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A System Automation using Human Eye Motion Based on Active Appearance Model(AAM)

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Abstract— Eye detection and tracking has been an active area in the field of research in last few years, since it provide convenience in usage of various applications. One of the applications is where handicapped people with several disabilities cannot take advantage of usage of computer. Hence to facilitate those people, controlling technique is required that can control the system through eye movement. This paper presents a vision-based human-computer interface system which detects deliberate eye blinks and elucidates them as control commands. The active appearance model (AAM) is used for eye motion detection and template matching. The test results indicated that the interface is useful in offering an alternative means of communication with computers to disabled people. The interface is based on a desktop equipped with a PS-3 camera and requires no extra light sources.

Keywords— Active Appearance Model, Eye Detection, Human Computer Interface, Eye Blink detection

I. INTRODUCTION

Recently there has been a growing interest in developing the system that provides natural interaction between human and computer. For that Purpose, several studies for human-computer interaction in ubiquitous computing are introduced. The vision-based human-computer interface uses technique that extracts information about eye motion without any high cost equipment from an input video image. For vision-based human computer interaction, eye tracking and movement is a major issue. Eye tracking research is distinguished by the emergency of interactive applications. However, to develop a vision-based multimodal human computer interface system, an eye tracking and their recognition is done. Real-time eye input has been used most frequently for disabled users, who can use only their eyes for input.

In this paper, a vision-based system for detection of voluntary eye-blinks is presented, together with its implementation as a Human–Computer Interface for people with disabilities. The proposed algorithm allows for eye-blink detection, estimation of the eye-blink duration and interpretation of a sequence of blinks in real time to control a non-intrusive human–computer interface. The detected eye-blinks are classified as short blinks (0.287 sec), click time (0.504 sec) or long blinks (1.51 sec). Separate short eye-blinks are assumed to be impulsive and are not included in the designed eye-blink code.

The active appearance model (AAM) is one of the most powerful appearance-based representation for images of definable objects. This model uses principal component analysis (PCA) based linear subspaces to model the two-dimensional (2-D) shapes and textures of the images of a certain object class. With the help of such representation, AAM is able to represent an image having small number of parameters.

The rest of this paper is organized as follows. In Section 2, we review the related works in human eye detection using AAM. In Section 3, the proposed algorithm for human eye motion detection is discussed. In Section 4, an implementation of the system is shown using some screenshots of interface developed. Finally conclusion and future scope is discussed in Section 5.

II. MOTIVATION

This section provides the brief description of various research papers studied for this study. The given below table 1 represents the summarization of various methods applied in computer vision area for eye detection.

TABLE 1: METHODS APPLIED IN COMPUTER VISION AREA FOR EYE DETECTION

Sr. No.	Title	Method	Description
1.	Fast and Accurate Algorithm for Eye Localization for Gaze Tracking in Low Resolution Images	New model based on boundary tracing and ellipse fitting	A.George et. al.[1] have proposed a new method for determining iris centre in low-resolution images in the visible spectrum. Firstly, iris centre(IC) locations are obtained using a fast convolution based approach and then refined by using boundary tracing and ellipse fitting. This proposed algorithm has been evaluated on public databases like BioID, Gi4E and is found to outperform the state of the art methods.
2.	Accurate eye center location through invariant iso-centric patterns	Isophate propery based localization algorithm	R. Valenti et al. proposed [10] an isophote property based iris centre localization algorithm. They have used the illumination invariance of isophote curves along with gradient voting for the accurate detection of iris centres.
3.	Eye movement analysis for depression detection	Active Appearance Model(AAM), Support Vector Machine(SVM)	S. Alghowinem et. al. [3] have used the AAM model to extract the eye movement features fron the face videos and used the hybrid SVM with Gaussian mixture model and statistical method to perform the classification task to identify the depressed and non depressed persons.
4.	Face Recognition Technique Based on Active Appearance Model and Support Vector Machine	AAM, SVM	H. T. Rashid [4] has used the AAM model for face feature extraction and SVM for classification. He used three datasets i.e. YALE, FERET and CASIA dataset. The experimental results showed that the proposed technique was efficient in accuracy performance .
5.	Eye tracking and head movement detection-A Sate of Art Survey	Comparison based study of various methods	A. A. Rahayeeh et. al. [5] have presented a state-of-art survey for eye tracking and head movement detection methods.
6.	Statistical model of appearance for eye tracking and eye blink detection and measurement	statistical active appearance model	I. Bacivarov et. al.[6] have developed a statistical active appearance model to track and detect eye blinking and is robust to variations of head pose or gaze
7.	Hands-free PC control‖ Controlling of mouse cursor using eye movements	SRR, SVM, and template matching	A. Gupta et. al. [7] have focused on the analysis of the development of hands-free PC control - Controlling mouse cursor movements using human eyes; based on novel template matching technique. For adaptive search window positioning and sizing SSR Filter integral image and SVM are used.
8.	Proposed - Simulation of mouse using human face(HCI)	AAM, SRR and SVM,	S. Dongre et. al. [8] have presented an eye motion based eye tracking system. They have used AAM, SRR and SVM for the above purpose of eye detection and eye motion tacking.
9.	Eye Typing using Markov and Active Appearance Models	Markov and AAM Model	D. W. Hansen et. al. [9] have proposed a non-intrusive eye tracking system intended for the use of everyday gaze typing using web camera. They have shown that by using the Active Appearance Model, it is possible to directly deduce information regarding eye corners and pupil position in an easy and intuitive manner.
10.	Passive Driver Gaze Tracking With Active Appearance Models	AAM	S. Baker et. al. [10] have described a monocular driver gaze tracking system which is using an Active Appearance Model to track the whole head. From the AAM, the eye corners, eye region, and head pose are robustly extracted and then used to estimate the gaze.
11.	Statistically Learned Deformable Eye Models	AAM, Constrained Local Model, Supervised Descent Method	J. A. Medina et. al. [11] have studied the feasibility of using standard deformable model fitting techniques to accurately track the deformation and motion of the human eye.
12.	A Review of Active Appearance Models	Active Appearance Model	X. Gao et. al. [10] et. al. have discussed the effectiveness and challenges of using AAM models in practical applications. This review paper has provided a very good insight of recent research on AAM model.

III. PROPOSED ALGORITHM

In this section a complete procedure is presented that moves the mouse from one place to another on desktop through user's eyes movement. Before the processing for the movement of mouse begins, detailed processing is presented below:

1.Camera receives the input from the eye.
2. After receiving these streaming videos from the cameras, it will break into frames.
3. After receiving frames, it will check for lighting conditions because cameras require sufficient lights from external sources otherwise error message will display on the screen.
4. The captured frames that are already in RGB mode are converted into Black 'n' White.
5. Images (frames) from the input source focusing the eye are analysed for Iris detection (centre of eye).
6. After this, a mid point is calculated by taking the mean of left and right eye centre point.
7. Finally the mouse will move from one position to another on the screen and user will perform clicking by blinking their eyes for 5 seconds.

IV. IMPLEMENTATION

The user has to sits in front of the screen of personal computer or laptop, a user has to wear specialized PS3 camera to observe user's eye movement. The computer continually analyzes the video image of the eye and determines where the user is looking on the screen. Nothing is attached to the user's head or body. To "select" any key, the user looks at the key for a specified period of time and to "press" any key, the user just blink the eye. In this system, calibration procedure is not required. For this system input is only eye. No external hardware is attached or required. The given below figure.1 shows the flow diagram of human computer interface system. The figure 2 shows the interface developed for the system and figure 3 shows the screenshot of the coding done for the implementation of the system.

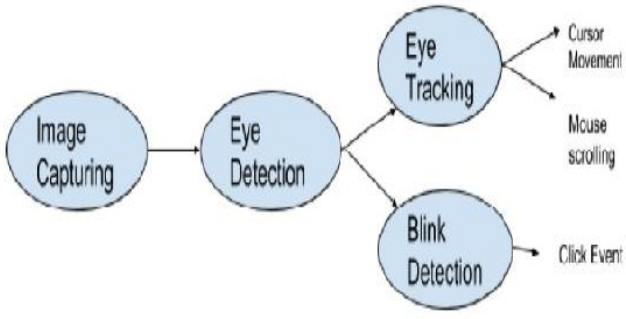

Fig.1. Flow Diagram of Human Computer Interface System

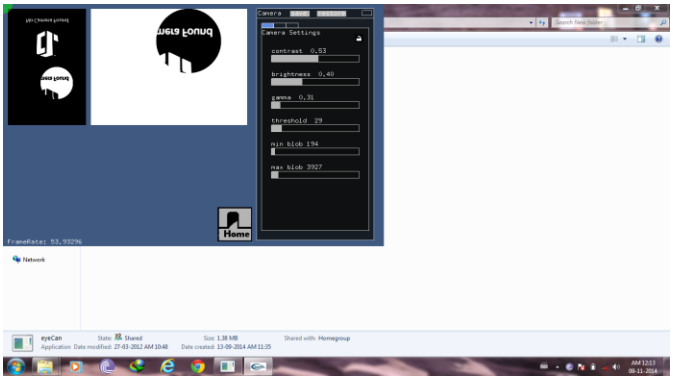

Fig.2. Interface developed for the system

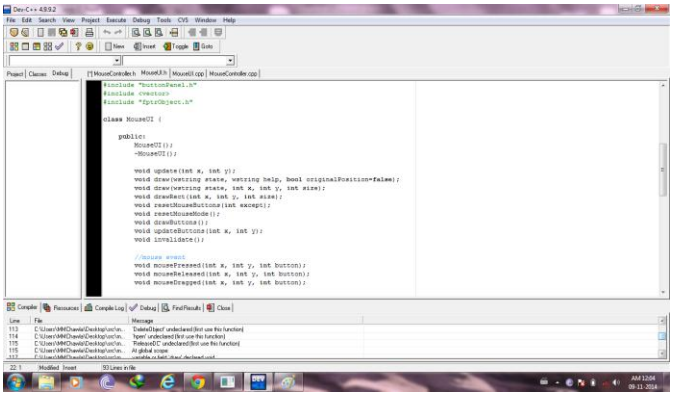

Fig.3. Screenshot of the coding done for the system

V. CONCLUSION & FUTURE SCOPE

In this paper, an eye motion based on low-cost eye tracking system is presented. The user with several disabilities can use this system for handling computer. A real time eye motion detection technique is presented here. The mouse pointer is operated using eye. A user interface is the system by which human interact with a computer. The user interface includes hardware and software components. The user with several disabilities can use this system for handling computer.

This technology can be further enhanced and can be used in various applications such as motion gamming through eyes by incorporating it with gesture recognition technology to provide an input to devices such as smart TV, high end gamming consoles and various other devices.

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