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Unconstraint Eye tracking on Mobile Smartphone

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Abstract -*Eye tracking techniques have been investigated by researchers in the computer human vision and the psychology community for the last some decades. Still its remains a challenging and difficult task due to the individuality of the eyes, location, and variability in shape, scale, and lighting conditions. Eye tracking has many usages in neuroscience and human-computer interaction. Eye tracking plays a good role in the field of human attention analysis, human factors in industrial engineering, marketing and advertising, gaze-based interactive user interfaces, and driver vigilance systems. Existing eye-tracking technologies include EOG and Coil Systems, which require additional hardware, mounted on the skin or specialized sensor to measure the eye movements. These methods were quite difficult; instead current commercial eye trackers systems use video images of the eyes along with additional hardware, such as infrared sensors. In this paper, we design and implement a low-cost eye-tracking system on mobile phone using only an off-the-shelf front camera. This paper presents various an eye detection techniques using Haar Cascade Classifier and Circular Hough Transform. Our invented technique first detects the entire face and then the eyes using Haar Cascade Classifier, Circular Hough Transform (CHT) is used to detect the circular shape of the eye and make sure that the eye is detected correctly by the classifiers. The propose technique able to detect eyes in various condition like wearing spec, lightning, driving, dark etc.*

Key Words: Gaze Estimation/Tracking, Mobile device, Image Processing, Eye Detection, Pupils Detection.

1. INTRODUCTION

Eye tracking is the technique of measuring the movement of the eyes. Person move their eyes to bring a portion of their visual field, so that they can see the detail of that portion. Eye tracking have many applications in neuroscience, and human-computer interaction. Researchers are interested in the physiological movements of the eyes to get to know about where the person is looking in space. On the other hand, another form of researchers is interested in gaze position. The gaze position is the point where the person is actually looking. Current commercial eye trackers available but they are very costly and require additional hardware, such as infrared sensors. In this paper, we present design and implementation of a low-cost eye tracking system using only an off-the-shelf front camera which is powerful to small head rotations, changes in lighting condition, and all but substantial head movements.

2. HUMAN VISUAL SYSTEM

Humans see the object, things with their eyes, which are located side by side in close accuracy. Both eyes see the same things or object in the world separately, each eye producing a different signal showing its visual field. The human brain then creates a unified image from these signals input. Structure of a typical eye region is shown in figure 1. Light rays enter the eyes through the cornea when they are reflected from an object. The cornea is the transparent covering and a focusing structure of the eye. In the visible portion of the eye, the iris is the colored portion which filtered the amount of light that going into the eye through the pupil. The pupil is the small hole inside the iris that allows the light to pass in. Usually the pupil is darker than the iris unlike of the color of the iris. The light rays then going through the lens. This lens can change its shape and focus them on the retina at the back of the eye. Typically a thin layer of tissue called the retina is at the back of the lens inside the eye. Many light-sensing nerve cells like rods and cones are located in this area. Total 6% of the total number of cells, are situated in an area called the macula. Main function of corns is to clears vision and helps to capture the colors and very fine details of an object. Inside Rods, total 94% of the total light-sensing nerve cells, are situated outside the perimeter of the macula and all over the outer edge of the retina. Rods are very sensitive to light and allow humans see objects in dim light and at night. They also help a person to detect motion. Light is then converted into electrical signals by rods and cones. The optic nerves then send these electronic signals to the brain which produces the exact image from this signal.

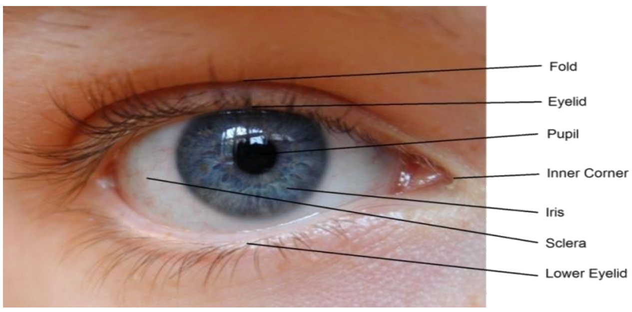

Figure 1: Human Eye

3. SYSTEM OVERVIEW

In this section, we present the eye detection Techniques which consists of four portions: face detection, eye Detection, iris detection based on CHT. Figure 2 shows the flow of the proposed system. In this proposed system, after capturing the image from input video which will be detected by front camera of android mobile, the system will firstly detect the face. Secondly, face is detected, and then it will detect the eye on the face region. After the eyes are successfully detected then the CHT will detect circular shape of the eye. Then finally, the System will determine the position of the eye.

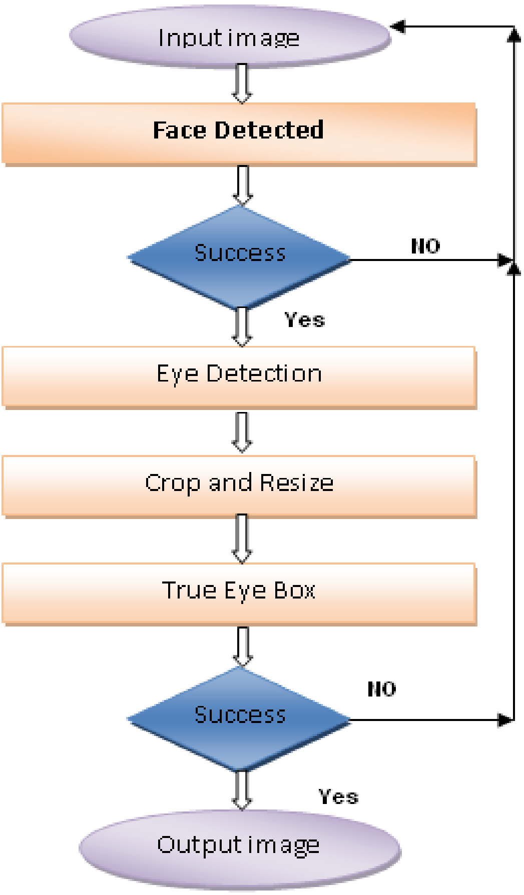

Figure 2: Flow of Algorithm

3.1 FACE AND EYE DETECTION

We have first apply Harr features CART-tree based cascade detectors, one apply for left eye and one for right eye. The eye region bounding box sizes may vary for different size of images, so their sizes are fixed to 100*100 pixels. The detected bounding box generally contains a large area including the eye brows, which is not necessary to eye tracking, so we crop a tight box around the eye to produce the final eye image. The pupil center is closely located at one half horizontally and two thirds vertically of the bounding box, given the eye detector was trained with eye images of this geometry. We crop 15 pixels from the top and bottom around the pupil center to form the final eye image, which covers the eye region tightly for most subjects as shown in figure 3. The horizontal dimension is untouched since the eye width varies widely among different subjects. As a result of the operations, the final eye image size becomes a fixed 30*100 pixels for each eye across all images.

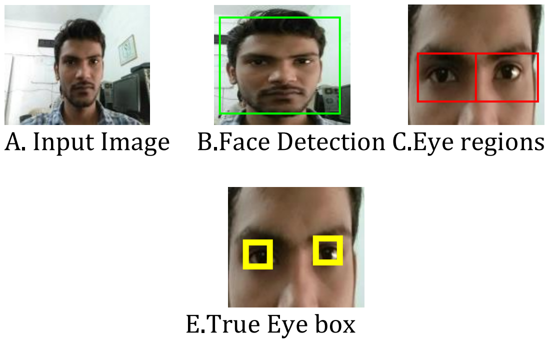

Figure 3: face and Eye Detection

3.2 IRIS DETECTION

Once the eyes have been detected by the classifiers, then the iris will be detected. In these techniques, CHT is mainly used to detect the exact circular shape of the eye.

3. EXPERIMENTAL RESULT

The results of detected faces, eyes, irises, and eye state detection images under different condition are shown in Figure [4] [5] [6] [7].

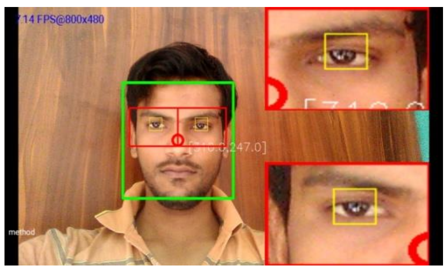

Figure 4: Face detection and Eye Detection lightning

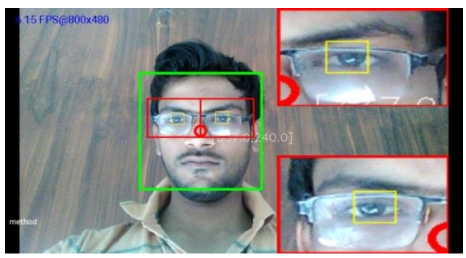

Figure 5: Face detection and Eye Detection with spec

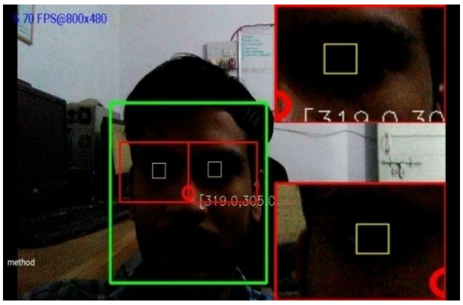

Figure 6: Face detection and Eye Detection under dark Condition

Figure 7: Face detection and Eye Detection during Travelling

4. CONCLUSIONS

In this paper, we are showing real-time eye detection techniques using Haar Cascade Classifier and CHT. This technique using Haar Cascade Classifiers for detecting the face. In order to anticipate the missed-classified by the classifiers, CHT was applied to detect circular shape in the eye region which is called as iris detection. This technique able to detect eye under various condition like wearing spec, lightning, driving, dark etc.

In future works, we are using this real time technique for driving assistance and it will be applied in the every kind of vehicle.

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BIOGRAPHIES

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