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# Automatic Eye Blink Tracking and Detection in an Image Sequence

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**Abstract-Human face, the most active and healthy part of human body and Eyes are one of the most complex features of it. It may be used to reduce some of their critical life complexities. Eye blinking is one of the prominent areas to solve many real world problems. The process of blink detection consists of two phases. These are eye tracking followed by detection of blink. The work that has been carried out for eye tracking only is not suitable for eye blink detection. Therefore some approaches had been proposed for eye tracking along with eyes blink detection.**

**Keyword:- image sequence, facial signs, eyes movements, blink detection, template image, template accuracy, face size.**

## 1. INTRODUCTION

There has been a growing interest in the field of facial expression recognition especially in the last two decades. Human-Computer Interaction (HCI) systems may also be Enriched by a facial feature tracker. We propose a robust and accurate method of tracking the eye locations, detecting the eye states, and estimating the eye parameters for each frame in a sequence. Our purpose is to develop an eye tracker [4, 5] which is robust to blinking, and which accurately recovers the eye parameters. Initialized the eye template in the first frame, the eye's inner corner can be tracked accurately by feature point tracking. We assume the outer corners of eyes are in the line connecting two inner corners of eyes.

## 2. CHALLENGES

1. Identifying and tracking the head location.
2. Identifying and tracking the location of the eyes.
3. Detecting blinks of the eyes.
4. Being able to process the information in real-time using a moderately priced processor that will be running other applications in the foreground.

## 3. PROPOSED METHODOLOGY

To make an automatic eye blink detection system for a video, we require extracting and tracking the eyes movements in an image sequence. For making such type of system, we have included three distinct phases: First, eyes are detected in each frame of a video. Motion analysis[1,2] techniques are used in this stage, followed by online creation of a template of the open eye to be used for the subsequent tracking and template matching that is carried out at each frame. A flow chart depicting the main stages of the system is shown in Figure 1.1.

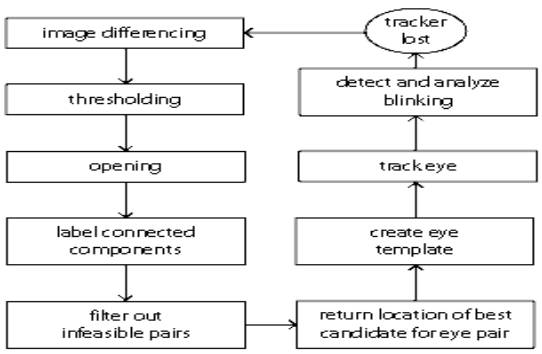


**Figure1.1: Overview of the main stages in the system.**

### 3.1 Eye Tracking

This measure is computed at each frame using the following formula:

$$\frac{\sum_{x,y}[f(x,y)-\bar{f}_{u,v}][t(x-u,y-v)-\bar{t}]}{\sqrt{\sum_{x,y}[f(x,y)-\bar{f}_{u,v}]^2\sum_{x,y}[t(x-u,y-v)-\bar{t}]^2}}$$

Where f(x, y) is the brightness of the video frame at the point (x, y), and fu, v are the average value of the video frame in the current search region, t(x, y) is the brightness of the template image at the point (x, y), and t is the average value of the template image[3,6].The result of this computation is a correlation score between -1 and 1 that indicates the similarity between the open eye template and all points in the search region of the video frame. Scores closer to 0 indicate a low level of similarity, while scores closer to 1 indicate a probable match for the open eye template.

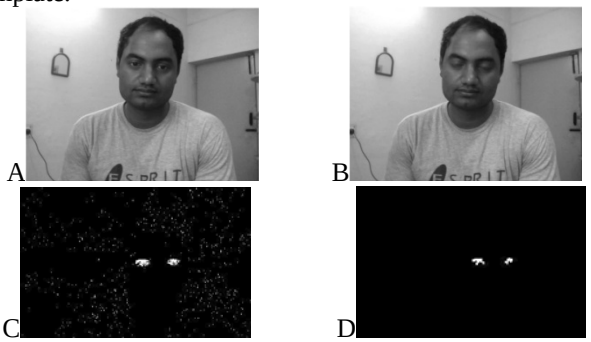


**Figure1.2 : Motion analysis phase:**

(A) User at frame f.
(B) User at frame f + 1, having just blinked.
(C) Initial difference of the two frames f and f+1.
(D) Difference image used to locate the eyes after performing the Opening operation.

### 3.2 Template Creation

**Figure1.2: Open eye templates.**

The user is assumed to be blinking at a normal rate of one involuntary blink every few moments. Again, no offline templates are necessary and the creation of this online template is completely independent of any past templates that may have been created during the run of the system.

## 4. EXPERIMENTS AND RESULTS

Since the aim of this thesis is to count the number of eye blinks automatically, we collected a video database of facial signs to experiment the proposed approach. The frame size of each video is 480×640 and face size varies according to the motion in the video

**Figure1.3: Some Frames Captured From Different Sign Videos.**

### 4.1 Eye Detection and Tracking Experiments

The system was primarily developed and tested on a Windows XP PC with an Intel Pentium IV 2.8 GHz processor and 1 GB RAM. The approach is tested on the created video database of ten different subjects for eye detection and tracking. For experiment, total 15 videos are used in different lightning condition using inbuilt USB camera of Toshiba L310 laptop. The size of each frame is 480 x 640. The result of template creation accuracy and total blink detection is tabulated in Table 1 for each video. 67% accuracy in template creation is achieved and 61% accuracy is achieved in counting of eye blink for 15 videos. The result may be tested for more number of videos.

**Table 1.1 Results of template detection and eye blink detection**

| Video Number | Template Accuracy | Number of Blinks Detected Automatically | Number of Blinks Detected Manually |
|---|---|---|---|
| Video 1 | Not Correct | nil | 08 |
| Video 2 | Correct | 00 | 03 |
| Video 3 | Not Correct | nil | 05 |
| Video 4 | Correct | 10 | 03 |
| Video 5 | Not Correct | nil | 05 |
| Video 6 | Correct | 15 | 12 |
| Video 7 | Correct | 10 | 03 |
| Video 8 | Correct | 08 | 09 |
| Video 9 | Correct | 13 | 11 |
| Video 10 | Correct | 14 | 12 |
| Video 11 | Correct | 16 | 12 |
| Video 12 | Not Correct | nil | 14 |
| Video 13 | Not Correct | nil | 07 |
| Video 14 | Correct | 10 | 08 |
| Video 15 | Correct | 10 | 03 |

## 5. DISCUSSION

The automatic initialization phase (involving the motion analysis work) is greatly simplified in this system, with no loss of accuracy in locating the user's eyes and choosing a suitable open eye template. The reliability of the system has been shown with the high accuracy results. The accuracy percentages in these cases were approximately the same as those that were retrieved in normal lighting conditions. The camera is placed too high above the user's head, in such a way that it is aiming down at the user at a significant angle, the blink detection is no longer as accurate.

## 6. CONCLUSION

After studying and analyzing results of above technique following points is concluded-

1. A good accuracy is achieved in different illumination conditions.
2. The initialization technique is efficient and gives good results.
3. The system responds slowly and requires more work for real time implementation.
4. Testing must be done on large database of videos.

## 7. BENEFITS OF RESEARCH

The improvement of driver carefulness and accident reduction. The driver's face is tracked while he is driving and he is warned if there seems to be an alerting fact that can result in an accident such as sleepy eyes, or looking out of the road. For many people with physical disabilities, computers form an essential tool for communication, environmental control, education and entertainment.

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