tennis player and a beginner tennis player. The measured eye movements of the players are compared and analyzed. The eye movements are recorded using an eye-tracker. Main observation made in this paper is that beginners have a tendency to follow the tennis ball unconsciously for a moment.

Smart-Eye Tracking System [3] proposes a sensible Eye tracking system which is intended for people with disabilities and elderly people. The concept of this research is to use eye movement to control appliances, wheelchair and communicate with caretaker. This technique comprises of four components, imaging processing module, wheelchair-controlled module, appliances-controlled module and SMS manager module. The image processing module consists of webcam and C++ customized image processing, the eye movement image is captured and transmitted to Raspberry Pi microcontroller for processing with OpenCV to derive the coordinate of eye ball. The coordinate of eye ball is utilized for cursor control on the Raspberry Pi screen to control the system

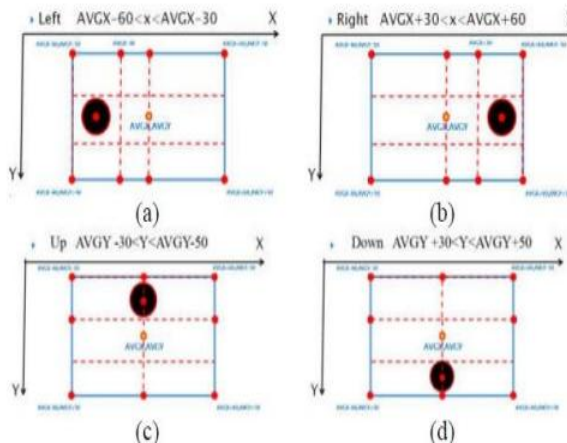


Fig 2: Eye ball movement detection

Besides the eye movement, the eye blink is applied in this system for entering a command as when you press, Enter button on keyboard. The wheelchair-controlled module is a cradle with two servos that can be moved to two dimensions and also adaptable to other wheelchair joysticks. This system also remotely controls some appliances and communicate with caretaker via send message to Smartphone.

Extension of Desktop Control To Robot Control By Eye Blinks using SVM [4] proposes to issues related issues related to Accessibility, which should eliminate, or at least reduce, the distance between disabled people and technology. For severely-impaired persons, there are still many challenges that must be overcome. We present eye tracking as a valuable support for disability in the accomplishment of hands-free tasks. Moreover, we stress the potentials of eye-based interfaces to enhance the user-machine interaction process in “traditional” activities based on keyboard and mouse. Through the description of some of the projects we have recently developed a robot which can move according to the movements of the eye balls and can be triggered with some actions based on the eye blinks.

III.METHODOLOGY

The proposed model consists of a user friendly Graphical user interface(GUI) such that the user can interact with the system. Pygame or OpenCV could be used for the purpose. Whenever the user opens the application, the GUI will prompt the user either to login or register as a new user. Primarily, the user needs to register by providing a user ID of their choice, a PIN and a Keyword or Keyphrase. Once the registration is successful, user is allowed to login

using the credentials involving userID and password. The PIN input is captured from web camera in the form of morse code.

In the back end, the entered PIN is checked against the stored PIN which was entered by the user while registering. If the entered PIN is not correct, it exits the screen. If the entered PIN is correct, it displays successful authentication. If the user has forgotten his password then he can use the keyword to answer security questions to authenticate and update the existing password with a new one using mouse buttons. The updated password would be saved in the database

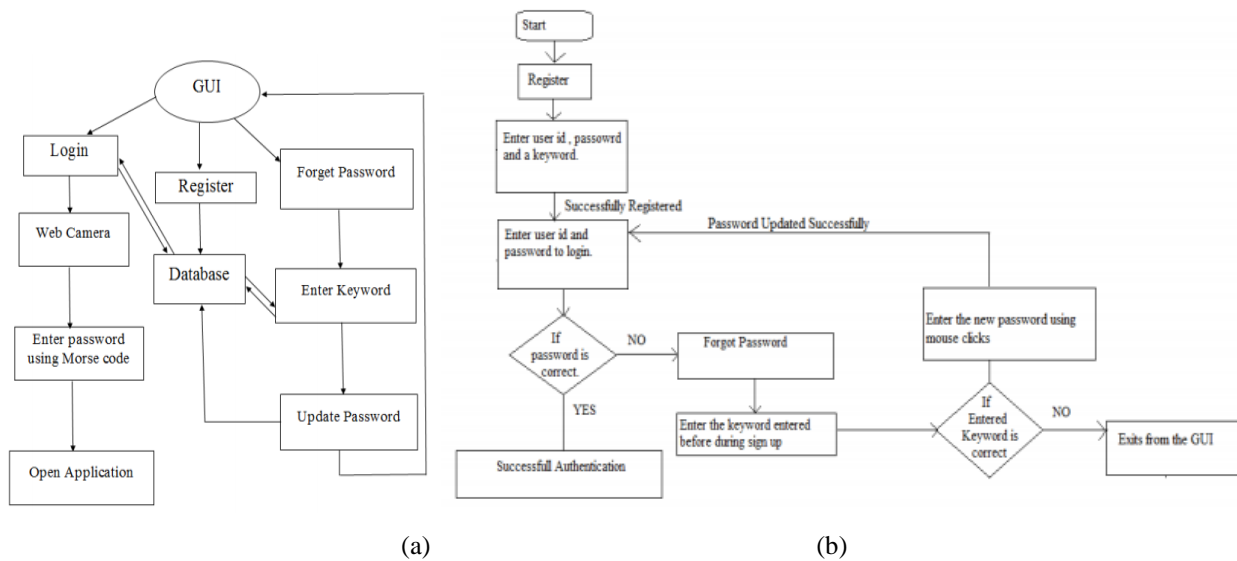


Fig 4: (a) Data flow model (b) Implementation model of Gaze based smart eye tracking system

The principle of this system is eye pupil detection and eye tracking. The primary component of the system is the web camera which has been programmed to capture the eye movement of the individual continuously until the user himself stops. Fig 5 shows the flow chart of the system. The image acquisition is done by capturing the raw image on smart camera. Facial Landmark Algorithm and Shape predictor are used for detecting the eye pupil location by Image processing. The first step is to detect the user's face accurately. Facial landmark algorithm is used for the purpose. After face detection, it will try to detect the eye inside the face region of interest. Now, the main target is to detects the eye pupil and define its center points. There is several images processing operation performed in system, such as blur Image, color conversion, thresholding, filtering, edge detection and object tracking. By using the USB webcam allowed to capture the images on Shape Predictor datasets. And Image Processing based all OpenCV libraries are installed in System. There it will process and working without any processing delay.

The system will crop the eye region of interest initially and it will detect all possible circle presented on that particular area in the eye pupil. Then it will successfully detect the eye ball. After the method we applied for eyes region of interest, and find out the corners. The average of two point defines its Center point. Now we measure distance between the Centre point and eye circle Centre point using coordinates system logic. According to the eye blinking, the authentication is done.

The system begins by capturing blinking eyes images continuously by camera. Webcam is used to capture the image at high pixel rates. Even if the person has only one eye, it takes one eye blinking as input. In idle condition the eye will be consider open. When the user blinks eye, the system will take that as input using facial landmark algorithm and shape predictor and then depend upon the Morse code the setting of password and resetting of password is done.

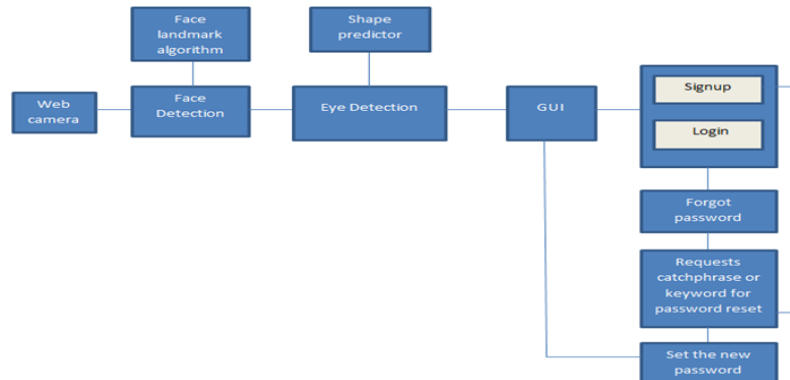


Fig 5: Flow chart of Gaze based smart eye tracking system

Facial Landmark

Face landmark detection is the process of finding points of interest in an image of human face. For example, we have shown the ability to detect emotion through facial gestures, estimating gaze direction, changing facial appearance (face swap), augmenting faces with graphics, and puppeteering of virtual characters. To achieve this, the landmark detector must find dozens of points on the face, such as corners of the mouth, corners of eyes, the silhouette of the jaws, and many more. Many algorithms were developed and implemented in OpenCV. To run the facemark detector, a pre-trained model is required. This pre-trained model which we have used is shape_predictor_68_face_landmarks. The indexes of the 68 coordinates can be visualized on Fig 5 (b).

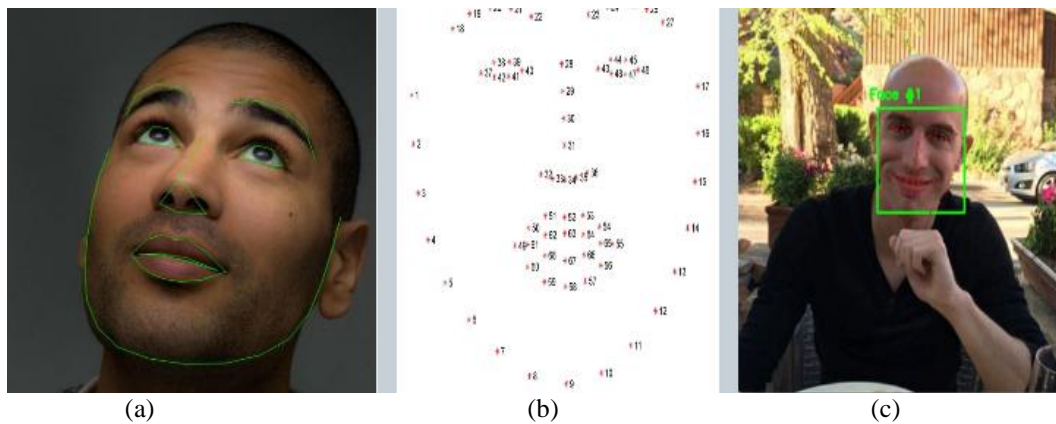
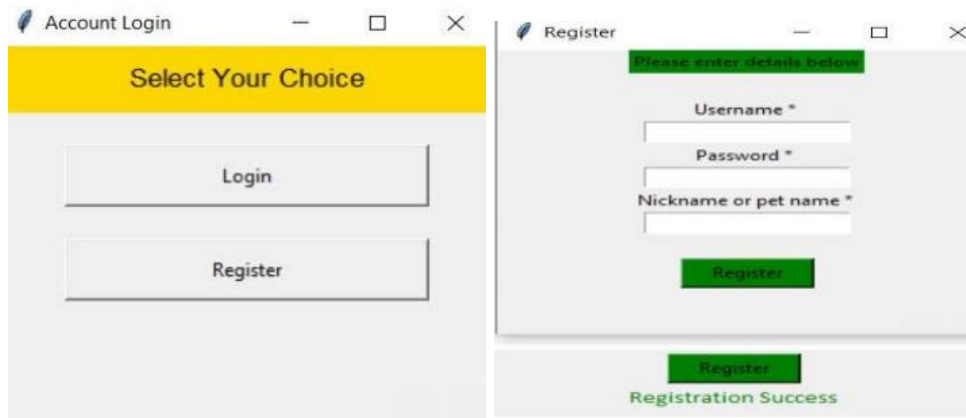


Fig 5: (a)Face detection (b)Visualizing the 68 facial landmark coordinates (c) Shape prediction

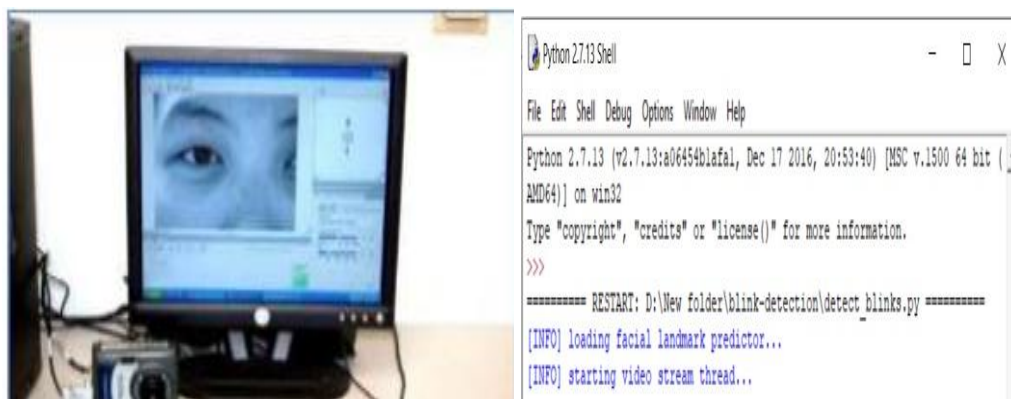
IV. EXPERIMENTAL RESULTS

Figures below shows the results of every modules of Gaze based smart eye tracking system. Figs. 6 (a) shows the home terminal of the system (b) register terminal and register success terminal of the Gaze based Eye Tracking For Password Authentication system. Here, the user enters his or her credential. If the login is a success, the user will be asked to can authenticate the password through gaze based authentication. If the user forgets his password, he can create a new password by entering the keyword presented in register module. Figs. 7 (a) and (b) shows the image acquisition process and conversion of the grey scale image automatically by web camera to calculate eye aspect ratio.



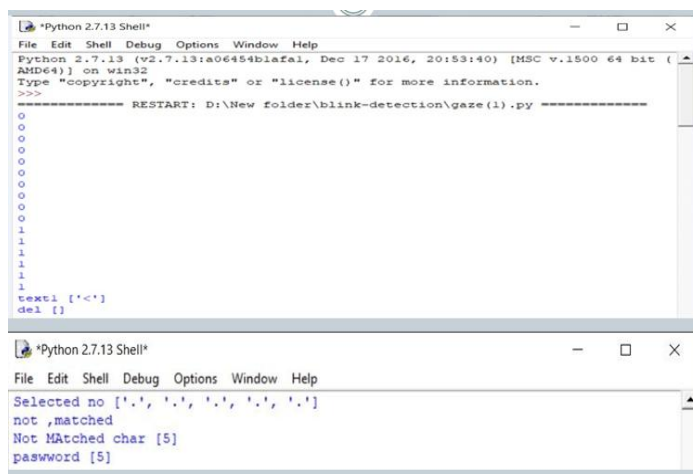
(a) (b)

Fig 6: (a) Home Page (b) User registration



(a) (b)

Fig 7: Eye blink detection by (a) Image Acquisition (b) Facial landmark predictor application



(a)

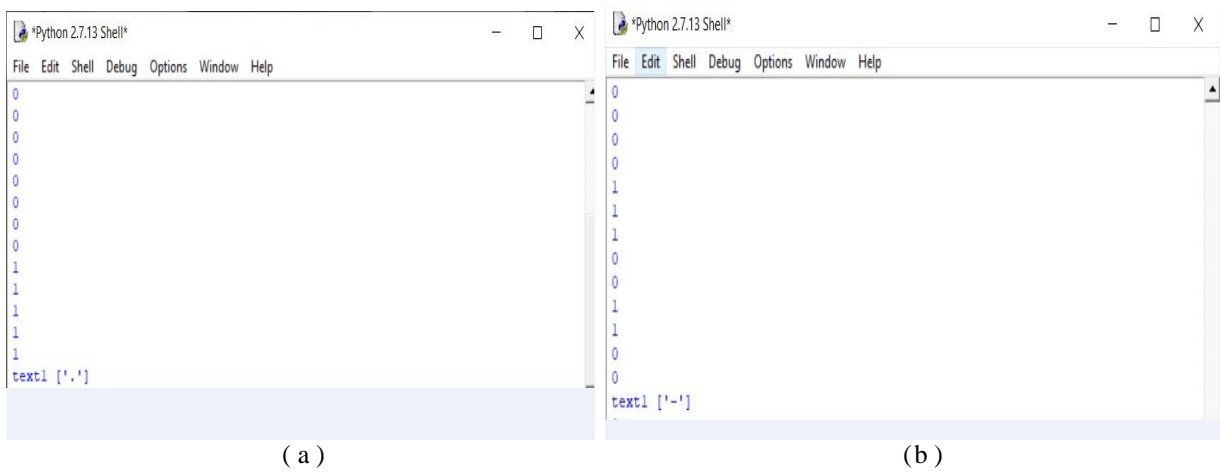


Fig 8: (a) Calculation of Eye aspect ratio by determining whether a person is (b) blinking dot (c) blinking dash/delete

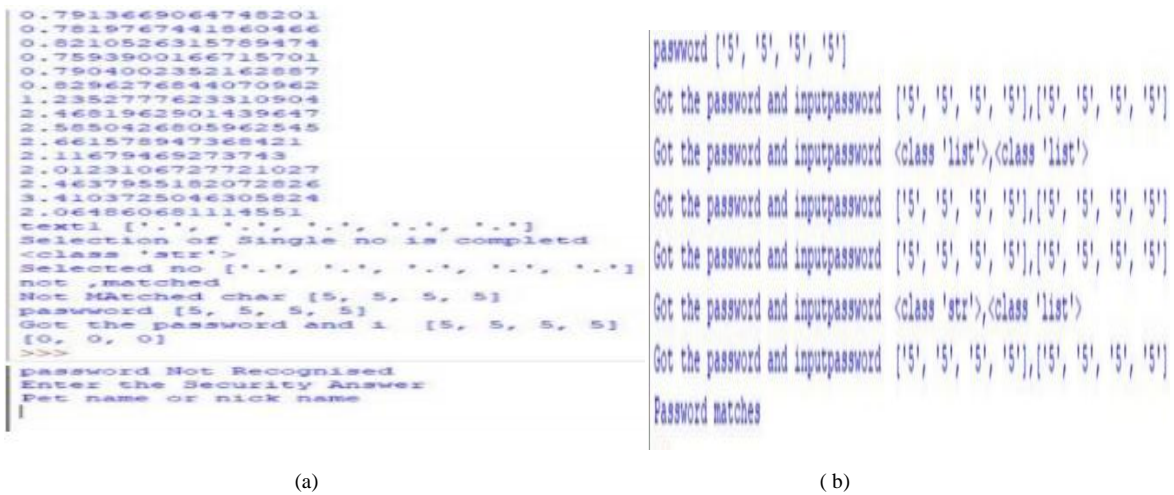


Fig 9: (a) Password incorrect attempt (b) Password successful login

V. CONCLUSION

In this paper we discussed two factor authentication , wherein two layers of security are provided for password authentication. One via gaze based authentication and another using mouse clicks with an intention to convert the alphabets or numbers into source code leading to improved security. This system tries to fulfill the void in the realm blind and visually impaired users. People from different age group whoever has a basic knowledge about morse code can utilize this system. Furthermore, in the near future facial recognition based authentication could also be implemented so that there won't be any necessity of inputting password at all.

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