Head Tracking Virtual Mouse System based on Ad boost Face Detection Algorithm

Meghna S. Mahajan ,AshleshaTambat , Kachan K. Lakade , AmolBaviskar
Department of Information Technology, Vishwatmak Om Gurudev College of Engineering, Mohili-Aghai, Maharashtra
meghnamahajan1993@gmail.com, ashli2427@gmail.com, kachanlakade95@gmail.com, amolbaviskar222@gmail.com

***Abstract*—**The paper is based on Head Tracking Virtual Mouse which uses the feature classification method to detect. Eyes opening and closing actions that are mapped to a mouse pointer on the screen. This system can be used for the upper limb disabled who failed to use the traditional mouse and keyboard. It is based on Adaboost face detection algorithm, which is a position-based head motion detection algorithm that does not depend on the specific biometric identification and tracking. It is designed to operate the computer by image detection of head and eyes movements. The combinations of head and eyes movements are mapped to various mouse events, including move, click and drag, and so on. We define five motions as the basis of head movements namely standard head, left head, right head, head up, and head down includes five sub-graph. There are two rectangles in each sub-graph. The outer rectangular frames the face which represents detected the head and the inner one frames the eye which represent the detected eye open area. Furthermore, it can also be used for general computer users to do neck rehabilitation training, computer somatic games, etc.

Keywords - *Head Tracking Virtual Mouse, Adaboost, biometric identification.*

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I. INTRODUCTION

Head Tracking Virtual Mouse is an application that uses the feature classification method to map the mouse pointer on the screen to the movements of head and eye in frames through a camera. The system analyzes the relationship between different combinations of the detected head and eye open and closing action, and then maps them to mouse events on the Computer System. Our aim is to use this application mainly for the upper limb disabled who are unable to use the traditional mouse. The previous proposed systems used complex algorithms. They were based on the biometric identification techniques. Some needed to mount devices on the user like Lasers which was not feasible. Hence, our aim is to devise an application that will be cost effective and not be dependent on the biometrics but on the feature classifications of the user. It should use less hardware and simpler algorithms. The objective is to use such a system that will help the upper limb disabled who cannot use the traditional mouse or keyboard.

The advantages of the concept are listed below:

- Quick response time
- Customized processing
- Small memory factor
- Highly secure
- Really helpful for disabled people

II. LITERATURE SURVEY

Chen etal developed a system that contains an infrared transmitter mounted onto the users eye glasses, a set of infrared receiving modules that substitute the keys of a keyboard, and a tongue-touch panel to activate the infrared beam. Hutchinson et al studied the eye gaze direction to operate the computer by measuring the corneal reflection. These methods presented above are contact, which mostly use contact sensors to measure human reflections or activities. The contact methods can accurately detect features, but they commonly require expensive auxiliary equipment. Therefore, it is difficult to be applied widely. Recently, along with the development of image processing technology and the improvement of computer performance, it has been a hot research area of using the non-contact and image processing methods to study human interactions. Betkeetal. proposed a system that tracks the biometric features and then translates them into the movements of the mouse pointer on the screen. Nabati and Behrad presented a novel approach to estimate the 3D head pose from a monocular camera images using various algorithms for the control of mouse pointer movements on the screen and clicking events. These non-contact methods are more comfortable and convenient for the users and involve less expensive communication devices. However, these methods have high requirements for the camera, as well as high performance of computer image processing and computing. Currently, no contact technology is mainly used in some special application systems. A specialized software or system to control computer through this technology is still not common. We study the algorithms of detecting head movement and eye status. Based on these algorithms, we design a Head-Trace Mouse to operate computer by detecting the movements of head and eye.

III. SYSTEM IMPLEMENTATION AND HARDWARE REQUIREMENT

The block diagram of the proposed system is delineated below in Fig. 1.

A. System Requirements

To be used efficiently, all computer software needs certain hardware components or other software resources to be present on a computer. These pre-requisites are known as system requirements and are often used as a guideline as opposed to an absolute rule.

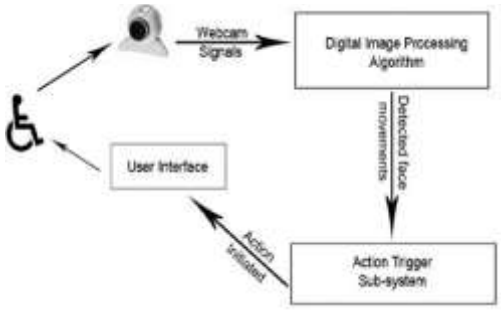

Fig. 1. Proposed System

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Supported Operating Systems:
• Windows XP/Vista/7
• Supports both 32 bit as well as 64 bit OS.
The software requires following applications installed on the server machine:
• JDK1.6 or above
• NetBeans IDE 7.0 or above.
• OpenCV Hardware Requirements:
• Web camera
• Laptop or a Computer

B. Description of overall System Architecture

A system architecture or systems architecture is the conceptual model that defines structure, behavior and more views of a system. An architecture description is a formal description and representation of a system, organized in a way that supports reasoning about the structure of the system which comprises system components, the externally visible properties of those components and provides a plan from which products can be procured and systems developed, that will work together to implement the overall system.

The system architecture is shown in Fig. 2.

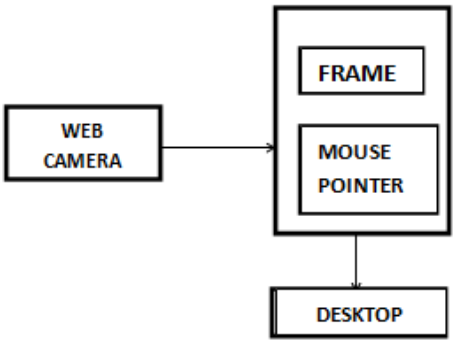


Fig. 2. System Architecture

1. WEB CAMERA

A webcam is a camcorder that nourishes its picture progressively to a PC or PC system. It is an equipment gadget that inputs pictures of the User and supplies it to the edge grabber. Much the same as an advanced camera, it catches light through a little lens at the front utilizing a minor lattice of light-finders that changes over the photo before the camera into computerized position. Not at all like a computerized camera, a webcam has no inherent memory chip. Henceforth, it transmits them instantly to a PC.

2. DESKTOP

The vast majority of the preparing happens on the desktop. It just needs to show the picture got from the web camera and give presentation to the client.

3. FRAME GRABBER

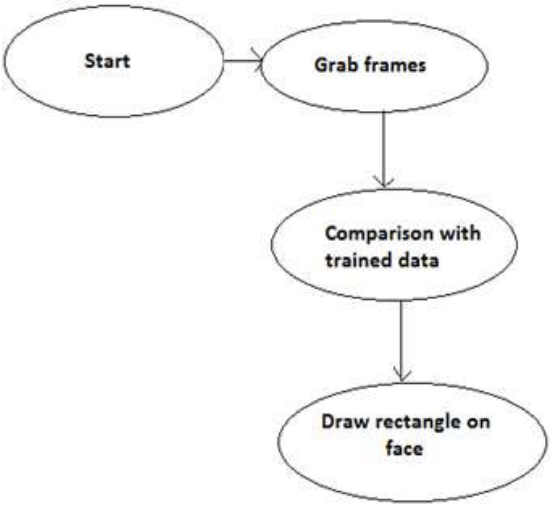
Outline grabber is an electronic gadget that catches individual, computerized still edges from a simple video signal or an advanced video stream. It is normally utilized as a segment of a PC vision framework, in which video edges are caught in computerized structure and afterward shown, put away or transmitted in crude or compacted advanced structure.

4. MOUSE POINTER

The mouse cursor, or mouse bolt, or mouse pointer is frequently formed like a bolt or a little hand with the forefinger directing towards the highest point of the presentation gadget. The mouse pointer moves as the client moves his or her head and squinting of eyes triggers clicking occasions.

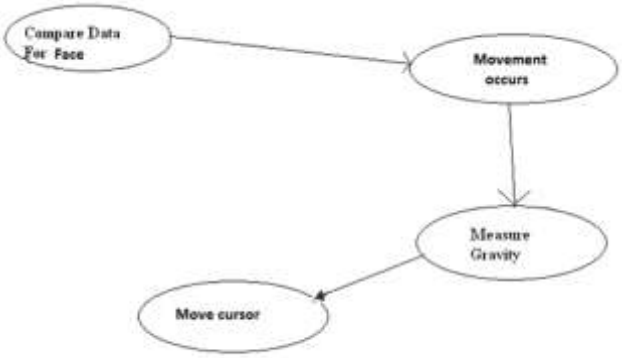
Information Flow Diagram

An information stream chart (DFD) is a graphical representation of the stream of information through a data framework, displaying its procedure viewpoints. Frequently they are a preparatory stride used to make an outline of the framework which can later be explained. DFDs can likewise be utilized for the perception of information preparing. The camera gets client photographs at the rate of 30 casings for every second and contrasts it and the as of now bolstered in and prepared information to plot the rectangle on the face appeared.



DFD Level 0

After detecting the face, as movement occurs, the pointer on the screen moves accordingly by measuring gravity to the mapped movements of the mouse.



DFD Level 1

For eye detection, the same procedure is carried out and a rectangle is drawn for detection. Now, by using algorithms of haar classification, the needed action of the mouse pointer is mapped with face movements and blinking of eyes.

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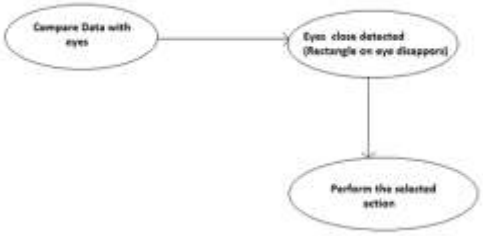


DFD Level 2

IV. RESULT ANALYSIS

First the system captures images by camera then detects the head area in the images. Let the origin coordinates (0, 0) be at the top left corner in the Figure. And the horizontal and vertical coordinate are noted x and y respectively, shown as an example in Fig. 6.1(a).

The coordinate values are calculated in pixels. The rectangle which frames the face is the detected head area. We calculate the geometric center of the rectangle, and name it as head central coordinates, i.e. (Sx, Sy) in Fig. 6.1(b).

Then we can analyze the specific head movement by time series relationship of the central coordinates. The algorithm HEADMOVE for detection of head movements is described as below.

• Initialization: User sits up in front of the computer. Let the Head-Trace Mouse run.

If the head is detected, the head signals in the first 3 seconds are initialized by statistical methods, and then the head central coordinates (Sx, Sy) of the standard head is calculated, as shown in Fig.6.1.

• Set threshold value: Determine the threshold value (Kx, Ky) based on experience.

• Judge the head movements: Analyze the images after initialization.

The head central coordinates of one image is noted as (Cx, Cy). We compare (Cx, Cy) with (Sx, Sy) to get the following conclusions:

a) If Cx - Sx>Kx, the judgment is that head moves left, abbreviated as left.
b) If Cx - Sx< - Kx, right.
c) If Cy - Sy< - Ky, up.
d) If Cy - Sy>Ky, down.
e) If | Cx - Sx | <Kx and | Cy - Sy | <Ky, standard head.

• Standard head relocation: If the standard head has been detected in several continuous images, the average value of these head central coordinates will be calculated as the new head central coordinates (Sx, Sy) of the standard head.

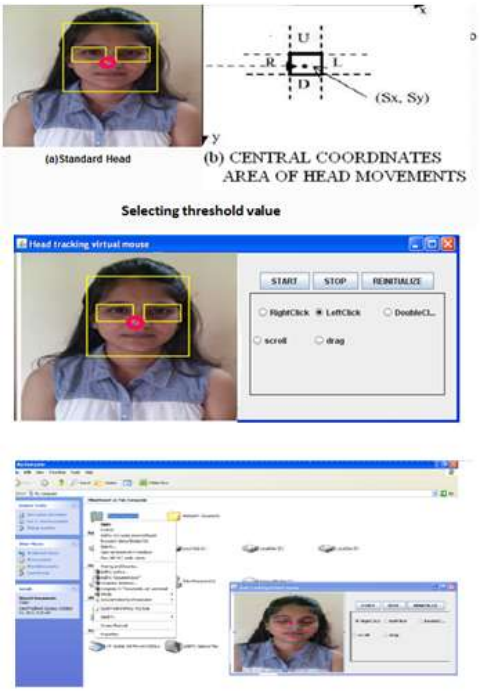
• Go back to step (2); Fig.6.1 shows a standard head image captured by camera, where the outer rectangular frames the detected standard head.

In Fig 6.1 the central point (Sx, Sy) in the rectangular with solid lines, is the central coordinates of the standard head. The solid lines frames rectangular shows the region of head motionless. In the course of system operation, if the head central coordinates are within this region, the head is declared as motionless. If not, an associated movement is ensured.

In Fig 6.1 the U, L, D, R parts are the head movement direction, meaning head move up, left, down, right, respectively, as noted in step (3) of HEADMOVE algorithm.

V. CONCLUSION

We have implemented a system to access the mouse pointer on the computer screen using only Head and Eye movements. With the use of a camera and Java technology, the system architecture is prepared. User is able to view head and eye movements captured through the camera which is displayed on the screen, accordingly the user can move the mouse pointer as needed and also perform various mouse actions. The proposed system is feature based thus allowing any user to use the system without prior registration. This system is especially useful for the upper limb disabled. Currently, we are extending our implementation to support keyboard press technology for the ease of the User to use the Keyboard hands free along with the already existing mouse movements provided by the system. This would then enable the User to access the computer owingto only facial features and movements without the use of traditional mouse and keyboard i.e Hands free system.



Results Showing Proposed System

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