Human Machine Interface Based on Eye Wink Detection

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Article Info

ABSTRACT

The research of human-computer interfaces has become a growing field in computer science, which aims to attain the development of more natural, intuitive, unobtrusive and efficient interfaces. The present work describes a Human Machine Interface Based on Eye Wink Detection for helping the severely handicapped people to manipulate the household devices and to perform day to day activities. Algorithm for eye detection that is conducted through a process of extracting the face image from the video image followed by evaluating the eye region and then eventually detecting the eye state based on skin colour segmentation. Binary values 1 and 0 is assigned based on the opening and closing of eye. Finally applying the dynamic programming to translate the code sequences to a certain valid command. Experiment conducted for different test video, displayed significant results which is carried out with different set of inputs.

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1. INTRODUCTION

Today, the keyboard and mouse are the main devices in information exchange between human and computer. Interacting with keyboard-mouse-based computers, however, can be a cumbersome experience because it requires the user to adapt to the computer by learning how to use the keyboard and mouse. In our daily life, we employ vision, hearing and touch as natural ways of interaction to communicate with one another. The computer could understand the visual and audio information from the human, then it would be able to communicate with humans in natural ways. As a result, rather than requiring the human to adapt to the computer, the computer can adapt to the human intelligently as if it were a human by understanding the human, such as what the mood of the human is, where the human is looking, what the human is doing, and how the human performs certain tasks. Therefore, by equipping the computer with the ability to see and sense the human, it will make the interaction between human and computer easier, more efficient, more intuitive, and more flexible. D. Sidibe. etc [1] proposed a simple and efficient eye detection method for face detection tasks in color images. The algorithm first detects face regions in the image using a skin color model in the normalized RGB color space. Then, eye candidates are extracted within these face regions. S. Asteriadis .etc [2] present a new method for eyes localization on a face, based only on geometrical information. A face detector is applied first to detect the bounding box of the face, and the edge map is extracted. A vector is assigned to every pixel, pointing to the closest edge pixel. Length and slope information for these vectors is consequently used to detect and localize the eyes. Zhiwei Zhu [3] Robust real-time eye detection and tracking under variable lighting conditions and various face orientations. Most eye trackers based on active IR illumination require distinctive bright pupil effect to work well. However, due to a variety of factors such as eye closure, eye occlusion, and external illumination interference, pupils are not bright enough for these methods to work well. Tanmay Rajpathak . etc [4] Eye

Detection Using Morphological and Color Image Processing Eye detection is required in many applications like eye-gaze tracking, iris detection, video conferencing, auto-stereoscopic displays, face detection and face recognition. This paper proposes a novel technique for eye detection using color and morphological image processing. It is observed that eye regions in an image are characterized by low illumination, high density edges and high contrast as compared to other parts of the face. Zhaojie [5] presents an approach for eye state recognition and closed-eye photo correction. For eye state recognition, AdaBoosted cascade open-eye detectors of different scales are trained. For closed-eye photo correction, a PCA generative model of concatenated corresponding closed-eye and open-eye texture patterns is built, and given a closed-eye texture pattern, an algorithm is proposed to recover its corresponding open-eye one for closed-eye replacement. M. Hassaballah. Etc [6] presents An Automatic Eye Detection Method for Gray Intensity Facial Images Eyes are the most salient and stable features in the human face, and hence automatic extraction or detection of eyes is often considered as the most important step in many applications, such as face identification and recognition. Kun Peng.etc [7] presents a robust eye detection algorithm for gray intensity images. The idea of our method is to combine the respective advantages of two existing techniques, feature based method and template based method. mehmet turkan,etc[[8] presents human eye localization using edge projections.In images and video is presented for faces with frontal pose and upright orientation. a given face region is filtered by a high-pass filter of a wavelet transform. alberto de santis .etc [9] robust real time eye tracking for computer interface for disabled people gaze is a natural input for a human computer interface (HCI) for disabled people, who have of course an acute need for a communication system. Hong LIU. etc [10]presents an automatic and real time method for detecting eye states is proposed. The method is based on the fact that the regions of iris and white regions of an eyeball can be detected when it is open.

The reminder of this paper is organized as follows: Section 2 describes the proposed algorithm. Section 3 describes face detection algorithm. Proposed system for eye detection and localization is presented in section 4. Experimental results are shown in section 5. Conclusion form the last section.

2.   PROPOSED METHOD

Block diagram of proposed system as shown in Figure 1. System imports the video data and converts it into frames which are still images. The face is detected and extracted from this image using colour space method . Since the system is based on the eye blink rate we further extract the region of importance which is the eye region in our case. According to the normal position of the eye it is reasonable to assume that it would lie between the upper 1/6th and 2/5th part of the face .The eye region image is then separated into left and right images. Eye state detected based on skin colours of eye and iris.

3.   FACE DETECTION

There are different techniques for face detection, but we can divide all of them into two major categories: face features and face colors. For face features we used distance of two eyes, distance eyes and mouth, distance eyebrow and eye and some other features that are fixed in the face. For second method we have some color space like HSI space, YCbCr space, CMYK and YIQ space. We test HIS color space and YCbCr color space .We used a CCD camera for capture images, our images are in the RGB color space, so at first we should change it to YCbCr color space given by equation 1.

$$\begin{bmatrix} Y \\ Cb \\ Cr \end{bmatrix} = \begin{bmatrix} 16 \\ 128 \\ 128 \end{bmatrix} + \begin{bmatrix} 65.481 128.553 24.996 \\ -37.797 - 74.203 24.966 \\ 112 - 93.786 - 18.214 \end{bmatrix} \begin{bmatrix} R \\ G \\ B \end{bmatrix} \tag{1}$$

In this space Y didn't change between various skin color. A skin color map is derived and used on the Chrominance components of the input image to detect Pixels that appear to be skin. Working in this color Space we have found that the range of Cb and Cr most representatives for the skincolor reference map are

$80 \leq Cb \leq 120 and 133 \leq Cr \leq 173$

So, for each pixel we should check amount of Cb and Cr if it being in above limitation, amount of this change to 1 else change to 0.

4.   EYE AND EYE STATE DETECTION

After detecting the face the eye region can further be enhanced by removing unwanted facial features. The eye region is extracted from the face using the assumption that it lies between the upper 1/6th and 2/5th of the entire
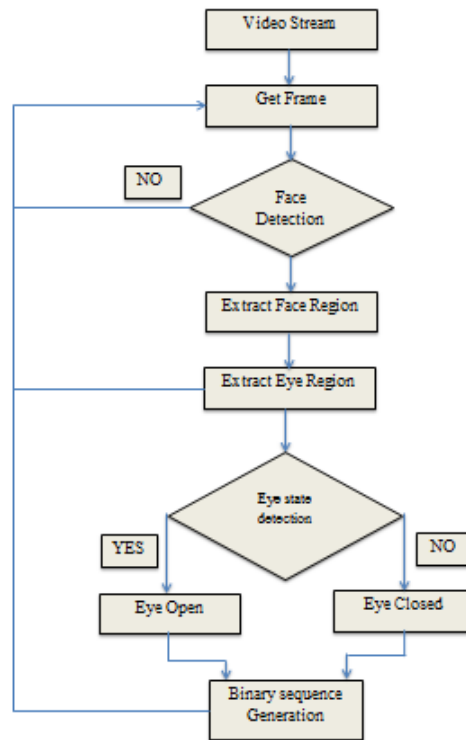
Figure 1: Block diagram of Proposed System

face region.

This eye region is further divided into individual eyes i.e. the left and the right eye. This is done by dividing the extracted eye region image vertically from the center. Eye state detected based on skin colours of eye and iris. Eye skin colour similar to face colour. When eye is opened skin color less because of presence of iris and sclera and also when eye is closed skin color is high. Based on this idea we can detect eye states. eye image and its binary form shown in figure 7.

After Eye state tracking, we distinguish between the open eye and the closed eye. If the eye opens and exceeds a fixed duration, then it represents a binary digit '1'. Similarly, the closed eye represents a '0'. So we can convert the sequence of eye winks to a sequence of '0's and '1's. The command interpreter validates the sequence of codes and issues the corresponding output command. Each command is represented by the corresponding sequence of codes.

5.   EXPERIMENTAL RESULTS

The proposed HCI system, depicted in Figure 1, is implemented on a laptop with intel i3 processor and 3 Ghz CPU running Microsoft Windows 7. The video frame rate of the image acquisition equipment is 30 Hz. Figure 2 shows input video frames , face detection and eye detection results shown in figure 3 and figure 5. respectively. Detection of opening and closing states of eye is represented by symbol + (purple colour) and white colour for different frames of input video is shown in figure 5 and figure 6. From the figure 7 conclude that when eye is open number of white pixels more and when eye is closed number of white pixels less, based on this condition eye state detection can be achieved.
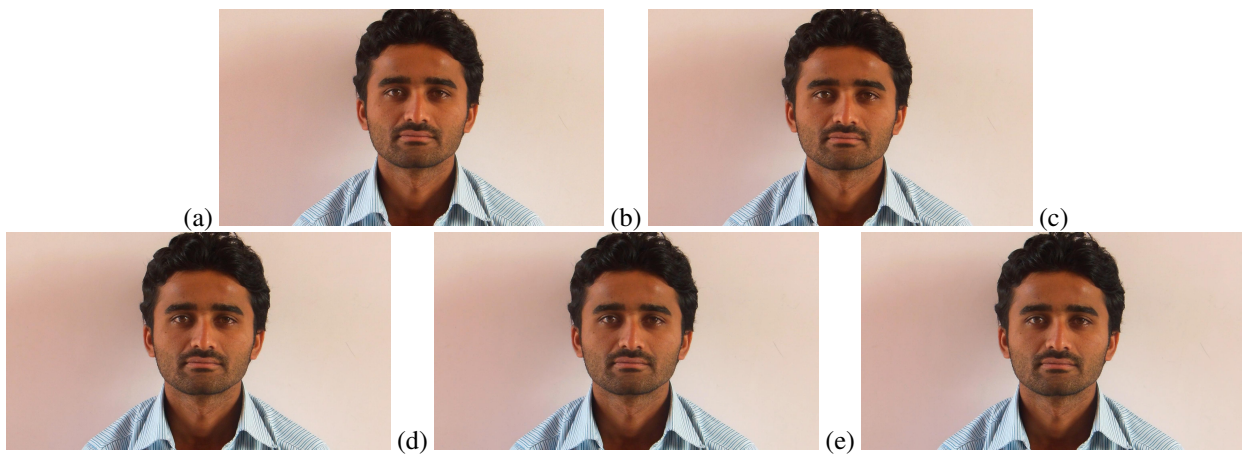
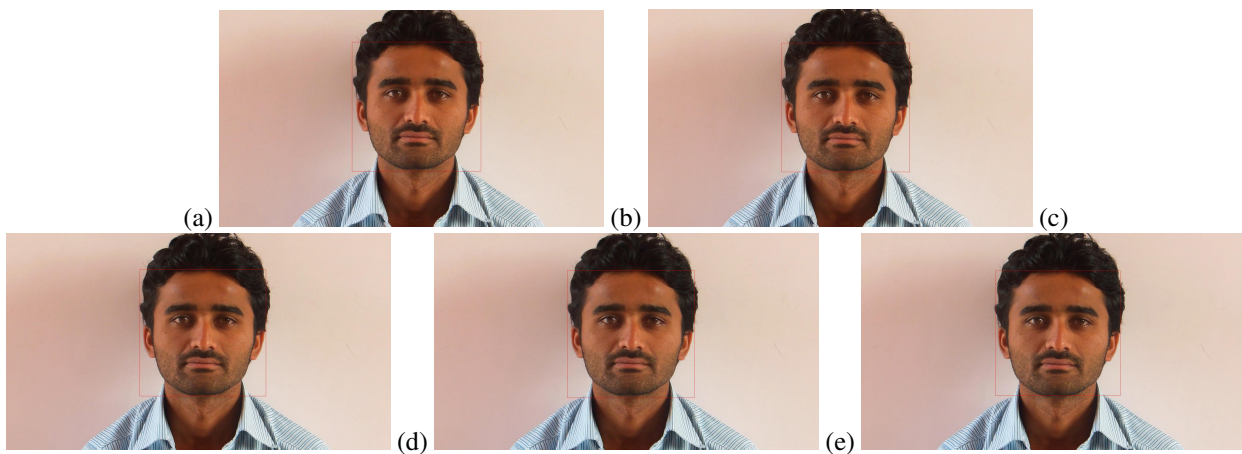Figure 2: (a) Frame 1 (b) Frame 6 (c) Frame 11 (d) Frame 16 (e) Frame 21

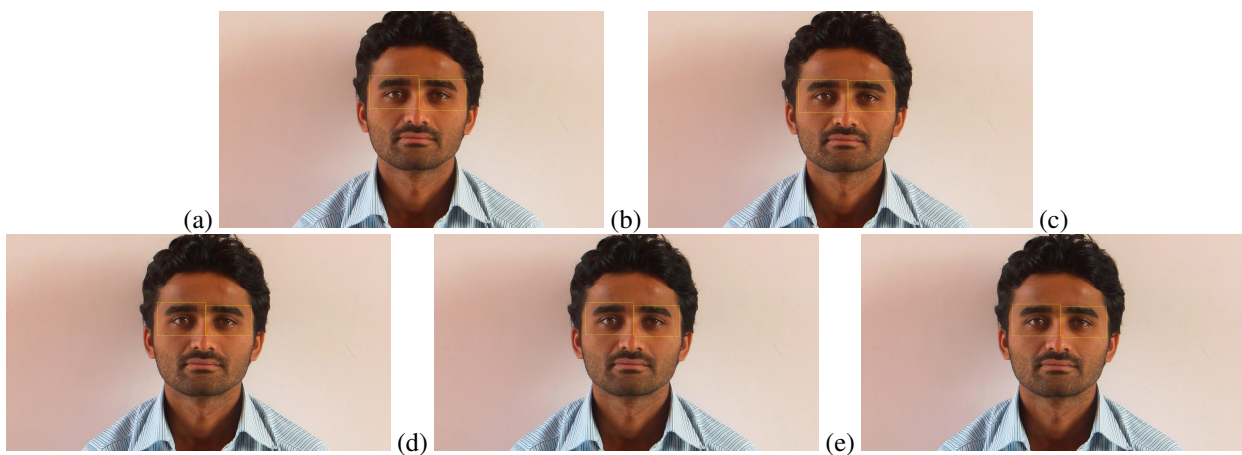Figure 3: (a) Frame 1 (b) Frame 6 (c) Frame 11 (d) Frame 16 (e) Frame 21

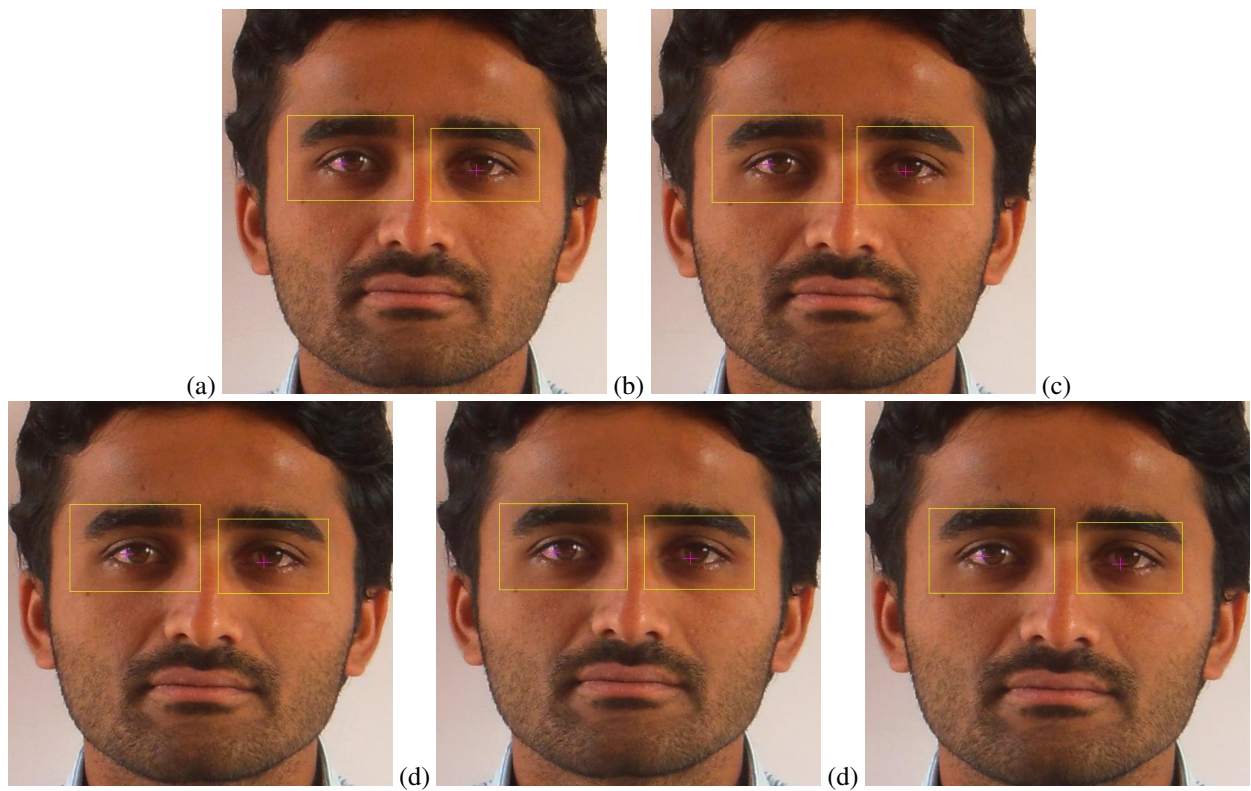Figure 4: (a) Frame 1 (b) Frame 6 (c) Frame 11 (d) Frame 16 (e) Frame 21

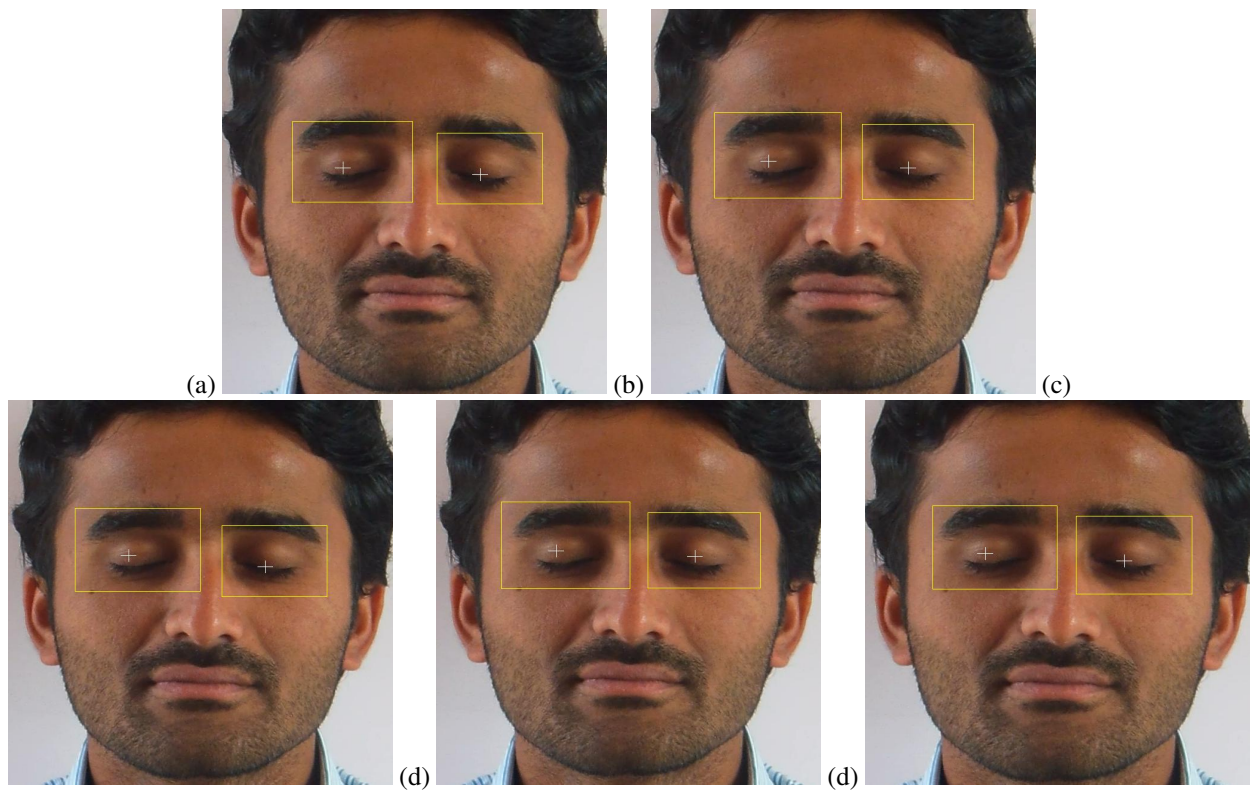Figure 5: (a) Frame 1 (b) Frame 6 (c) Frame 11 (d) Frame 16 (e) Frame 21

Figure 6: (a) Frame 320 (b) Frame 326 (c) Frame 331 (d) Frame 336 (e) Frame 341
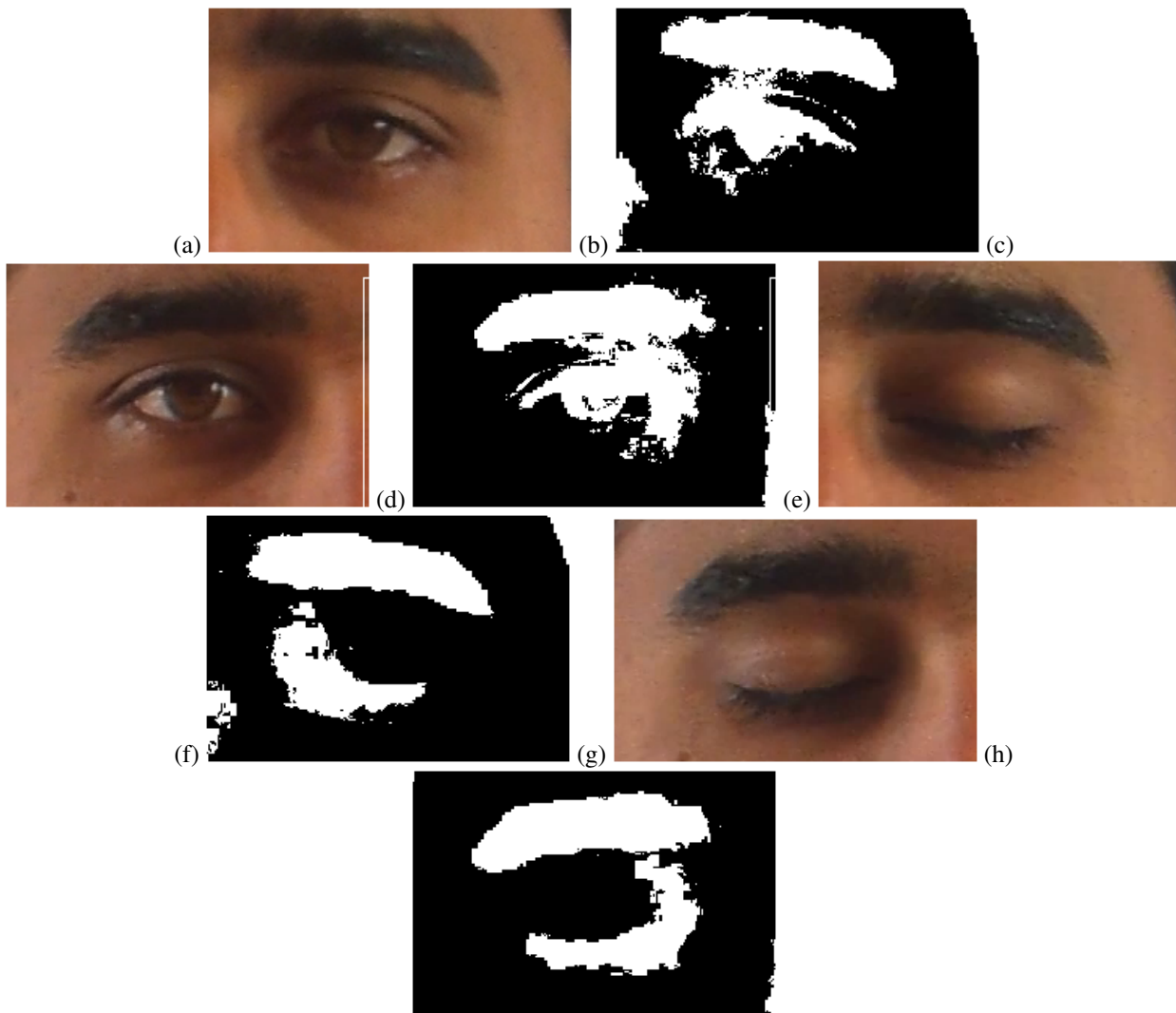
Figure 7: (a) Left eye open(b) binary image of Left eye open (c) Right eye open (d)binary image of Right eye open (e) Left eye closed (f) binary image of Left eye closed (g)Right eye closed (h) binary image of Right eye closed

Total frames indicates the total number of frames in each video. Tracking failure frame is the number of frames in which the eye tracking fails. The eye tracking fails when the system cannot locate the eye accurately, and then it may miss-identify the open eye as a closed eye or vice versa. The correct rate of eye tracking is defined as

$$correct\,rate = \frac{Total\,frame - Tracking\,failure\,frame}{Total\,frame} \qquad (2)$$

Table 1 shows the results of eye-winks based human computer interface system operating on the test video sequences of four different users.

Table 1: Result of tracking

	video 1	video 2	video 3
Total frames	1341	1231	1321
Face tracking failure frames	12	8	21
Eye tracking failure frames	12	8	21
Eye state tracking failure frames	15	12	8
Correct rate			
Face	99.11	99.35	98.41
Eye	99.11	99.35	98.41
Eye-state	98.88	99.03	99.39

6. CONCLUSION

In the present research is proposed and implement a new method for eye detection and localization , which leads to new method for human machine interaction. At first Input image/frame is captured from camera and face is extracted from input image using colour space method and after face is extracted ,eye region is extracted from the face using the assumption that it lies between the upper 1/6th and 2/5th of the entire face region. Based on skin colours of eye, eye state detected. Binary values 1 and 0 is assigned based on the opening and closing of eye. Finally applying the dynamic programming to translate the code sequences to a certain valid command.

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Dr. Mohana H S Obtained his B.E Degree in Electrical and Electronics Engineering from University of Mysore, during 1986. Since then, serving technical education field in various capacities. Obtained M.E from University of Roorkee, presently IIT ROORKEE with the specialization in Measurement and Instrumentation. Worked as chairmen and Member of Board of Examiner and Board of Studies with several universities. Presented research findings in 10 International Journals, 12 National Conferences and in 4 International conferences held across the world. Honored as session Chair in IEEE International conferences held at Singapore and India. Recognized as AICTE expert committee member in the inspection and reporting continuation of affiliation and Increase in intake of the Engineering Colleges. Completed, one AICTE/MHRD-TAPTECH project, and one AICTE/MHRD- Research project successfully. Coordinated TWO ISTE Sponsored STTP for the technical college teachers. Presently, working as Professor of Instrumentation Technology at Malnad College of Engineering, HASSAN.

Dr. Vijaya P A obtained her B.E. from MCE, Hassan in 1985, M.E. from IISc, Bangalore in 1991 and Ph.D. from IISc, Bangalore in 2005. She is currently serving as Professor in E&C Department, BNMIT, Banglore, Karnataka, India. Her areas of interest are Pattern Recognition, Data Mining, Image processing, Operating Systems, Computer Architecture, Microprocessors, Embedded Systems and Real time systems. She has 25 national/international publications to her credit.

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