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Multimedia Assistance for paralyzed patients using Eye blink Detection

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Abstract:
The lack of muscle control is known as paralysis. In India, paralysis affects around 9.5 million people. Even though they are cognitively aware, many paralysed patients are unable to move any portion of their bodies. They are unable to speak, type, or communicate in any way. Their thoughts and ideas have been locked inside these victims. Eye movement is generally controlled by those with paralysis. As a result, the goal of this research is to create a real-time interactive system that allows paralysed people to express themselves just by blinking their eyes.
We show how to identify eye blinks in real time using video and image processing methods. The need to disable those who are unable to motivate this research is the requirement for those who are unable to converse with humans to be disabled. For face and eye detection, a Haar Cascade Classifier is used to obtain eye and facial axis information. In addition, the same Haar-like features-based classifier is utilised to determine the relationship between the eyes and the facial axis for eye location. The position of the identified face is used to propose an efficient eye tracking approach.
Keywords: *Eye Tracking, Haar Cascade, eye blinks.*

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I. INTRODUCTION:

Motor neuron disease (MND) is an incurable disease in which the patient's motor neurons become disabled. It can also cause muscle weakness in the hands, feet, or voice. As a result, the patient is unable to undertake voluntary behaviors and finds it difficult to convey his or her demands. In this electronic age, solutions for patients with the disorders listed above can be identified; one such innovation is the proposed system, which is described in detail throughout. Eye blinks can be used to control and communicate with other people in the suggested system. Due to significant technological advancements in recent years, there has been an increased demand for human-computer or human-mobile interaction. The blink of an eye Blinking is the fast closure and opening of the eyelids. Blink detection is a key enabler in a variety of fields, including human-computer interaction, mobile interaction, health care, and driving safety.

The system captures footage of the patient with an internal camera and utilizes a facial landmark algorithm to identify the patient's face and eyes. The device then displays a series of images one after another on the screen, with the patient having the option of blinking over the image he wishes to indicate his desires. The technology uses the eye aspect ratio to recognize the blink and then the patient's requirement. The technology detects eye blinks and distinguishes between them a deliberate long blink and a regular eye blink the proposed technology can be used to communicate with and control other people.

II. Literature Review:

1] Atish Uday Shankar, Amit R Kaushik—Assistance for the Paralyzed Using Eye Blink Detection| IEEE Paper Fourth International Conference on Digital Home, 2012 In this paper, the device that uses the signals from patient and then convert it into some form of data that is for communication.

2] Assis.Prof. Are A. Mohammed, Suleiman, Shereen - Efficient Eye Blink Detection Method for disabled people domain| International Journal of computer science and Application, Vol.5, No.5, 2014 In this paper, they have designed a real-time interactive system that can help paralyzed to control the appliances like fan, lights etc. through the pre-recorded sample of eye blinking. Detection of eye blinking by using video camera with region of interest.

3] Young-Joo Han, Woo sung Kim and Joon -Sang Park— Efficient Eye Blink Detection on Smartphone's: A Hybrid Approach Based on Deep Learning, 21 May 2018. In this method, they have proposed a hybrid approach combining two machine learning techniques, the linear SVM classifier with HOG features such that eye blink detection can be performed efficiently.

4] Mu-Chun Su, National Central University, Department of Computer Science & Information Engineering—An Implementation of an Eye-blink- based Communication Afro People with Severe Disabilities, August 2008 The method presents an implementation of a low-cost vision based computer interface which allows people with disabilities to us

5] Tambe Sameen Mohammed, Rajeshwari P—Review on Smart Eye Blink Solution for and Patient Using Python, March 2019 |Volume 4, Issue 3 The growth of technology in medicine field diminishes the difficulties of patients to a large extent. The disease named Motor Neuron Disease (MND), one of the major physical disabilities leading to paralysis. MND patient is unable to do work like talk, walk, express their feelings and communicate due to the weakening of muscles. The patient has control only on his eye blinks, the problems facing by MND patient is obtaining a solution day by day. The broad review on literature of different solution of MND patients is described in this paper.

6] Aleksandra Krolak and Pawel Strumillo –Eye Blink Detection system for human computer interaction, universal access in the information society, 2012. Królak, A., Strumiłło, P.: Eye-blink controlled human–computer interface for the disabled. Advances Intel. Soft Compute. 60, 133–144 (2009) In this paper a vision based human computer interface is presented. The interface detects voluntary eye-blinks and interprets them as control commands. The employed image processing methods include Haar-like features for automatic face detection, and template matching based eye tracking and eye-blink detection.

7] Alex Poole, Linden J. Ball "Eye tracking in human Computer interaction and usability research: current status and future prospects", Encyclopedia of human computer interaction 2006. pp.211 219 Detecting and tracking the facial features abruptly, thereby fast enough to be applied in real- time. The human face of different races that can be captured with the help of night vision camera that detects the facial features correctly and translates it into some events which are further used to communicate with the computer.

8] Kristen Grumman, MargritBetke, James Gips, Gary R. Bradski "Communication via eye blinks detection and duration analysis in real time", Proceedings IEEE conf. on computer vision and pattern recognition, Lihue, HI, vol.1, pp.1010, 2001

9] Appearance for eye tracking and eye-blink detection and measurement Ioana Bacivarov; Mircea Ionita ; Peter Corcoran IEEE transaction on consumer electronics (Volume: 54, Issue:3 , August 2008) A statistical active appearance model (AAM) is developed to track and detect eye blinking. The model has been designed to be robust to variations of head pose or gaze. We analyze and determine the model parameters which encode the variations caused by blinking. This global model is further extended using a series of sub-models to enable independent modeling and tracking of the two eye regions. Several methods to enable measurement and detection of eye-blink are proposed and evaluated. The results of various tests on different image databases are presented to validate each model.

10] Grauman, K., Betke, M., Lombardi, J., Gips, J., Bradski, and G.R.: Communication via eye blinks and eyebrow raises: Video-based human–computer interfaces. Universal Access in the Information Society, 2(4), 359–373 (2002)

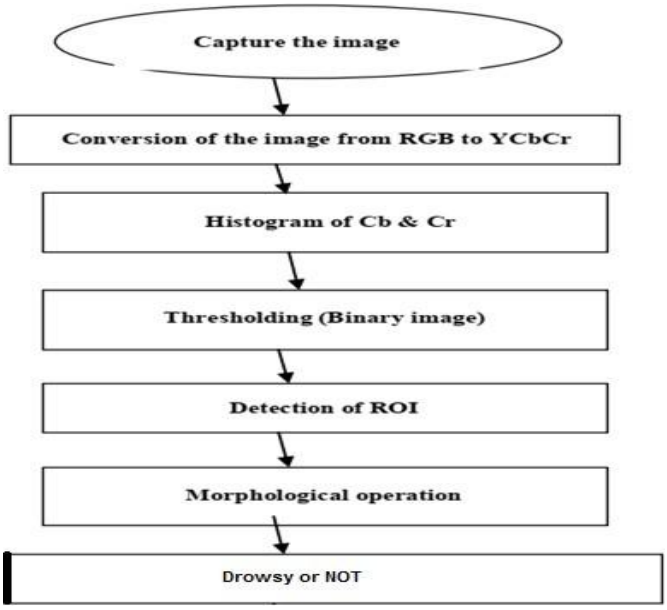
11] Bradski, G. R., "Computer Video Face Tracking for Use in a Perceptual User Interface," Intel Technology J., Q. 2, 1998 Kim, C. and Turk, M., "Biased Discriminant Analysis Using Composite Vectors for Eye Detection," Proc. of the 8th IEEE Int. Conf. on Automatic Face and Gesture Recognition, Amsterdam, The Netherlands, September 17- 19, 2008. A Method for Real-Time Eye Blink Detection and Its Application

III. Design:

This section is likewise broken down into three sections.
The operating system is the initial component.
The second section covers Python coding environments.
The final section discusses Open CV library, an open source library.

3.1 Methodology:

The image analysis techniques have been greatly accepted and applied. In the proposed method, A Web camera is for taking consecutive facial images of the driver. It then uses program which is written in python code to detect the position of eyes based on the images taken.



3.2 IMPLEMENTATION:

The suggested application's initialization is the first stage. After then, using the front camera, take a short video of the participant's face. To construct the frames from the collected video, a process framing method will be employed. The colored frames will then be transformed to grey scale frames by removing only the brightness component. Using a trained classifier called haar cascade to detect objects. OpenCV is a learning-based technique that includes both a detector and a trainer. The face and eye can be recognized using this method. Shape predictor is used to gather the face and eye region in the live video stream. Dlib is a library that may provide you 68 face points (landmarks). With pre-trained models, the landmark facial detector is used to estimate the placement of 68 coordinates (x, y) that map the facial points on a person's face. After obtaining the right and left index values, the Eye Aspect Ratio is determined. The parameters are provided to the prepared dataset and facial landmark detection is performed, as shown. Blink detection is quantified by computing the eye aspect ratio (Euclidean distance between the eyes is determined). The eye landmarks are identified for each video sequence. The aspect ratio between the eye's height and width is calibrated. When one eye is open and coming close to zero, the Eye Aspect Ratio is at its most stable isn't in an open state. When a person stares at the camera for a long time, the Eye Aspect Ratio (EAR) is normal, but it drops to a low number when he or she closes one eye.

In order to detect blinks we are setting threshold value, and we can check to see if the eye aspect ratio is below

$$\mathrm{EAR} = \frac{\|p2-p6\| + \|p3-p5\|}{2\|p1-p4\|}$$

our blink threshold - if it is, we increment the number of consecutive frames that indicate a blink that takes place. From the above methods the number of blinks are counted and are initialized to some applications through voice messages.

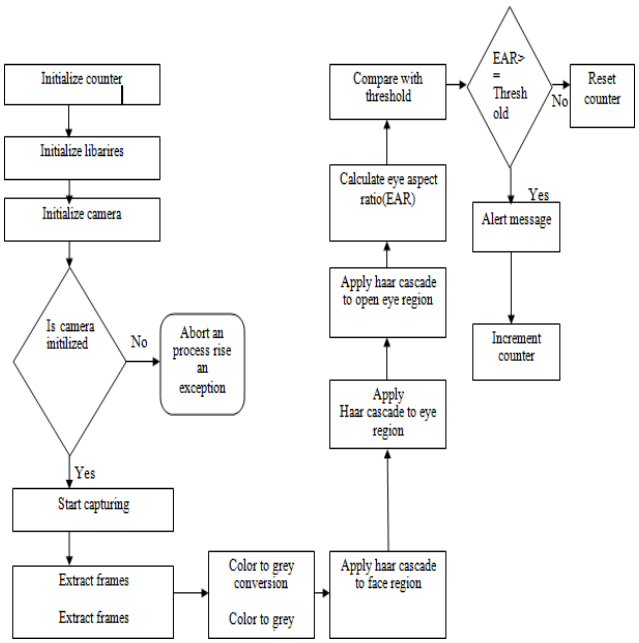


Figure.2. Eye blink detection algorithm

3.3 IMAGE PROCESSING FOR THE DETECTION OF EYE:

This section explains the various steps involved in the detection of ROI implementing the image processing.

3.4 Capturing the image:

The driver's face appears in a photograph taken inside a vehicle. Normally, a camera captures images using the RGB model (Red, Green and Blue) [3]. The RGB model, on the other hand, incorporates brightness in addition to colors. Distinct brightness for the same color signifies different color in the sight of humans. The RGB model is quite sensitive to image brightness when assessing a human face. As a result, the second step is to eliminate the brightness from the photos [6]. Because it is extensively used in video compression standards, we employ the YCbCr space [5]. We nonlinearly alter the YCbCr color space to make the skin cluster luma-independent because skin-tone color is reliant on brightness. This makes it possible to distinguish between dark and light skin tones [7]. The key benefit of transforming the image to the YCbCr domain is that we can remove the effect of luminance during image processing. Each component of the image has a variable brightness in the RGB domain (red, green, and blue). Because the Cb (blue) and Cr (red) components are independent of luminosity in the YCbCr domain, the Y component provides all information regarding brightness. To divide the RGB image into its Y, Cb, and Cr components performs the following conversions:

$$Cr=0.439 *R-0.368*G-0.071*B+ 128$$
$$Cb=0.148*R- 0.291*G- 0.439*B+128$$

3.5 EYE REGION DETECTION:

We know the region of interest is the region containing the eyes because we are only taking the face area. The eyes will be in the uppermost two quadrants of the face, which has been divided into four quadrants [5]. We may presume that the right eye will be positioned at the top left-hand side of the face because both eyes blink at the same time. As a result, calculations will only be based on one sight [7]. Taking these assumptions into account, the search for the eye will be limited to the area, making the search more efficient. A computer vision system built with opencv that can automatically detect driver tiredness in a real-time video if the driver appears tired, the system will sound an alarm.

IV. RESULTS:

The Patient Eye blink 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.

V. CONCLUSION:

Eye blink detection is primarily intended to assist impaired patients. The alarm signal is created by an embedded device to meet a patient's demands, such as drinking water or making a phone call. The OS, in conjunction with the camera, is used to calculate the patient's Eye blink in real time. Blink is assessed by detecting face and eye with a classifier called Haar Cascade Classifier, specifically facial landmarks with a shape-predictor, and calculating the Euclidean distance between the eyes with the Eye Aspect Ratio (EAR). The amount of blinks can be calculated using accurate eye detection and faces in each frame. When the patient's blink hits the maximum threshold, a loud warning will sound and a voice message will be transmitted. In the future, For diverse lighting situations, the implementation can be done in a bright room with consistent light.

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