Eye Gaze Detection

Manjeet Singh[1] and Namita Goyal[2]

[1]Information Technology, Maharaja Agrasen Institute of Technology, New Delhi, India.
[2]Information Technology, Maharaja Agrasen Institute of Technology, New Delhi, India.

Abstract: The main aim of this paper is to develop the system that can detect the movement of the eyes specifically speaking the pupils of the eye. Due to its low price, webcam has become one of the most promising sensors with the rapid development of computer vision. However, the accuracies of eye tracking and eye movement analysis are largely limited by the quality of the webcam videos. We will detect the face from the live web cam of your system. We will be using dlib a python trained model used to estimate the 68 coordinates that maps the facial points on the persons face. These points are identified from the pre-trained models. We will also be using the cv2 library of python. Eye gaze is the mirror of speech, the language of non-verbal communication. This system will detect the eye movement of the person and will say where he is looking whether left or right of the screen. It will also detect and count the blinks of the persons in the screen. The purpose of the paper is to provide an inclusive expansion in the application of the eye-gazing estimate system. Also, an implementation of a low-cost eye-gaze detector. We will mainly focus on the movement of the pupils of the eye and track their movement whether it is left or right.

KEYWORDS: Eye-gaze estimation, web-cam, eye movement.

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INTRODUCTION

Eye gaze tracker devices are used to trace the movement of the eyes. Before the digital computers were there, they were made of metal contact lenses. With the advancement in the computer technology, it has become easy using different algorithms to trace the movement of the eye ball from digital images in real time and use them to predict the point of fixation. In today's world the most common used eye gaze tracker is the one which uses the infrared camera and the bright or dark pupil technique. The bright pupil technique allows to track the center of the pupil.

Then the eye gaze tracker locates where the person was looking. Corneal-reflection methods that use multiple cameras and multiple infrared lights have been successfully applied such as Tobii and SMI eye tracker. The precision of this method is satisfactory since the pupil center and the glint can be easily extracted to calibrate the errors caused by head movements. However, complex calibration, high cost and ill-health caused by IR lights are unavoidable. Moreover, IR light-based systems are not reliable when used in outdoor conditions

In this paper I will be explain how with the use of the web cam of your laptop or computer you can track where you are looking or in which direction whether left or right are you looking. I will also tell you about how to count the number of time person in the screen has blinked. These things will be very useful to us as we will start using artificial intelligence and deep learning in our day-to-day life. I will discuss all this in detail in this paper.

For most of us the sense of sight is the primary source of data about surrounding environment. Therefore, it is natural to assume that information about where a gaze is focused could be helpful in determining how we communicate with the surroundings. In the area of Human Computer Interaction (HCI) that knowledge is crucial for creating an intuitive and ergonomic user interface. However, the fundamental step in implementing such an interface is the exact location of a user eye pupil. Currently, the eye tracking techniques develop in two directions, electrooculography (EOG) and digital image analysis. The last one, which is the research area of this work, uses cameras operating in the visible light spectrum and software analyzing digital images. The increase in computing power also gave way to the number of techniques carrying out such analysis. The advantage of methods using visible light is their versatility. They are independent of such individual characteristics of an eye such as current flow in the cornea.

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METHODOLOGY

To understand the eye gaze detection, we first must know the 68 face landmarks. These landmarks are successful in detection of the face alignment, head pose estimation, face swapping, blink detection and much more. Since our focus in this paper will be the eye detection and their movement so will focus only on those landmarks that are related to our eye detection. Out of the 68 face landmarks there are 12 face landmarks which focus on our both eyes. 6 for the left eye and 6 for the right eye. These landmarks are labelled from 0 to 67. Point from 36 to 41 are for the right eye and from 42 to 47 these are for the left eye. The diagram below locates all the 68 facial landmarks of a person's face.

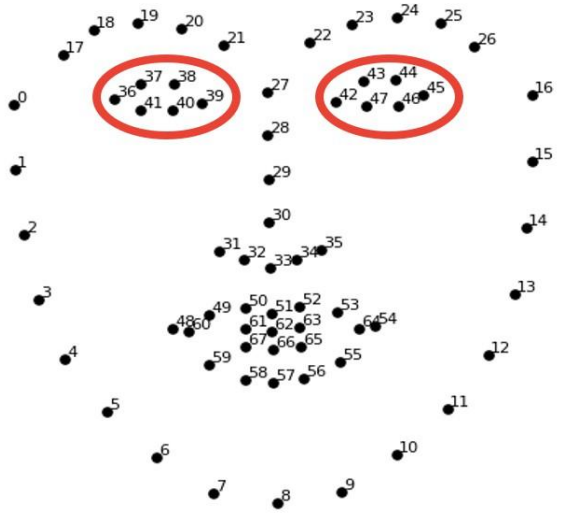


Figure: Facial Landmarks

Our focus and all our work will be on these 12 points for eyes.

Face detection is the first methods which locates the human face and return the values in x, y, w, h which is a rectangle.

After getting the rectangle we have to through the points inside the rectangle. After that we will take the points which are for the left and right eye. We will do our operation on both the eyes on at a time.

To detect the blink:
First, we divide the eye into two parts upper eye and lower eye. Assign the three points to both the parts. Then we will find the top and bottom mid-point from the lower and upper part. Also, we will find the horizontal distance. Then we find the blink ratio for both the eyes. If the ratio>4 then we count it as a blink.

For the eye movement:
First, we mask the full face except the eyes i.e., we turn the face black except the eyes. Then we crop the eyes portion form the face. We then get the width and the height of the eyes.

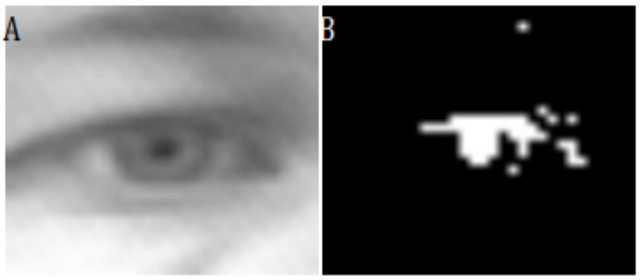
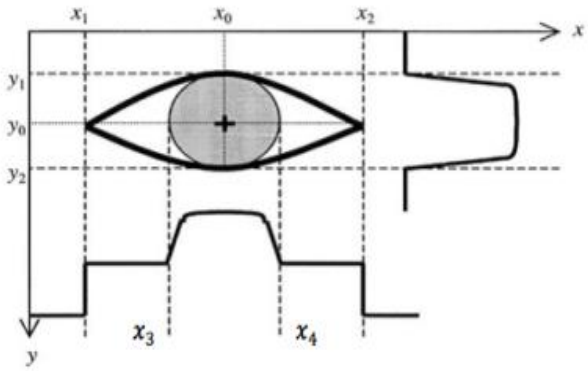


Fig. Masking the face except the eye.

Then we divide the eye into three parts, right part, left part and the center. Then we calculate the black pixel in each part of the eye using numpy.
Then by comparing the count of the black pixel in all the three parts, the one in which the pixel is the maximum we say that the person is looking in that direction.

MATH'S

TO CALCULATE THE PUPIL POSITION:



PUPIL POSITION (X_0,Y_0)

$X_0 = (X_3+X_4)/2$, $Y_0 = (Y_1+Y_2)/2$

APPLICATIONS

There will be a lot of use of the eye trackers when the use of Artificial Intelligence and the Machine Learning will increase. Following are the few applications of the eye gaze tracker which I have told in this paper.

1. In the time of pandemic the whole education system is running online. All the exams are online. With the online exams the probability of cheating also increases. Students can look away from the screen and can take reference from the other screen. To deal with this today what we are doing is we record video of the whole session of the exam which take a lot of memory and to save the memory with the help of this tracker we can send only the direction in which the student is looking. We save the data of the directions in which the student is seeing in an array. It will save a lot of space. One more thing that we can do is we can take samples of the students giving test and examine their behavior and collect the data that how frequently the student looks left or right during the exam and then we can just by counting the left and right eye movement count can say whether the student was doing exam by his own or he was using any external source.

2. Another application is by using the blink feature. Suppose a driver is on the road and he did not sleep from last 1 day. There is high probability that he will fall asleep which he is driving if he did not take rest. As soon as he will fall asleep the probability of the accident

will increase exponentially. So, by using the blink feature if the eyes of the driver for a particular time are closed (let's say 5 seconds) auto break will be applied and an alarm will ring and it will alert the driven and he can drive consciously or he will take rest.

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