CLICK – AI Virtual Mouse

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ABSTRACT – ***This research introduces an AI-powered virtual mouse, a transformative technology poised to redefine the landscape of human-computer interaction (HCI). Utilizing advanced artificial intelligence (AI) and computer vision techniques, the virtual mouse interprets eye & lip gestures and movements, enabling precise and natural control of on-screen cursor dynamics. Through artificial intelligence, the virtual mouse intelligently adapts to user behaviour, tailoring its responses and interactions to individual preferences, thereby enhancing overall usability and productivity. Emphasizing inclusivity, the virtual mouse integrates accessibility features, accommodating a diverse user base. Moreover, its cross-platform compatibility ensures a seamless user experience across various operating systems and devices. This research presents the AI virtual mouse as a groundbreaking HCI tool, demonstrating its potential to revolutionize the way users interact with and navigate the digital realm.***

Keywords: Artificial Intelligence, virtual mouse, Human Computer Interaction (HCI), OpenCV.

I. INTRODUCTION

Traditional computer mouse and touchpad interfaces can be limiting in terms of precision and accessibility for various users. The objective of this project is to develop an AI-powered virtual mouse system that can offer a more intuitive, precise, and adaptable pointing and clicking experience for users across different devices and scenarios. This AI virtual mouse should address issues related to input accuracy, user comfort, and accessibility, ultimately enhancing user interaction with digital interfaces.

The primary objective of this invention is to accurately identify users eye movement and project the movement into the screen through

virtual arrow movement of mouse, implemented by OpenCV (python library). The research demonstrates how models make predictions for the target classes. Real-time detection of users is pivotal for the effective working of the technology.

The development of this system was inspired by comparative observations of real-life events around the world. Using technological advances, we aim to develop an accurate and flexible framework for a virtual mouse which can be operated without any physical touch. With advancing technologies everything is becoming software oriented rather than hardware inclined. Also, with upsurge in COVID 19 cases globally in the past few years, hands free technologies are rising substantially.

Therefore, this technology aims to provide virtual mouse movement, with the help of Python IDE PyCharm and various python libraries, such as – Numpy, Autopy, OpenCV.

II. PROBLEM STATEMENT

• Traditional computer mouse and touchpad interfaces can be limiting in terms of precision and accessibility for various users.

• The objective of this project is to develop an AI-powered virtual mouse system that can offer a more intuitive, precise, and adaptable pointing and clicking experience for users across different devices and scenarios.

• This AI virtual mouse should address issues related to input accuracy, user comfort, and accessibility, ultimately enhancing user interaction with digital interfaces.

III. METHODS AND MATERIAL

Various convolutional networks were trained on images by removing the final layer to extract their feature vectors. These feature vectors were then stacked using the stacking ensemble technique and subsequently utilized to train a convolutional network. The real-time detection of user's face serves as the cornerstone for numerous functionality which helps to make the technology more robust and inculcate precision.

The Technology used in the invention is as follows:

- Windows-10 OS
- Python Programing Language
- PyCharm – python IDE
- NumPy and OpenCV

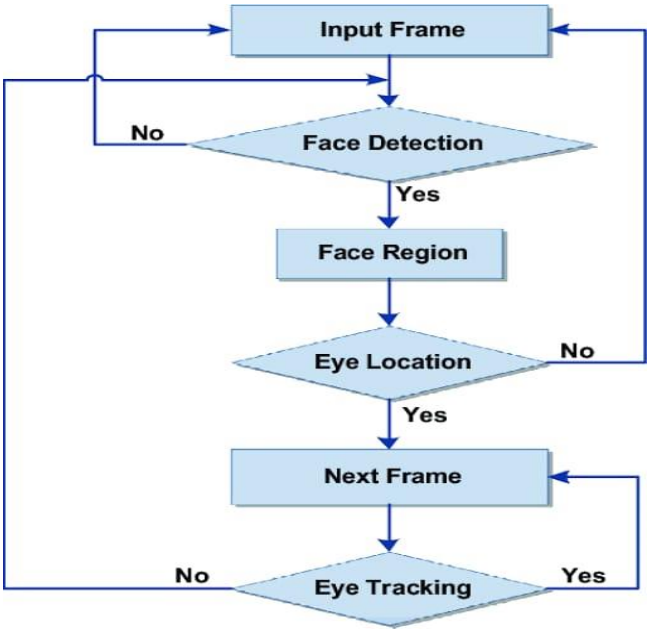


Fig. 1 represents the Algorithm Process Flowchart of the working model in the present invention.

IV. RELATED WORK

S. Shriram [1] "Deep Learning-Based Real-Time AI Virtual Mouse System Using Computer Vision to Avoid COVID-19 Spread", 25 Oct 2021, This research paper talks about the main objective of the

AI virtual mouse system. It is used to control the mouse cursor functions by using the hand gestures instead of using a physical mouse. The proposed system can be achieved by using a webcam or a built-in camera which detects the hand gestures and hand tip and processes these frames to perform the particular mouse functions. From the results of the model, we can come to a conclusion that the proposed AI virtual mouse system has performed very well and has a greater accuracy compared to the existing models and also the model overcomes most of the limitations of the existing systems. Since the proposed model has greater accuracy, the AI virtual mouse can be used for real-world applications, and also, it can be used to reduce the spread of COVID-19, since the proposed mouse system can be used virtually using hand gestures without using the traditional physical mouse.

[2] S. U. Dudhane, "Cursor control system using hand gesture recognition," IJARCCE, vol. 2, no. 5, 2013.Humans communicate mainly by vision and sound. Therefore, a man-machine interface would be more intuitive if it made greater use of vision and audio recognition [1]. Another advantage is that the user not only can communicate from a distance, but need have no physical contact with the computer. However, unlike audio commands, a visual system would be preferable in noisy environments or in situations where sound would cause a disturbance.

[3] J. Katona, "A review of human–computer interaction and virtual reality research fields in cognitive InfoCommunications", Applied Sciences, vol. 11, no. 6, p. 2646, 2021. This research papers talks about the human–computer interaction (HCI) and virtual reality (VR) research fields in CogInfoCom during the eight-year period from 2012 to 2020 based on the International Conference on Cognitive Infocommunications and its special issues. These works were classified in terms of application areas into two categories:
(1) human–computer interaction
(2) virtual reality.

The study provided a brief overview of the results published and most cited in the two most important research areas of the CogInfoCom discipline based on the International Conference on Cognitive InfoCommunications and its special issues.

V. OBJECTIVES

From the innovation, we aimed for the following objectives –

A. **Enhanced Precision**

Develop an AI virtual mouse system that offers superior pointing and clicking accuracy compared to traditional input methods.

B. **Gesture Recognition**

Enable gesture recognition capabilities, allowing users to perform common mouse functions through intuitive facial movements.

C. **Adaptive Sensitivity**

Implement dynamic sensitivity adjustments to accommodate user preferences and different tasks, such as graphic design, gaming, or text editing.

D. **Natural Interaction**

Create a virtual mouse that mimics eye & lip movements to reduce user fatigue and discomfort during prolonged use.

VI. SYSTEM DESIGN

The system helps in performing basic cursor functions using eye and lip gesture. The systems functionality can be summarized as –

- Implementing the system installation on computers.

- Employing precise cameras to detect the facial movements.
- Alerting the user if face out of the screen.
- Detecting the minute eye and lips movement to provide the user with well-functioning arrow movement of virtual mouse.
- The sensitivity of the arrow movement could be set according to the user's comfort.

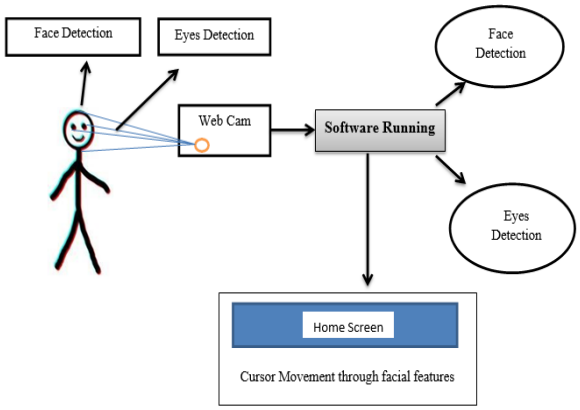


Figure 2: Architecture design of system

VII. EXPERIMENTAL RESULT

In the proposed AI virtual mouse system, the concept of advancing the human-computer interaction using computer vision is given. Cross comparison of the testing of the AI virtual mouse system is difficult because only limited numbers of datasets are available.

So, Manual testing is performed for the eye gestures detection and lip detection have been tested in various illumination conditions and also been tested with different distances from the webcam for tracking of the eye gesture and lip detection. An experimental test has been conducted to summarize the results. The test was performed 25 times by a person and this test has been made in different conditions and at different distances from the screen, and person tested the AI virtual mouse system.

In each set of test, 12 actions are performed and actual results are recorded and then analyzed against the expected output and a remark is given as fail or pass. If a majority of these actions are marked as Pass, then only the test is considered as passed.

The same set of test is repeated 25 times and each time a test is performed, we perform tap function 2 times to test the cursor funtions.

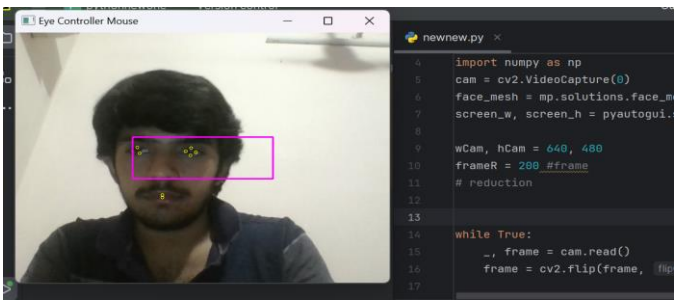
This is an example set of actions, expected output, actual output and the remark, each time the system is tested.

	Input	expected output	actual output	remark
2				
3	lips movement	lips distance calculator and click	distance calculated and click implemented	pass
4	face out of screen	no action, cursor do not move	camera closes	fail
5	multiple face in camera	non recognition of multiple faces .	only one face recognized	pass
6	saying - "tap"	click	no action happened	fail
7	moving face	stable cursor movement	unstable cursor movement	fail
8	command to open camera	open camera	no action	fail
9	left eye movement	left cursor movement	left cursor movement	pass
10	right eye movement	right cursor movement	rightcursor movement	pass
11	up eye movement	up cursor movement	up cursor movement	pass
12	down eye movement	down cursor movement	down cursor movement	pass

Out of 25 times, the system was able to detect the eye gesture 24 times i.e. accuracy of 96% and moved the cursor in the right direction, out of 50 times saying "tap" the system was able to perform click function 46 times i.e. the accuracy is 92%.

While testing the system, certain actions were seen –

- **Successful detection of eye gestures**.



- **Moving out of the screen.**

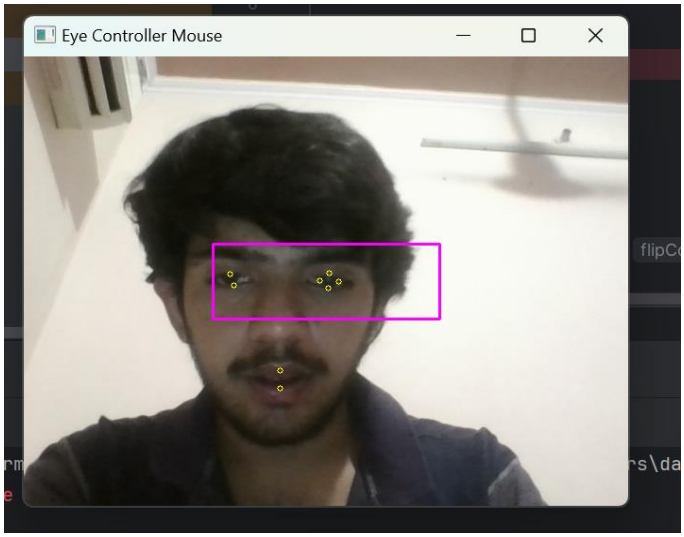
This message is shown in console -

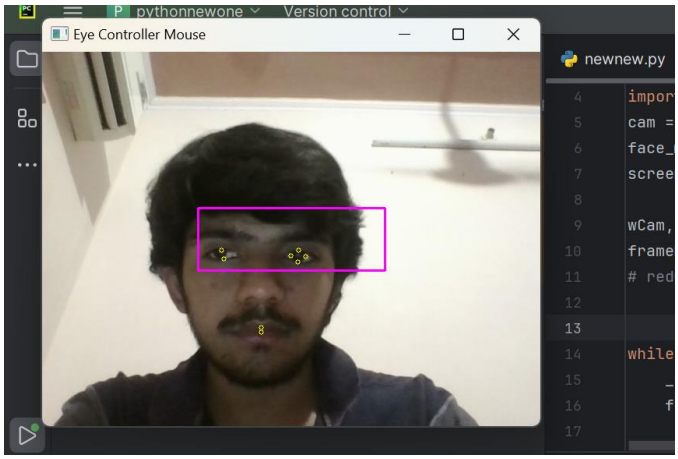
File"C:\Users\dagar_okcnktp\PycharmProjects\pythonnewone\.venv\lib\site-

packages\pyautogui__init__.py", line 1734, in failSafeCheck raise FailSafeException(pyautogui.FailSafeException: PyAutoGUI fail-safe triggered from mouse moving to a corner of the screen. To disable this fail-safe, set pyautogui. FAILSAFE to False. DISABLING FAIL-SAFE IS NOT RECOMMENDED.

Process finished with exit code 1.

- **Detection of lip movement.**





When the distance between both the lips increases by certain distance then the “Click” function is performed.

VIII. CONCLUSION

In conclusion, the AI virtual mouse represents a transformative advancement in human-computer interaction (HCI). Through the integration of advanced artificial intelligence and computer vision technologies, it offers users an intuitive, precise, and adaptable means of interacting with digital interfaces. The virtual mouse's ability to interpret natural eye & lip gestures and continuously learn from user behaviour enables a personalized experience, enhancing efficiency and productivity across a range of tasks. The potential applications of the AI virtual mouse span from everyday computing for general users to specialized fields like graphic design and healthcare. By addressing the need for efficient, hygienic, and intuitive interaction, this technology sets the stage for a future where AI-driven interfaces play a central role in shaping how we interact with the digital world. As we continue to advance in HCI, the AI virtual mouse exemplifies the promise of AI in creating more intuitive and intelligent user-centric computing experiences.

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