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Research Article

Eye and Face-Controlled Mouse Based on Human-Computer Interaction

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Abstract
In the current digital era, prospects for computer improvements are constantly presented by developments in the applied sciences. Hands-free computer solutions are becoming more and more popular these days, especially for people who have quadriplegia. A Human-Computer Interaction (HCI) system that is especially helpful for amputees and other people who might have trouble utilising their hands is presented in this study. Eye motions including blinking, looking, and squinting are translated into comparable mouse cursor operations via the created system's eye-tracking interface, which works similarly to a computer mouse.The gadget under discussion makes use of a regular camera, and it requires Python (3.6), OpenCV, NumPy, and a number of other facial recognition-related apps. The HOG (Histogram of Orientated Gradients) technique may be used to recognise faces by combining the sliding window approach with a deep learning algorithm (CNN) or linear classifier. Because it doesn't require any extra gear or sensors, this system is completely hands-free.

Keywords: HCI, CNN, and OpenCV.

1. INTRODUCTION

These days, a lot of people use the computer mouse or their fingers to move the pointer around on screens. The mouse or finger movements are recognised by the system and matched to the

movement of the cursor. Individuals who have lost the of their arms, to as 'amees,' face challenges using standard mouse technology. Therefore, by tracking eye movements and determining the direction of the user's gaze, it's possible to translate these eye movements into cursor control, allowing the amputee to navigate the cursor freely. An 'eye-tracking mouse' would be incredibly beneficial for amputees. At present, eye-tracking technology is not widely accessible, as only a few companies have developed it for use. We aim to create a mouse that operates using eye tracking and facial features, providing most of the typical mouse functions so that users can control the cursor with their face. We will assess the user's 'gaze' direction and move the cursor accordingly, with clicking motions carried out when the left or right eye is closed.

2. METHODOLOGY

The process by which a theoretical concept becomes a functional tool is referred to as implementation. Currently, the burden of resilience and the influence on innovative strategies is shifting toward the consumer sector. If the implementation process is not well-organized and monitored, it can lead to confusion; therefore, it is crucial for the development of a new system that users believe the new system will function effectively. The act of utilizing the developed system is termed implementation, which encompasses all operations related to the new software. Once planning is finalized, the primary challenge for the organization is to ensure that the system's processes run smoothly. Requirements must be fulfilled before the implementation phase begins.

Code Design Code is a systematic representation of symbols used to define an attribute in a particular manner. It serves multiple purposes, including detailing the physical or functional characteristics of an object and providing operational instructions. Codes can also be linked to security and privacy. Coding has improved the performance and operational efficiency of machines. Code that is well-written is clear, extensible, succinct, scalable, even, portable, dependable, significant, and easy to use.

Effective code creation for preliminary problem evaluation takes a lot of time and work. This is scripting for an object-focused active server. Designed to make transactions easier, the source code explains how an object works and is linked to the pertinent details for every item utilised in the project. Within it, the project flow is also detailed. Strong internal comments and linguistic characteristics are incorporated into the source code by using standardised coding techniques.

Functionalities Used The implementation phase of a project is where theoretical concepts are realized. The user department now bears the main responsibility, experiencing the largest shifts and greatest impact on the current system. Insufficient planning and supervision of the implementation can lead to confusion and uncertainty. Implementation entails all necessary tasks to transition from the old system to the new one. An old human or automated system might be completely replaced by the new system, or it could greatly improve an existing system. Effective execution is essential for creating a framework that meets the organization's

needs. Even if the company does not improve with the correct implementation, it will prevent the consequences of a faulty installation.

During the implementation phase, various activities take place:

- Careful planning
- Examining the system and its limitations
- The creation of change management techniques
- Staff training throughout the changeover
- Evaluation of the change process

Initially, the timeline and process for implementation are established. Next, the program undergoes thorough scrutiny, and users are trained on the latest practices. The final installation of the application in its intended environment, user satisfaction, and system performance are all included in software deployment. In many organizations, individuals who do not directly engage with the software project are appointed. Those who are skeptical about whether the software will ease their work often exhibit initial doubts about the program. It is essential to ensure that these doubts do not escalate by confirming that:

- Active users understand how the system operates
- Users have confidence in the software
- Users receive appropriate guidance to comfortably navigate the application

3. Objective

I. Seeking to provide a substitute method for individuals with physical limitations or difficulties that impair their capacity to utilize a conventional mouse and keyboard efficiently.

II. Enhancing the overall user experience by enabling hands-free operation can be especially advantageous in scenarios where hands are busy or when interacting with touchscreens is not feasible.

III. To facilitate immediate interaction and feedback driven by facial expressions, enabling users to effortlessly browse, choose, and alter elements displayed on the screen.

IV. It enables individuals to operate a computer using their face or eyes, making it particularly useful scenarios where hands or fingers are busy or unavailable.

4. Analysing and modelling

The accompanying graphic shows our system's technological process.

- Our methodology for identifying camera frames is the gaze pointer; the camera is turned on, and then the camera frame data is recorded accordingly.
- To produce a crisper image, the acquired frames are subjected to histogram equalization, a procedure that standardizes the frame by modifying its hue, saturation, and contrast.
- Following this, the model identifies the face.
- The Hough circle, which shows the location of the eyeball and the eye's curvature, is identified by our model after features of the eyes are retrieved by image enhancement.

- Using real-time data, the trained model is then applied to identify the face to serve as a reference point and calculate the scaling factor for mouse actions.
- Once this phase is completed, we establish the screen coordinate values for the exact position of the mouse at that moment, as well as calculate resolutions of the screens.
- You may use the mouse to scroll by dragging your face in any of the following four directions: up, down, left, or right. Click actions require holding down the wink key for a certain aspect ratio and threshold value for a number of consecutive frames.

5. RESULTS & CONCLUSION

TEST CASE NO	INPUT	EXPECTED OUTPUT	ACTUAL OUTPUT	RESULT
1	Open mouth to activate mode	Scroll mode active	Scroll mode active	Pass
2	Wink left eye	Perform left click	Perform left click	Pass
3	Wink right eye	Perform right click	Perform right click	Pass
4	Move face to the right	Move cursor to right	Cursor moving to right	Pass
5	Move face to the left	Move cursor to left	Cursor moving to left	Pass
6	Move face up	Move cursor up	Move cursor up	Pass
7	Move face down	Move cursor down	Move cursor down	Pass
8	Open mouth to de-activate scroll mode	Scroll mode de-activated	Scroll mode de-activated	Pass

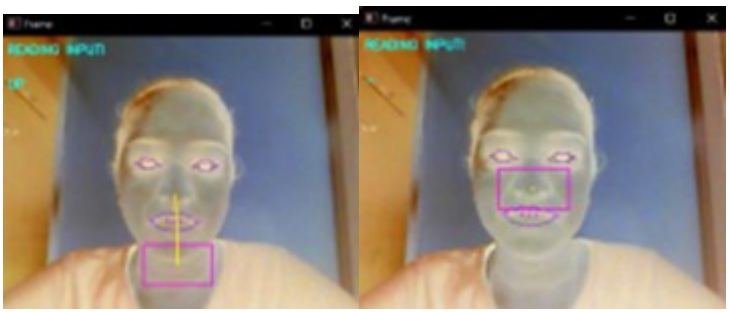

Fig a. Move the nose, Fig. b. open mouth to start reading input

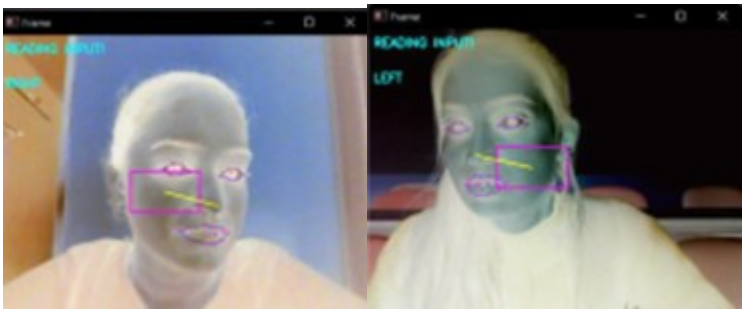

Fig c. blink right eye Fig d. blink left eye

6. CONCLUSION

An artificial intelligence-powered eye-controlled mouse for human-computer interaction has been developed successfully; it has been tested in a variety of scenarios and functions as intended. Thanks to this technology, people with impairments may use computers without a real mouse. They can click left and right, scroll up and down, and do other common mouse functions. Future advancements in this technology could greatly enhance capabilities, potentially allowing artificial intelligence to replace tangible devices.

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