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Detect Eye blink using Motion analysis Method

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Abstract: A Motion analysis method is developed to track and detect eye blinking. In this work we want to put some light on new system in which Using eye as an interface to communicate with system for people that are severely paralyzed or affected by diseases in which they are unable to move or control most of their body parts except for their eyes. This paper gives overview of different techniques to the problem and describes best possible methods of eye blink detection techniques. The main propose system is the motion analysis method and finding frame difference used for tracking intentionally blink of eyes.

I. Introduction

As eyes are directly connected to brain, they are the last part of our body on which we can lose control. For some persons, who are suffering from a brain-stem stroke, neuro motor disability or due to any accident, the eyes are the only option for communication with the world. Blink of their eyes can be converted to vocabulary for such persons. But continuous monitoring and understanding is required to understand and communicate with them properly. This is bit difficult for human to understand the meaning of those blinks continuously.

World-wide there are many computer users who, due to their physical condition, are not able to use their hands or any part of body. Most of them have good control of their eyes and therefore communicate with the world is done solely using the movement of their eyes or eye lids. These eyes blink or eye lids movement can be replaced with mouse click functionality. We thought about using blink detection mechanisms to enable hands-free communication with computers for handicapped users [3].

The goal of our research is to propose a new technique for efficiently tracking a eye blink of a person from web-cam image sequences and using intentionally eye blink detection. This blink is used to control computer and do some specific task. Vision system that make computers to receive user's natural communicative signals such as intentionally eye blinks and interpretation of blink patterns[5] for communication between man and machine.

The inspiration for the system proposed here is to provide an inexpensive, less expensive means for disabled people to interact with simple computer applications in a meaningful way that requires minimal effort and cost. Recent advances in computer hardware, computer cameras, in particular, in motion and change detection, [2,5] offered practitioners a new way for detecting blinks based on video observations of the person's face. The need of the system for physically disable people motivated many researchers to develop eye tracking systems for providing an ease of use for those handicap users.

we propose a robust, accurate algorithm to detect eye blinks, and interpret them in real time to control a non-intrusive interface for computer users with severe disabilities[1]. Here we studied the advantages and disadvantages of different technique for detecting the eye blinking. The proposed system can detect both spontaneous and intentionally eye blinks and it doesn't required prior knowledge of face location or skin color, nor special lighting.

This paper is organized as follows. Section II presents a short survey of the existing methods in eye tracking and blink detection. The developed method for the detect eye-region is detailed in Section III. Section IV gives an overview of the proposed system, including the blink detection method and a brief theoretical introduction and steps for the proposed system design.

Section V presents some experimental results of each steps, while in section VI we draw some conclusions and discuss some possible future work.

II. Literature survey

Eye tracking systems use image processing techniques based motion analysis technique. In image processing the input data is converted into digital form and various mathematical operations are applied to the data to create a more enhanced image to perform tasks like recognition or authentication, and these tasks are performed by humans using digital computers[4]. One of the most commonly presently used techniques for people with now

brain stem injury is the one based on the Electromyograph (EMG) readings, which are obtained by using three small electrodes are attached to the skin with micro-pore tape around the obicularis oculi muscle [9]. Although in principle the EMG-based system should be effective in detecting the muscle signals from patients' eye blinks. The main disadvantage of EMG is it is related to electrical noise in patients environment and various factors concerned with electrode and EMG signal quality. EMG is also liable to interference and increase in the signal to noise ratio. due to variability skin conductance and slight positioning changes of the electrodes it difficult to collect true EMG data, such as base-line drift [3].

Another Recently, the new technique of using a webcam for the problem has been applied and the first tests showed promise for some people who have not had success with control and communication through other high-tech solutions [9].

There are many advantages of webcam-based system for detecting the eye blink compared to EMG is it is require limited set up and also , the webcam would sit at a distance from any patient with minimum intrusion so that nothing needs to be attached to the patient. The webcam is also a cheap, commercially available piece of hardware. One of the foreseen advantages is that if the patient moves position, for example after a spasm, then the webcam simply compensates, by looking at a different part of the picture.

The approaches to vision-based detection of eye blinks can be divided into three categories. The first category uses dedicated video equipment capable of capturing high resolution still images [10, 11]. Capturing eyes in high resolution, such that eye pupils diameter is higher than 10 pixels, allows one to extract pupils using Hough-like transforms and template matching decide on whether the eye is open or closed. The disadvantage of this approach is that it requires expensive camera and a lot of processing power.

The second category uses structured infrared light in addition to the regular video camera [12, 13]. These systems register the infrared light reflection in the users' eyes in order to locate the eye pupils and based on whether the pupils are detected or not make the decision on eye lid motion. In certain cases these systems are reported to perform very well. However they have problems detecting eye pupils in the presence of eye glasses and in day light. They are also partially intrusive.

The first and the second categories of approaches do not use the dynamic component of video, which, as discussed in [8, 14] is intensively used in biological vision systems in a similar scenarios. Consequently, there exists a third type of approaches to the eye blink detection, based on detecting the eye lid motion. It is this type we dedicate our effort to.

III. Method

The system uses various computer vision techniques in combination. Eye blink motion is used to automatically locate the user's eyes in the video sequence.

In order to recognize blink-based commands from the user using the motion component of video, we developed the following hierarchy of tasks to be executed (see Figure 1).

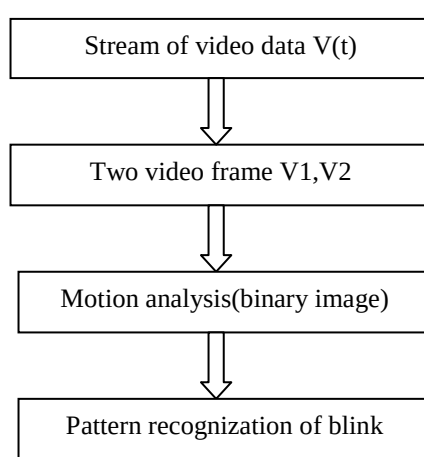


Figure 1: Detecting eye blink-based commands from a user using the motion component of video.

First of all video frames $V(t)$ has ben captured after that selecting the two consecutive frames $V(1)&V(2)$ for detecting the visual change caused by facial motion. The second task is to analyze the detected change in order to see whether it contains the information about the eye lid motion. If it does, then, based on the eye-lid motion history, determine whether the eye closing and opening was intentional or not, and if it was intentional, then recognize pattern of eye blink.

IV. System Design

This section shows the Mathematical model and system design flow of the developed system that shows the interrelationships of each phase and relationships among different variables of the developed system. The motion detection design flow for the eye blink detection are shown in figure 2.

Naturally, the first step in motion analyzing the blinking of the user is to locate the eyes. To accomplish this, the difference image of each frame $V(t+1)$ and the previous frame $V(t)$ is created and then thresholded, resulting in a binary image showing the regions of movement that occurred between the two frames.

Next, a 3x3 star-shaped convolution kernel is passed over the binary difference image in an Opening morphological operation [15]. This functions to eliminate a great deal of noise and naturally-occurring jitter that is present around the user in the frame due to the lighting conditions and the camera resolution, as well as the possibility of background movement. In addition, this Opening operation also produces fewer and larger connected components in the vicinity of the eye, which is crucial for the efficiency and accuracy [2].

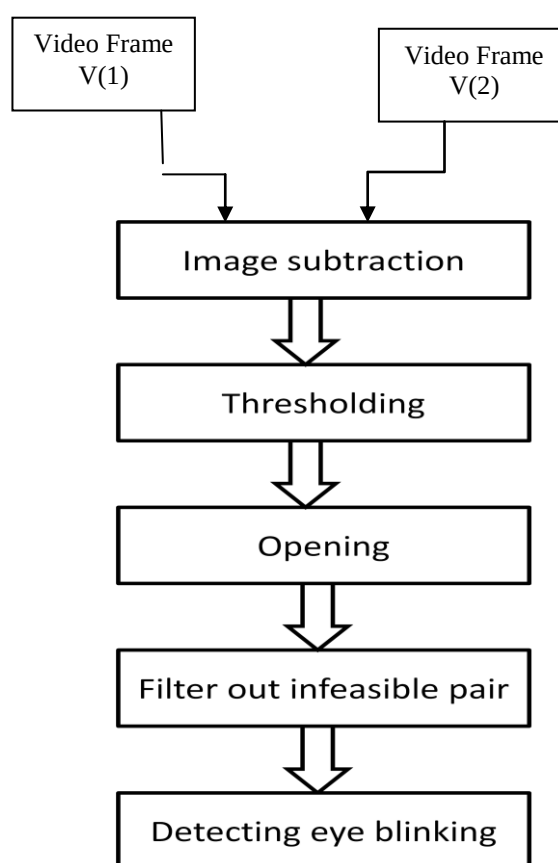


Figure 2: system design flow for the eye blink detection using motion analysis method

A. Image subtraction:

The system first analyses the images, being grabbed by the video, for detection of any moving object. The image subtraction algorithm is used for this purpose, which gives as output the position of the moving object in the image.

B. Thresholding operation

Now perform the Binary Thresh-holding Operation on $V(d)$ separating the pixels corresponding to the moving object from the background .This operation also nullifies any inaccuracies introduced due to the camera flickering. The result of this operation is a binary image, $V(th)$, where in only those pixels are set as '1' which correspond to the moved object. In the thresh-holding technique a parameter called the brightness threshold (T).

During the thresholding process, individual pixels in an image are marked as "object" pixels if their value is greater than some threshold value (assuming an object to be brighter than the background) and as "background" pixels otherwise. This convention is known as *threshold above*. Variants include *threshold below*, which is

opposite of threshold above; *threshold inside*, where a pixel is labelled "object" if its value is between two thresholds; and *threshold outside*, which is the opposite of threshold inside. Typically, an object pixel is given a value of "1" while a background pixel is given a value of "0." Finally, a binary image is created by colouring each pixel white or black, depending on a pixel's labels.

$$g(x, y) = \begin{cases} 1 & \text{if } f(x, y) > T \\ 0 & \text{if } f(x, y) \leq T \end{cases}$$

Thresholding may be viewed as an operation that involves tests against a function T of the form where $f(x, y)$ is the graylevel at the point (x, y) .

A thresholded image is defined as thus pixels labelled 1, say, correspond to objects, and pixels labelled 0, say, correspond to the background.

C. Morphological opening operation

After converting the threshold image into binary image apply morphological opening binary operation. Opening consists of an erosion followed by a dilation and can be used to eliminate all pixels in regions that are too small to contain the structuring element. In this case the structuring element is often called a probe, because it is probing the image looking for small objects to filter out of the image. Opening of an input image A by a structuring element B is defined as follows:

$$A \circ B = (A \ominus B) \oplus B$$

An equivalent definition for opening is: $A \circ B = \bigcup \{B + x : B + x \subseteq A\}$

This means that in order to open A by B we first translate B by x so that this lies inside A. The union of these translations constitutes $A \circ B$. For instance, the opening of a triangle A by a disk B (the origin coincides with the centre of the disk) is the triangle A with rounded corners. In general, opening by a disk rounds or eliminates all peaks extending into the image background. Connectivity can be defined in a more general way for any dimension by using for conn a 3-by-3-by-...-by-3 matrix of 0s and 1s. The 1-valued elements define neighborhood locations relative to the central element of conn. Note that conn must be symmetric about its central element. Under the circumstances in which this system was optimally designed to function, in which the users are for the most part paralyzed, this procedure yields only a few connected components, with the ideal number being two (the left eye and the right eye). In the case that other movement has occurred, producing a much larger number of components, the system discards the current binary image and waits to process the next intentionally blink in order to maintain efficiency and accuracy in locating the intentionally count eye blink.

V. Experimental Results

Here as shown in Fig(3) part (A) & (B) moving part of image is User's eyes. so after getting result will be shown in Fig(4). it note the great deal of noise in background due to light conditions and camera properties



Figure 3: User at frame $V(t)$ in open eyes (A), User at frame $V(t+1)$ close eyes (B).

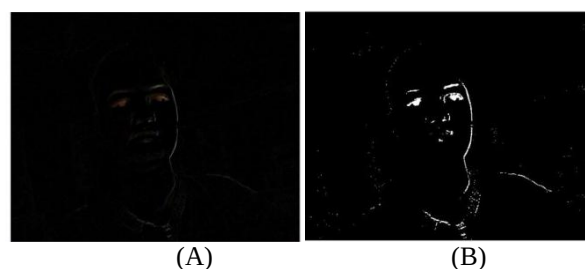


Figure 4: Initially subtraction of two image $V(t)$ & $V(t+1)$ i.e $V(b)$ (A), Thresholded difference image (B).

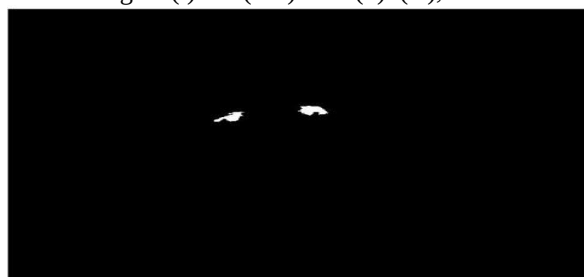


Figure 5: Difference image used to locate the eyes and indicating the blink after performing the Opening operation.

VI. Conclusion

This research provides a system that is able to open the file in computer for controlling an interface for the people who are suffering from severe physical disabilities and who cannot use their body part rather than eyes. The system is able to track eye blink efficiently and accurately by using the motion analysis method and detected change in order to see whether the eye lid blink or not. The system can track eye portion with accuracy. This system does not require to attach the hardware to user as it is the good for the paralyzed personas it is user friendly and easy to operate. This system tracks the eye position of user.

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