Efficient Eye Blink Detection Method for Disabled People: Assisting System for Paralyzed

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Abstract:
A real-time method based on video and image processing algorithms an eye blink detection is presented. The motivation of this project is the need of disabled people (tetraplegia) who cannot control the calls with human mobile interaction directly without the need of hands. Tetraplegia is a paralysis caused by illness or injury that results in the partial or total loss of use of all four limbs. This is caused by damage in the brain or the spinal cord injuries. Designing systems to detect the human gestures and movements is an important area in computer vision. A Haar Cascade Classifier is supplied for face and eye detection for getting eye and facial axis information. In addition, the same classifier is used same based on Haar-like features to find out the relationship between the eyes and the facial axis for positioning the eyes. An efficient eye tracking method is proposed which uses the position of detected face. Finally, an eye blinking detection based on eyelids state (close or open) is used for controlling android mobile phones. The proposed method will use 5-megapixel camera that captures patient’s face and eye, it processes the images to detect patient’s eye blink. On the detection of eye blink,[2] the programmed system alert the nearby people through an alarm. The proposed method constitutes of various stages to determine eye blink of patient. According to this output, the alert message is generated. Haar Cascade Classifiers is used to detect the blink duration of the patient and Eye Aspect Ratio(EAR) is calculated. Finally, the alert message is sent to the nearby people. For this built-in camera with OpenCV(Python) is used.

Keywords: Eye Blink detection, Haar-Cascade, OpenCV, Feature Extraction, Eye Aspect Ratio(EAR).

1. INTRODUCTION

In these days electronic devices are improving day by day and their demand is also improving Smartphones, tablets are few example of this. The system detects the eye blink and differentiates between an intentional long blink and a normal eye blink. Tetraplegia is a condition where people cannot move parts below neck [3]. The proposed system can be used to control and communicate with other people. In the recent years due to the rapid advancement in the technology there has been a great demand of human computer or mobile interaction (HCT or HMI). Eye blink is a quick action of closing and opening of the eyelids. Blink detection is an important enabling component in various domains such as human computer-interaction, mobile interaction, health care and driving safety. For example, blink has been used as an input modality for people with disabilities to interact with computers and mobile phones. Haar Cascade Classifier is used for identifying subregion of image, with the fast calculation of integral image technique, it can work in real time. Eye tracking [2] provides an almost seamless form of interaction with the modern graphical user interface, representing the fastest non-invasive method of measuring user interest and attention. While the mouse, keyboard and other touch-based interfaces have long reigned as the primary mediums associated with the field of human computer interaction, as advances continue to improve the cost and accuracy of eye tracking system they stand poised to contend for this role. An open and close eye template for blink pattern decisions based on correlation measurement is used. The method was specifically useful for people with severely paralyzed. A real-time eye blinking detection was proposed based on SIFT feature tracking with GPU based implementation. This method is based on image processing techniques for detecting human eye blinks and generating inter-eyeblink intervals[2]. A Haar Cascade Classifier and Camshaft algorithms for face tracking and consequently are applied for getting facial axis information. Adaptive Haar Cascade Classifier from a cascade of boosted classifiers based on Haar-like features using the relationship between the eyes and the facial axis applied for positioning the eyes. The algorithm results show that the proposed method can work efficiently in real-time applications. A system that capable of mobile applications/functions using only the user’s eyes movement and actions (e.g., wink).

2. METHODOLOGY

The main aim to detect Eye blink of the patient, it can be done by measuring Eye Aspect Ratio (EAR). Blinking pattern is different for each and every individual. The pattern gets varied in terms of squeezing degree of eye, blink duration and speed of closing and opening the eye. The proposed method involved with the following methodologies such as Haar Cascade Classifiers, Shape Predictor_68_facial landmark detection, Eye Aspect Ratio(EAR).

2.1 Frame capturing
The first step of the proposed application is the initialization. After taking a short video of the participant’s face using the front camera. A process framing method will be used to create the frames from the captured video. Afterwards the coloured frames will be converted to gray scale frames by extracting only the luminance component.[1]

2.2 Haar Cascade Classifier
A Haar Cascade Classifier is basically a classifier which is used to detect the object for which it has been trained for, from the same source. The Haar Cascade is trained by
superimposing the positive image over a set of negative images. The training is generally done on a server and on various stages. OpenCV is a learning-based method, packed with a detector as well as a trainer. For training, a separate database is maintained for face and eye with several positive and negative images having eye closed and opened conditions and different set facial images.

2.3 Shape Predictor _68_ Facial Landmark detection and Eye Aspect Ratio (EAR) In order to predict the face and eye region in the live video stream, shape predictor is used. Fig.1 shows the blink detection which is measured by calculating the eye aspect ratio (Euclidean distance between the eyes are calculated), the arguments are passed to the predefined dataset and facial landmark detection is carried out. For every video sequence, the eye landmarks are located. The aspect ratio between width and height of the eye is calibrated.[2]

![Figure.1. facial landmarks associated with eye](image)

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\text{EAR} = \frac{||p2-p6||+||p3-p5||}{2||p1-p4||}
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Where p1,……,p6 are the two-dimensional landmark location, represented in Fig.2. The EAR is mostly stable when an eye is open and is getting close to zero while the eye is not in open state. If the person viewing the camera continuously, the Eye Aspect Ratio (EAR) is found to be normal and it reaches low value when he/she closes the eye. OpenCV is effective with python IDLE. It involves programming in software with extensions of OpenCV computer vision installed. The program will start to run and it can be terminated using command line interfaces in terminal or the system is turned off. In order to initiate the program execution, it will import the following libraries like NumPy, OpenCV, play sound, argpares, Dlib, distance, timer, and camera.

Programming Algorithm

3. RESULTS AND DISCUSSION

The Patient Eyeblink can be measured using Eye Aspect Ratio (EAR). The ratio of the eye varies for each and every person. Eye closing rate is measured after every 0.5 seconds and if the value crosses the already existed threshold value, then the system counts the number of blinks and sends the alert message from speaker. The alert signal is generated from speaker device. The OS along with camera is used to detect the eye blink of the patient in real time. The detected blinks are then converted into voice messages like need of medicine, need of water, make an phone call, this helps the paralyzed people to communicate with the world.

4. CONCLUSION

Eyeblink detection is designed mainly to help the disabled patients. The alert signal is generated from embedded device to fulfil needs of a patient like drinking water, make a phone call. The OS along with camera is used to calculate the Eyeblink of the patient in real time. Blink is measured by detecting face and eye using a classifier called Haar Cascade Classifier, especially facial landmarks is detected using shape-predictor and Eye Aspect Ratio (EAR) by calculating the Euclidean distance between the Eyes. Accurate eye detection and faces in every frame will help to calculate number of blinks. When he/she reaches maximum threshold the patient blink is detected will be alarmed by a loud warning and the voice message is sent. In future, the performance can be carried out in a bright room with consonant light, for different lighting conditions.

5. REFERENCES

[1]. Efficient Eye-Blinking Detection on Smartphone’s: A Hybrid Approach Based on Deep Learning. Correspondence should be addressed to Woo Seong Kim; wooseong@gachon.ac.kr and Joon-Sang Park; jsp@hongik.ac.kr. Received on 15 December 2017, Accepted 26 March 2018 and Published 21 May 2018
