Reviews on Eye blink detection

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Abstract: we are surrounded by technologies; spend more and more time with visual display unit (VDU) devices such as computers, laptops, TV screens, mobile phones and tablets. Use of VDU devices is often associated with eye and visual problems. Normally eye should blink 10 – 15 times per minute. But the rate of spontaneous eye blinking while using computer reduces significantly (up to 60% reduction). Blinking helps us to spread the tear film, moisten and disinfect the surface of the eye, due to which the reduced blink rate causes dryness of our eyes which causes dryness, redness, burning, sandy-gritty eye irritation or sensitivity to light and eye fatigue. These symptoms are also known as Dry Eye, which is a major part of the Computer Vision Syndrome (CVS). CVS is a set of problems related to the computer use including dry eyes, eyestrain, headache, blurred vision, neck pain and backache. The easiest way to avoid the symptoms of Dry Eye is to blink regularly. There are only few available hardware or software solutions which try to prevent from dry eye symptoms. This paper gives a brief overview of Gabor's filters and Circular Hough Transformation for a method for extracting circles from images.

Index Terms— eye blink, Gabor filteris, Computer Vision Syndrome

1 INTRODUCTION

The number of users for computers every day increases rapidly Which causes the users suffering from symptoms collectively called Computer Vision Syndrome (CVS). It is a set of problems related to computer use. The rate of unconscious eye blinking while looking at luminous objects within close distance reduces significantly (up to 60 % reduction). Blinking helps us to spread the tear film and moisten the surface of the eye, due to which the reduced rate of blinking leads to dry Eye. Typical ocular complaints experienced by intensive computing work (more than 3 hours per day) include dryness, redness, burning, sandy-gritty eye irritation or sensitivity to light and eye fatigue. The easiest way to avoid the symptoms of Dry Eye is to blink regularly. The main aim is to create eye blink detector, which could be used in real-time blink detection system. In case of low blink rate it will notify a user to blink more frequently. This paper proposes two different methods on blink detec-

tion. The algorithms we focus on achieve good blink detection results and have the ability work in real-time. Most of these techniques consists of three steps. Firstly face detection, secondly eye detection and lastly eye blink detection.

Blink detection and the frequency measuring are used by application with the aim to protect users from dry eye syndrome. Some approaches are designed to be used by disabled people and they do not suppose any head movements. The only solution we found, detects blinks in order to protect the eyes from CVS is Vision Guard. It is the application which analyses the frequency of blinking from images obtained by webcam to detect an eye fatigue. In the case of reduced blink rate it recommends the user to have a short break by balloon notifications. It provides information about the actual blink rate and statistics of blinking. The eyelid movements are estimated by normal flow
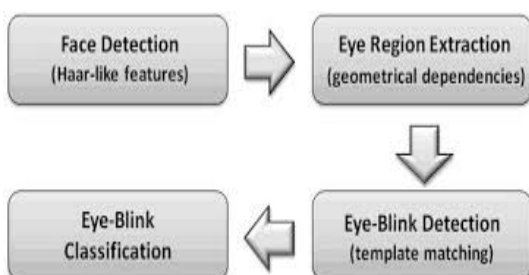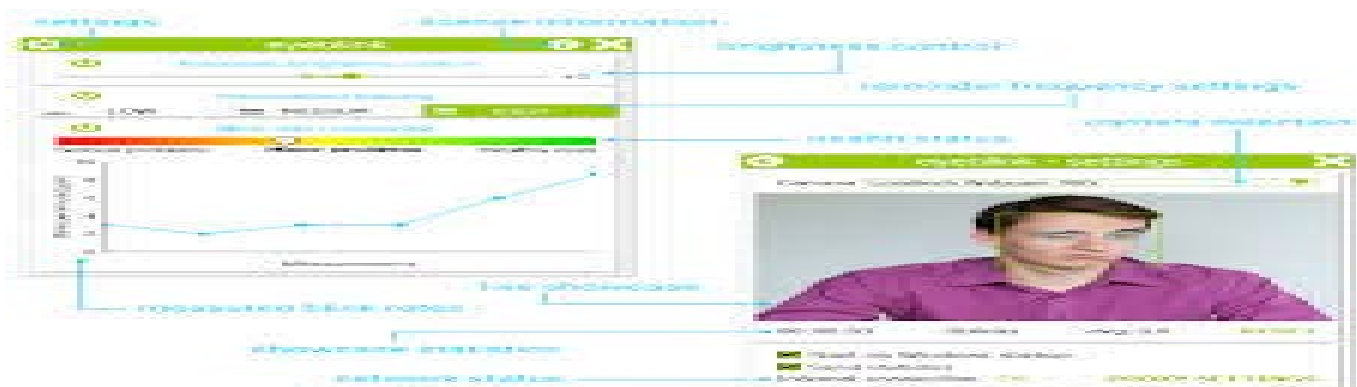

instead of optical flow. It is the component of optical flow that is orthogonal to the image

Fig 2 Normal Flow Method

gradient. Presently Gabor filter-based method for blink detection, Gabor filter is a linear filter for extracting contours within the eye. After applying the filter, the distance between detected top and bottom arc in eye region is measured. The main aim

Fig 1: General process of blink detection algorithms

is to create eye blink detector, which could be used in real-time blink detection system. different distance indicates closed or opened eye. The problem of arc extraction arises while the person is looking down.

Normal Flow

Eyelid movements are estimated by normal flow method instead of using optical flow method. Optical flow integrates information over image regions and calculates the overall image movement whereas normal flow can be computed using only local information. Hence normal flow calculation is more effective can be also applied in real-time. Normal flow vectors computed in the eye region are used to detect eye blinks. The flow is corrected and normalised. normal flow are used in a deterministic finite state machine (DFSM) to estimate blink parameters. DFSM

has three states to determine in which phase are the subject's eyes: steady(open), opening and closing state. The disadvantage is that the threshold strategy used in this algorithm requires to set various thresholds manually depending on the subjects and conditions.This approach utilises and improves DFSM from previous work by adding a new state: closed to detect more variations in eye movements.

Gabor Filter

Gabor filteris a linear filter used in image processing for edge detection. It can be used to extract contours within the eye regions. Blinks are detected after measuring the distance between the upper and lower eyelid. Measured distance differs in case of closed and open eye. Mathematically it is given by equation 1

$$g(x, y) = s(x, y)\ wr(x, y) \text{-----------(1)}$$

$$g(x, y, \theta, \varphi) = \exp(-\ x\ 2 + y\ 2\ \sigma2\ )\ \exp(2\pi\theta i(x \cos \varphi + y \sin \varphi))) \text{----------------(2)}$$

Equation 2 specifies the ellipticity of the Gabor function. Gabor function is the result of modulation of a sinusoidal plane with a Gaussian. Gabor filter-based image is obtained by convolution using the Gabor kernel in the image. After applying the filter, the distance between detected top and bottom arc in eye region is measured. Different distance indicates closed or opened eye. The problem of arc extraction arises while the person is looking down. Then the difference in distance of closed and open eyes is too small.
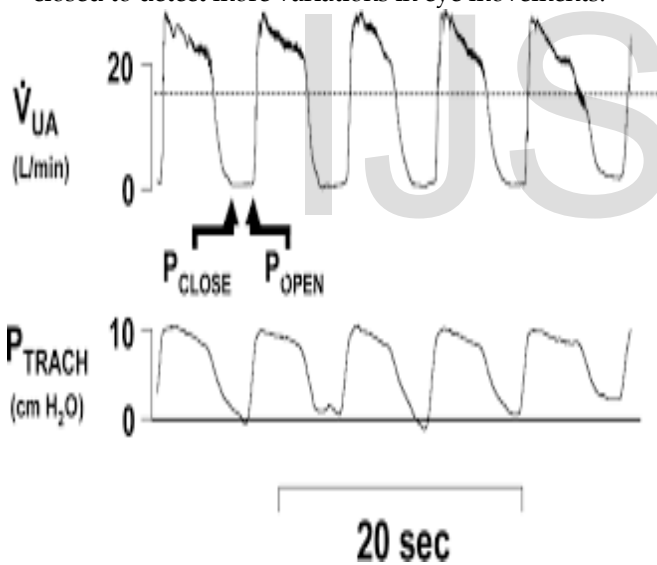

Fig 3: Normal flow displacement of closing and operating eye

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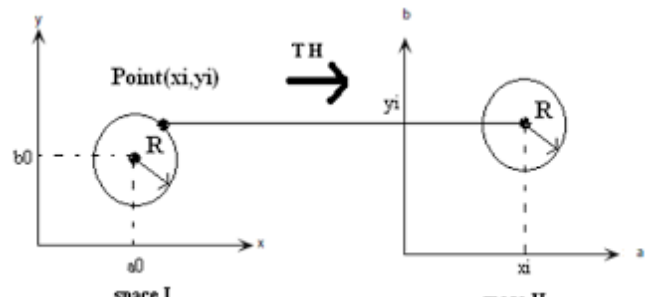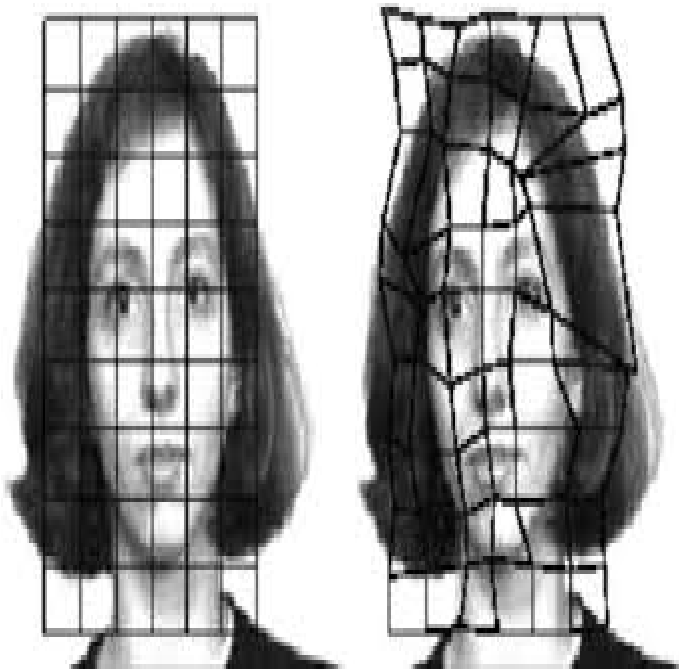
Fig 6 Circular hough transform

Fig 5. Practical Application of Gabor Filter

Circular Hough Transformation

The Circular Hough Transformation (CHT) is a method for extracting circles from images. Each circle can be defined the equation:

Analytic Form	Parameters	Equation
Line	ρ, θ	$x\cos\theta + y\sin\theta = \rho$
Circle	x_0, y_0, ρ	$(x-x_0)^2 + (y-y_0)^2 = r^2$
Parabola	x_0, y_0, ρ, θ	$(y-y_0)^2 = 4\rho(x-x_0)$
Ellipse	x_0, y_0, a, b, θ	$(x-x_0)^2/a^2 + (y-y_0)^2/b^2 = 1$

In order to simplify the algorithm the value of radius is often fixed or minimum and maximum threshold are defined. For each `Type equation here.` edge point(x;y) a circle is drawn around the edge point with radius r.increment the values of accumulation matrix corresponded to the coordinates of points on the perimeter of the drawn circle. Each value in the matrix denotes how many circles pass through the individual coordinates. The matrix cells with the highest values represent the most possible candidates for the centre of the circles.he closed eye state is detected by computing the direction of the upper eyelid. If the curve of the eyelid is downwards, blink is identified. If the actual eye state is not determined by the previous two methods, the

distance between the eyelids decides on the state.Hough transform is an effective method of binary image detection on straight line, circle, ellipse and other graphics.

Evaluation

Blink detection algorithms are evaluated on two datasets. these dataset includes 8 individuals(4males and 4females, one person wearing glasses) under different lighting conditions who sit in front of a
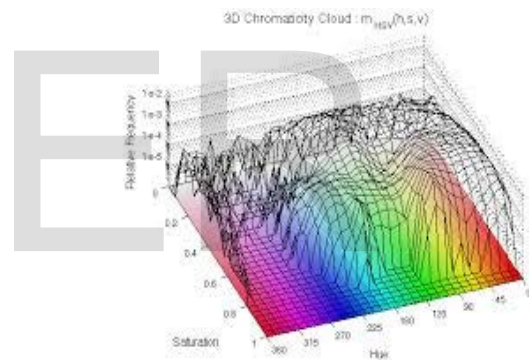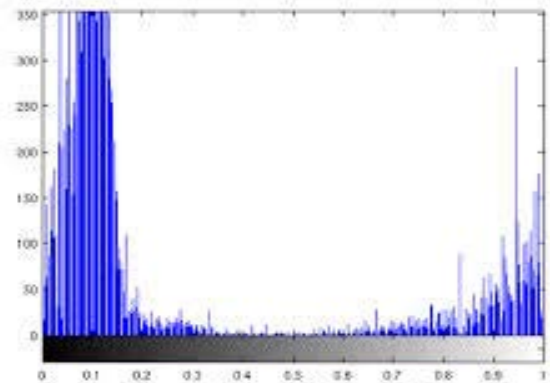

Fig 7 Results of Matlab

computer screen mostly in a stable position and looking directly at the screen. It consists of 7000 frames and 128 blinks. The second image sequence we have tested our algorithms and compared their blink detection abilities to the optical flow the best true and false positive rate are achieved by Inner movement detection. It detects 93,75% of blinks on own dataset and 98,36% of blinks on the age differ in case of skin and pupil in most light conditions, thus it provides reliable information about user's blinks. However hue channel is often different in whole eye regions. Sometimes it is without any significant changes when eye blinks. It

happens mostly in very dark images. False detections are the results of luminance changes, poor light conditions hanges in gaze direction, facial mimicry such as smiling and eyelid makeup. In such cases it is very difficult to recognize whether a user blinks or not. Back projection using hue-saturation

histogram has many missed blinks when an individual wears glasses. using Matlab these datasets can be easily evaluated

CONCLUSION

In this paper we proposed two techniques for eye blink detection Gabors filters and Circular Hough Transformation for a method for extracting circles from images. The main aim is to create eye blink detector, which could be used in real-time blink detection system. It provides o better true positive rate and about lower false positive rate. Normal Flow Gabors filters and Circular Hough Transformation are also discussed in brief.

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