ALGORITHM FOR AGE-RELATED MACULAR DEGENERATION IN RETINA

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Abstract—Assessment of the risk for the development of Age related Macular Degeneration requires reliable detection of retinal abnormalities that are considered as precursors of the disease. A typical sign for the later are the so-called squint, which appear as misalignment of the eyes. This paper presents a Hough transform algorithm for detection of abnormalities in images of the human eye acquired from a depth vision camera. In this paper we implement an efficient algorithm to detect drusen in eye images by extracting the useful information without being affected by the presence of other structures. We provide experimental results from the application of our technique to real images, where certain abnormalities (drusen) have slightly different characteristics from the background and are hard to be segmented by other conventional techniques. We present a fast method for locating eye features in frontal face images based on the Hough transform and determine the Vision loss in the turned eye. It consists of an initial detection and a tracking which uses eye features from initialization for speeding up computation. The algorithm was applied to images of subjects taken under normal room lighting conditions.

Keywords—Hough transforms, image processing, co-variance filter.

1. MOTIVATION

We decided to explore the capabilities of an approach which is mostly based on the Hough transform although current methods for eye feature extraction use deformable templates[1][2]. The advantage of the Hough transform over using templates is that the final result is computed from a number of independent partial solutions. The Hough transform is therefore well-suited for the fusion of partial results with predictions from a model. The algorithm has been applied to test images of faces which were taken under different lighting conditions. The two irises and their features are detected during initialization. Given the features the localization information will be fine-tuned by evaluating a small neighborhood of each iris.

2. INTRODUCTION

Squint is the term used when the eyes are not pointing in the same direction or eyes are not aligned with respect to each other they point towards different direction. Most commonly one eye either turns in or out. Occasionally one eye may be higher than the other. Some common ways to detect vision loss relate to symptoms that words on a page look blurred, a dark or empty area appears in the center of vision, or straight lines are distorted, it has been identified that age is the greatest risk factor and there is also a hereditary nature associated with the disease. Depth vision cameras have been developed to capture the eye images for accurate on-line analysis. The goal of our research is the on-line processing of eye images, so as to detect the presence of drusen and help the examiner meet the right decision.

If the eyes are not looking in the same direction then they are sending different signals to the brain and this can cause double vision. In this condition eyes are not straight. In most cases one eye appears to look straight ahead while the other eye turns inwards, outwards, upwards or downward and stop working with other eye. The medical name for Squint (or crossed-eye or lazy eye) is Strabismus which means misalignment of eyes. [3].

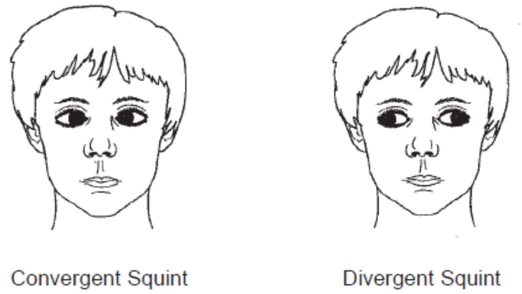

Fig. 1

2.1 What Causes Squint

A squint can occur for a number of different reasons these include Damage to the muscles controlling the eye, poor development or damage to the eye muscle control centers in the brain and poor vision in the eye can stop the brain being able to keep the eyes together. This occurs in adults who have had a squint as a child.

3. DETECTION APPROACH

We make the following assumptions for detecting and tracking squint eye in human face images:

3.1 The image is a frontal view of the face, i.e. the two eyes are visible and have approximately the same distance from the camera.

3.2 Image should not be too noisy.

3.3 Eyes should be in normal horizontal position 3.4 Iris diameter should not be very small with respect to the size of image.

3.5 The two candidate circles for irises must have similar radiuses.

3.6 The distance between the two centers of the circles divided by the average radius of one circle had to be bounded between some values. We could also use the distance between the centers of the ellipses for similar considerations.

3.7 The iris in each eye is at least partially visible.

3.8 The brightness of the iris is lower than that of the visible part of the sclera.

4. DETECTION USING HOUGH TRANSFORM

The Hough-Transformation is suited for the detection of the squint eye. It is based on the idea of transforming *all* contour points belonging to the structure into *one* point of transformation space (accumulator array). This point is identified as the global maximum of the AA. It becomes more prominent the greater the number of contour points belonging to the transformed object. The Hough Transform can be calculated for any curve described by parameters, which turn into the axes of the Accumulator Array. Centre, corner and radius of the circular iris in space can thus be read as coordinates of the global maximum of the Accumulator Array which in this case is three-dimensional. The binary edge image is produced by calculating the modulus of the gradient of the original image.

The Hough transform is a standard computer vision algorithm that can be used to determine the parameters of simple geometric objects, such as lines and circles, present in an image. The circular Hough transform can be employed to deduce the radius and centre coordinates of the pupil and iris regions. An automatic segmentation algorithm based on the circular Hough transform is employed. Firstly, an edge map is generated by calculating the first derivatives of intensity values in an eye image and then thresholding the result. From the edge map, votes are cast in Hough space for the parameters of circles passing through each edge point. These parameters are the centre coordinates X_c and Y_c, and the radius R, which are able to define any circle according to the equation

$$X_c^{\,2} + Y_c^{\,2} = R^2$$

A maximum point in the Hough space will correspond to the radius and centre coordinates of the circle best defined by the edge points. Hough transform to detect the eyelids, approximating the upper and lower eyelids with parabolic arcs, which are represented as

$$(-(x - h_j)\sin\theta_j + (y - k_j)\cos\theta_j)^2 = a_j((x - h_j)\cos\theta_j + (y - k_j)\sin\theta_j)$$

Where a_j controls the curvature, (h_j ,k_j is the peak of the parabola and θ_j angle of rotation relative to the x-axis. In performing the preceding edge detection step, bias the derivatives in the horizontal direction for detecting the eyelids, and in the vertical direction for detecting the outer circular boundary of the iris. The motivation for this is that the eyelids are usually horizontally aligned, and also the eyelid edge map will corrupt the circular iris boundary edge map if using all gradient data. Vertical gradients for locating the iris boundary will reduce influence of the eyelids when performing circular Hough transform, and not all of the edge pixels defining the circle are required for successful localization.

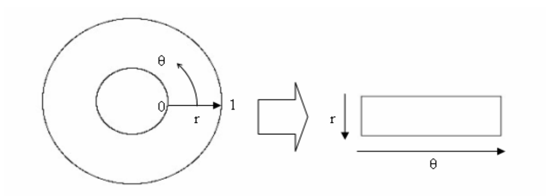

Fig 2

The remapping of the iris region from *(x, y)* Cartesian coordinates to the normalized non-concentric polar representation is modeled as:

$$I(x(r,\theta), y(r,\theta)) \rightarrow I(r,\theta)$$

with

$$x(r,\theta) = (1 - r)\, x_p(\theta) + r\, x_1(\theta)$$
$$y(r,\theta) = (1 - r)\, y_p(\theta) + r\, y_1(\theta)$$

where $I(x, y)$ is the iris region image, (x, y) are the original Cartesian coordinates, (r, θ) are the corresponding normalized polar coordinates, and are the x_p , y_p x_l , y_l coordinates of the pupil and iris boundaries along the direction.

5. DRAWBACKS

Detection of the iris becomes indifferent to disturbances which can be created by spectacle lenses. Glass reflexes appear as bright spots on dark background and lead to wrong detections even though they may have a radius corresponding to that of the iris. Problems are created by reflexes on spectacle frames which act as the amplitude of the gradient is taken into account may falsify the HT to such an extent that the iris is not detected. If the image is blurred and the model function for the Cross-Covariance-filter no longer matches and is discarded. Through the automatic analysis of images, strabometry becomes suitable for screening. The high sensitivity of the system leads to an early recognition of symptoms, and thus to the desired treatment of the illness at an early stage of its development.

6. CONCLUSION

In this paper we have focused the different squint aye detection technique. So the detection of abnormalities in human eye's retina is a biomedical problem, appropriate for image processing and automated segmentation, whose solution is intended to help the doctors in their decision making process. Hough Transform can be used for the detection of circle and ellipse then final eye is detected with amount of squint by neglecting the wrong detections and ruling out a pair of eyes based on geometrical considerations. This method is also applied for online eye detection purpose. It can not be supposed that the contour of the iris is closed and free of distortions .Due to the indifference to interruptions of the contour of an object the Hough-transformation is especially selected for squint eye detection. A significant factor that affects the overall performance of other approaches is the presence of noise, which makes surfaces look rough and renders the segmentation process difficult. Although, it is not a common case, since the presence of noise is rare in such images and provides adequate results even in the case of noise contamination.

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