International Journal on Recent and Innovation Trends in Computing and Communication ISSN: 2321-8169
Volume: 3 Issue: 7 4849 - 4852

Virtual Keyboard Interaction Using Eye Gaze and Eye Blink

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Abstract— A Human-Computer Interaction (HCI) framework that is de-marked for people with serious inabilities to recreate control of a conventional machine mouse is presented. The cam based framework, screens a client's eyes and permits the client to simulate clicking the mouse utilizing deliberate blinks and winks. For clients who can control head developments and can wink with one eye while keeping their other eye obviously open, the framework permits complete utilization of a regular mouse, including moving the pointer, left and right clicking, two fold clicking, and click-and-dragging. For clients who can't wink yet can blink voluntarily the framework permits the client to perform left clicks, the most well-known and helpful mouse activity. The framework does not oblige any preparation information to recognize open eyes versus shut eyes. Eye classification is expert web amid ongoing co-operations. The framework effectively permits the clients to reproduce a tradition machine mouse. It allows users to open a document and perform typing of letters with the help of blinking of their eye. Along with framework allows users to open files and folders present on a desktop.

Keywords- *Human computer interface, eye image analysis, mouse replacement system, eye blink detection, eye blink detection*

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I. INTRODUCTION

Eye movement-based human computer interaction (HCI) has become a very significant area of research in computer science. HCI refers to different techniques and algorithmic processes of non physical contact with the computing devices. These techniques are used to design, evaluate and implement various interactive computing systems.

Lately, there has been a push to plan assistive innovation that furnishes people with extreme incapacities a device for correspondence and access to the machine. Such technology may expand conventional human-machine interfaces like the keyboard and mouse. These conventional human-machine interfaces request great manual dexterity and refined engine control, which may be missing or unpredictable for individuals with serious incapacities. The inspiration of our exploration is to give an option specialized apparatus to non-verbal people whose engine capacities are greatly restricted by conditions going from traumatic cerebrum wounds to degenerative infections, for example, various sclerosis (MS), bulky dystrophy (Md),or amyotrophic horizontal sclerosis (ALS). These people might just have the capacity to control their head and eyes. Our objective was to create a machine vision framework that replaces the customary machine mouse with a framework that can be totally controlled with the head and eyes.

We propose an algorithm that permits a client to connect with the machine by utilizing their eyes to recreate clicking a conventional mouse. The algorithm has the capacity naturally place the client's eyes and take in the presence of the client's open and shut eyes. Online learning gives a level of robustness that permits the algorithm to work reliably for different people and has likewise demonstrated accomplishment for people wearing glasses. Work on camera-based blink detection has focused on specific tasks such as human-computer interaction[8, 9] or fatigue detection[10]. Blink detection modules have been part of more general systems on eye motion analysis and. Some research efforts in camera-based blink detection use infrared lighting. The advantage of an infrared framework is that the understudies of the client are highlighted when ex-postured to infrared lighting. While infrared frameworks make the issue of discovering the eyes simpler, the commonplace client does not have admittance to infrared lighting and there are security worries about long haul introduction to infrared lighting.

Our framework utilizes standard lighting with a common USB cam that is effectively accessible to clients. our framework permits cooperation with a machine on a level that is closer to utilizing a conventional mouse. Our framework empowers clients to move the mouse pointer on the screen and issue mouse-clicking summons without hands. For people who are not ready to control the muscles around their eyes to a degree that they can wink, the framework still empowers them to reproduce the left-click summon of a customary mouse. This is a change over present assistive mouse-substitution frameworks, for example, Camera Mouse[11], which restricts the client to left-click summons by drifting over a certain area for a foreordained measure of time. This is illogical as the absence of activity from the client causes a click to happen. It can lead the framework to issue a click charge that was not proposed by the client if the client is not moving the mouse inside the limit of drifting time. Our framework gives a more intuitive system to controlling the mouse, as it obliges a particular activity by the client to simulate a mouse click.

The eye detection is widely used in face detection and different areas like artificial intelligence (AI), virtual reality (VR), ubiquitous computing (UC), augmented reality (AR), artificial neural network (ANN) etc. Eye gaze is another method of HCI. In such techniques real time data is gathered for tracking and estimation of eye gaze.

II. RELATED WORK

The author P. Corcoron et al.[1] focused on the point that real time face detection combined with eye gaze tracking can provide a better means of user input into a gaming environment. This proposed idea can be used in various ways to enhance the user interface design and models that are sensitive to a user"s behaviors and mood. In their further study they stated that eye-gaze can be used as a means of direct user input for improving the accuracy of eye estimation. although the various table text styles are provided. The formatter will need to create these components, incorporating the applicable criteria that follow.

The author K. Kinoshita et al.[2] developed a fast and robust head pose and gaze estimation system which can detect facial points and estimate 3D pose angles and gaze direction under various conditions. Only one face image is used as input without any special devices such as blinking LEDs or stereo cameras. Without calibration the system shows a 95% head pose estimation accuracy and 81% gaze estimation accuracy.

The author B. Noris et al[3] presented A head-mounted gaze tracking system for adults, animals and infants of one year of age for the study of visual behavior with two CCD cameras that allows studying both the central and peripheral vision with offline calibration.

The author I. F. Ince et al[4], proposed method using low cost webcam with no ANN. No calibration is being discussed in the next review. Two shape and intensity-based deformable eye pupil-center detection and movement decision algorithms are introduced

The author Amir et al[5], presents a hardware-based embedded system for eye detection, simple logic gates, with no CPU and no addressable frame buffers. For exploiting the hardware implementations the paper presents a prototype of a system which uses a CMOS digital imaging sensor and an FPGA for the image processing.

The author T. Yagi[6], used another method of eye gaze technique, the electro-oculography (EOG) and developed two types of eye-gaze interfaces namely EOG Pointer and EOG Switch. EOG pointer enables a user to move a computer cursor or to control a machine using only eye-gaze while an EOG switch output an ON/OFF signal only. Various recording eye gaze interfaces have been developed by the researchers since 1980.

The author Orman, Z.[7], Certain methods also use template matching, eigenspace, and integral projection. In template matching face recognition is parameterized by using a function for a standard frontal face pattern. The existence of face is determined with the help of sub templates and the correlation values. These values are computed for the face contour, eyes, nose and mouth independently

III. PROPOSED FRAMEWORK

Fig. 1 represent framework for proposed system. It consists of SIX phases. Input face capture, captures frame using webcam. Face detection phase, detects face in a frame captured by camera. Next is to extract Eyes and Nose from the face detected. Once eye and nose region detected from face, then part comes for Eye blink detection and Identification followed with eye blink classification. Finally Interaction with Computer.

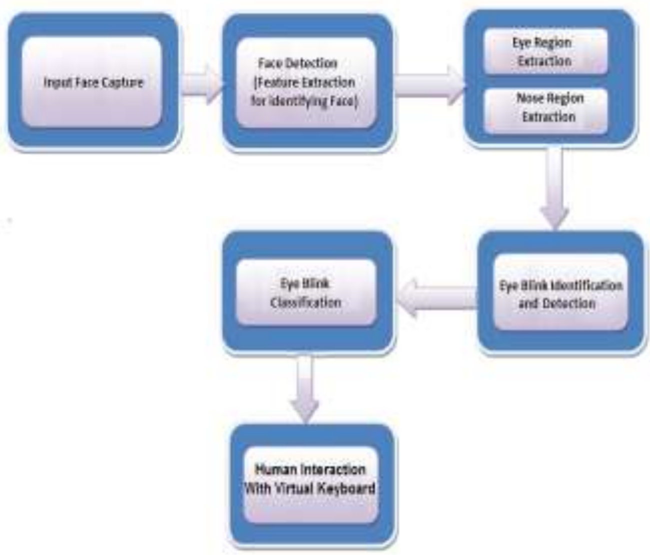

Figure 1. Proposed Framework

A. Video frame recording

This methodology starts with, starting webcam with OpenCV java framework and then read new frame from webcam. Once frame is read, display it on frame output and convert into MAT(opencv) format.

B. Frame processing

This requires loading HAAR classifiers(.xml) files that contains trained dataset. Once haar classifiers loaded, process frame to extract face, this process is followed with cropping frame to get exact face and finally process face to get exact eye.

C. Location tracking and Operations.

In this method, we are tracking face in a captured frame, once face is captured we are locating eyes in face. Once eye are located, send these locations to algorithm to compute new pointer position. Once pointer location is computed, send this to Robot to perform operation.

Eye Location Tracing
input: frm: current video frame
output: eyeXY: location of eye w.r.t frame
1: set mat_frm = convert frm to OpenCV mat format
2: Load HaarCascade_FrontalFace trained dataset to classifier
3: Load HaarCascade_Eye trained dataset to classifier
4: initialize Classifier with trained dataset
5: set rectF = classifier.detectFace(mat_frm)
6: set face = crop(mat_frm,rectF)
7: set rectE = classifier.detectEye(face)
8: set eyeFrm = crop(face,rectE);
9: set eyeXY = (|) //phi symbol i.e. null
10: set x = frm.x+face.x+eyeFrm.x;
11: set y = frm.y+face.y+eyeFrm.y;
12 : return eyeXY = {x,y};

Controlling
input: eyeXY: location of eye w.r.t frame
frmW : width of frame
frmH : height of frame
output: mouseXY
1: load display_info
2: set sW = display_info.width
3: set sH = display_info.height
4:load pointer_info
5: set pointerX = sW*(eyeXY.x/frmW)
6: set pointerY = sH*(eyeXY.h/frmH)
7: return mouseXY = {pointer,pointerY}

IV. EXPERIMENTAL SETUP

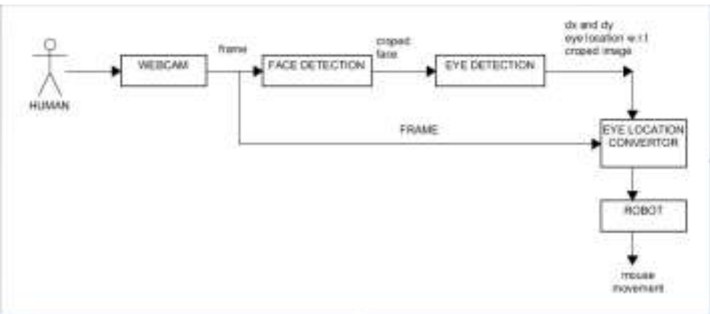

Fig. 2 Experimental Setup

Figure 2 shows experimental setup of system. In above figure, webcam main-frame is provided as input to face detection module, which will crops main-frame. Once main-frame is cropped to frame, cropped frame is provided as input to eye detection module, which further crops eye regions only. Which gives dx,dy location w.r.t eye region only. Eye location converter converts it to actual x,y location w.r.t original frame. Robot converts it to actual eye location.

V. EXPERIMENTAL RESULT

Figure 3, shows output of initial phases of proposed system. This consists of capturing frame using webcam, then detecting face from a frame and then extracting eye and nose region.

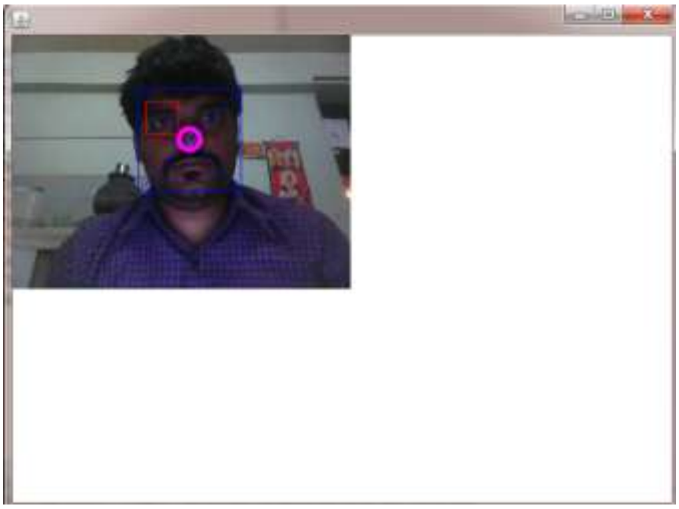

Fig. 3 Output of initial phases of framework.

We have highlighted different regions with the help of color coding. Face from frame is represented by Blue rectangle. Extracted eye region is represented as small red square and nose region is represented with ellipse.

Fig 4 . Keyboard interface

ISSN: 2321-8169
4849 - 4852

Figure 4, shows the Keyboard interface for our framework. With the help of eye blink, user can perform intended functions.

User can type keys provided on virtual keyboard using eye blink. Also he can perform shutdown, restart operations of computer. What user has to do, he/she has to move mouse pointer to specified button and perform blink operation. So it involve mouse pointer movement to specified location with the help of head movement and then perform blink.

A. Factors affecting performance of system

Table I. Computation time and Accuracy

Frame size	*Computation time*	*Accuracy*
160 * 120	70	48%
320 * 240	160	81%
640 * 480	890	91%
1280 * 960	1253	98%

As given in table above, we have tested performance of system by providing inputs of different frame size. We analyzed for small frame size, it requires less computation time but accuracy is low and vice versa.

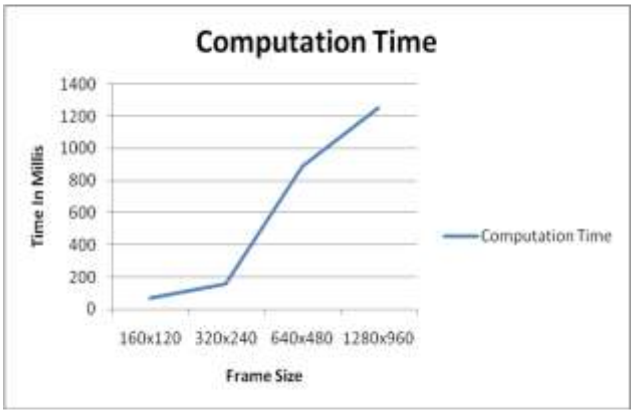

Fig. 5 Frame size Vs Computation time

.Acknowledgment

I wish to thank all the people who have directly or indirectly helped me in completing Paper work successfully. I express my gratitude towards my project guide Prof. P. D. Lambhate and also towards Head of Computer Engineering Department for their valuable suggestions and constant guideline during this paper work also acknowledge the research work done by all researchers in this field across the Internet for maintaining valuable document and resource on the Internet.

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