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Hands Free Mouse using Facial Expression for Physically Disabled People

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***Abstract*— This report explores the development of a Hands-Free Mouse system designed to empower physically disabled individuals through facial expression recognition. In the domain of assistive technology, where the focus is on enhancing accessibility, we delve into the novel application of facial expression recognition techniques. Commonly employed techniques in this domain include computer vision and machine learning algorithms, with diverse approaches such as deep neural networks and feature-based methods.**

***Keywords*— Computer-Vision, Face Landmark-recognition, Virtual mouse pointer, HCI, Hands-free**

I. Introduction

The project titled "Hands-Free Mouse Utilizing Facial Expressions for Individuals with Physical Disabilities" delves into the foundational principles, technologies, and concepts integral to the creation and deployment of a hands-free mouse system that operates based on facial expressions. This innovative approach aims to provide an effective alternative for those who may struggle with traditional input devices.

Objectives

The objectives outlined in this project aim to steer the research and development of the hands-free mouse system. These goals encompass a thorough examination of current methodologies, addressing existing challenges, comprehending feature extraction techniques, and identifying relevant evaluation metrics to assess system performance.

Scope

This initiative is centered around improving accessibility for individuals with physical disabilities, striving to enable hands-free control of computers. By developing tailored solutions for this specific demographic, the project seeks to empower users with limited physical mobility, fostering a more inclusive and intuitive computing environment. This focus not only enhances user experience but also promotes greater independence and engagement with technology.

II. LITERATURE SURVEY

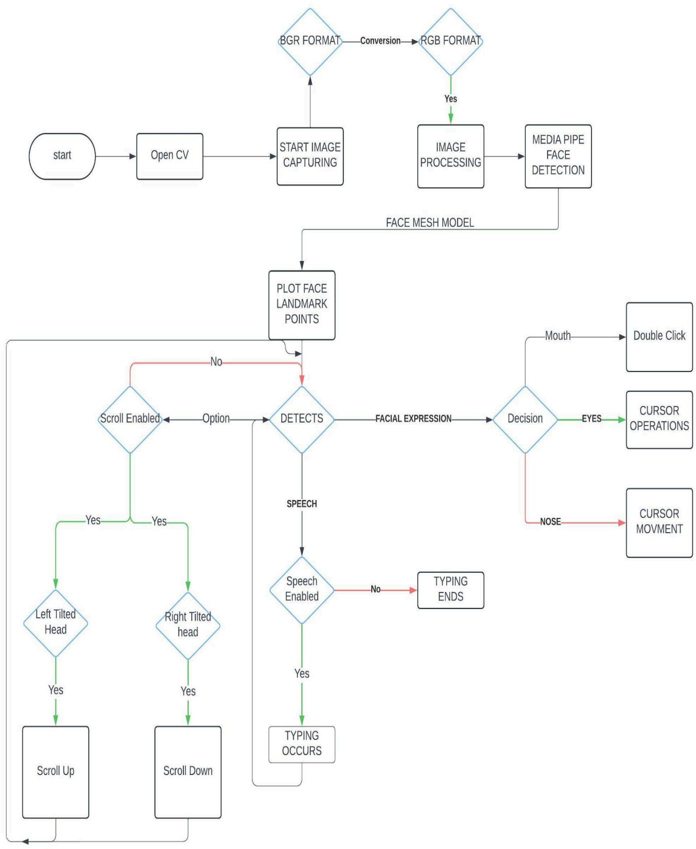
TABLE I

Year	Literature Survey Table		
	Author	**Advantages**	**Disadvantages**
2022	Shashidhar R, Snehith K, Abhishek P K, Pavitha N [1]	Real-time interaction, Vision-based interface, Multimodal HCI system	Configurability gap, Limitation with multiple faces, Scalability concerns
2021	Salsabiil Hasanah, Aulia Teaku Nururrahmah, Darlis Herumurti [2]	Universal accessibility, Non-intrusive HCI, Sophisticated methods	Room for enhancement, Age-related variances, Algorithm refinement needed, Image processing integration
2020	Akshada Dongre, Rodney Pinto, Ameya Patkar, Dr. Minal Lopes [3]	Accessibility, User-friendly interface	Lighting dependency, Limited device compatibility, Challenges for physically challenged users
2019	Vinay S Vasisht, Swaroop Joshi, Shashidhar, Shreedhar [4]	Hands-free cursor control for amputees using eye and facial movements	Challenges in achieving comfort, requires user adaptation
2018	Zhang Naizhong, Wen Jing, Wang Jun [5]	Hands-free interaction, Efficient head motion retrieval, Single camera utilization, Distinct mouth features, Neural network integration	Limited mouse functionality, Efficiency improvement needed, Unexplored avenues, Algorithm refinement necessary
2015	Khushal Snacheti, Sridhar Krishnan K, Suhaas A, Suresh P [6]	Addressing accessibility challenges, Innovative technology integration	Performance variations, False negative clicks, Efficiency gap, Ongoing research and improvements needed

III. PROPOSED METHODOLOGY

A. Implemented System

Introduction



Implementation Plan

This implementation utilizes OpenCV to capture real-time video from the webcam and MediaPipe's FaceMesh model to detect facial landmarks such as the eyes, mouth, and nose. These landmarks are tracked frame by frame to enable hands-free control of computer interactions. Cursor movement is managed by tracking the user's facial positions across frames. The system calculates the difference between the current and previous positions of stable landmarks (e.g., eyes and nose) to move the cursor. Sensitivity settings allow fine-tuning of movement speed based on facial shifts.

The system also detects specific facial actions, such as blinking and mouth movements, to trigger mouse clicks. For instance, if the left or right eye remains closed for longer than a defined threshold, a corresponding left or right click is executed. Similarly, opening the mouth for a prolonged duration triggers a double-click. To control scrolling, head tilts are detected based on the angle between the nose tip and the eyes. Once calibrated, tilting the head left or right moves the page up or down by scrolling. A neutral angle is calculated during initial frames, serving as a reference for detecting tilt movements beyond the set threshold.

Additionally, a speech recognition component could be integrated to convert speech to text for typing, though it isn't detailed in this section of the code. The program provides continuous feedback by displaying processed video with marked landmarks, allowing real-time adjustment. The system runs until the user presses the 'ESC' key, at which point the video feed is released, and the application terminates.

Table:

Action from User	Response in the display
Nose	Cursor Movement
Left-eye-Blink	Left Click
Right-eye Blink	Right Click
Head Left Tilt	Scrolling Up
Head Right Tilt	Scrolling Down
Mouth Open	Double Click

Algorithms / Techniques

Given below are the algorithms / techniques to be used :

1. OpenCV

OpenCV (Open Computer Vision) is used to capture real-time video from the webcam. It handles the conversion of video frames from BGR to RGB format and performs other image processing tasks such as displaying video with facial landmarks.

2.MediaPipe FaceMesh

MediaPipe FaceMesh is a deep learning-based model used for detecting and tracking 468 specific facial landmarks. It is applied in this program to identify facial features such as eyes, nose, and mouth, which are crucial for detecting blinks, mouth movements, and head tilts.

3.PyAutoGUI

PyAutoGUI is a Python package that automates GUI interactions like moving the mouse, clicking, scrolling, and typing. It is used here to simulate mouse clicks, scrolling, and cursor movements based on facial expressions.

4.PyQt5

PyQt5 is a set of Python bindings for the Qt framework, used to create desktop graphical user interfaces. In this case, widgets such as QWidget, QPushButton, QVBoxLayout, QSlider, QLineEdit, and others are used to build the GUI for controlling face tracking and speech-to-text functionalities.

5.Eye Aspect Ratio (EAR)

The EAR algorithm is used to detect eye blinks by calculating the ratio between the vertical and horizontal distances between eye landmarks. A low ratio indicates a blink, and the system uses this to trigger left or right mouse clicks.

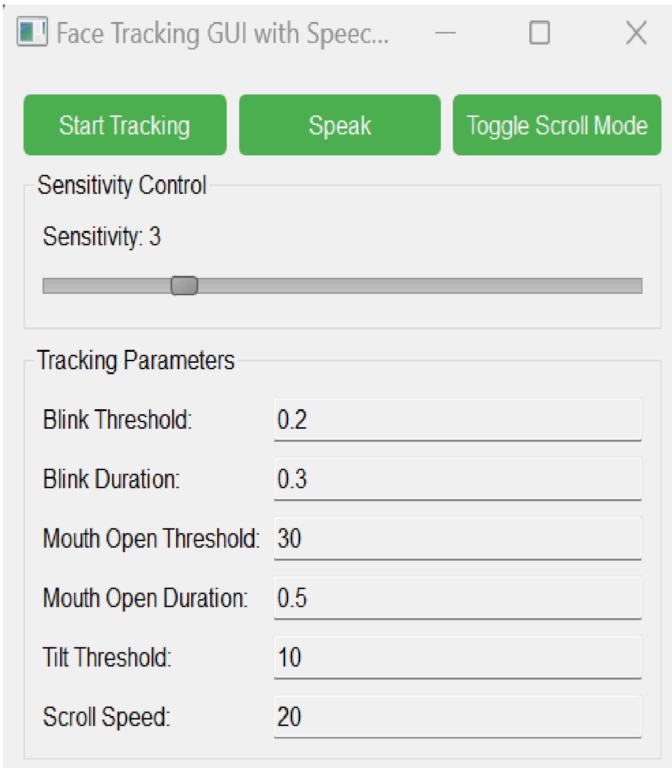
6.Head Tilt Detection using Angle Calculation

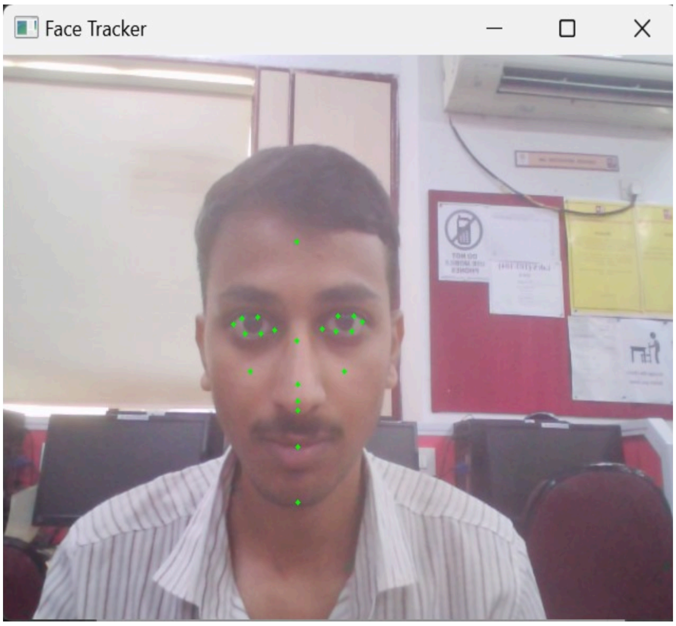
Head tilt detection is done by calculating the angle between the nose and the center of the eyes. By using trigonometry (arctangent), the program detects tilts in the user's head and uses this for scrolling actions.

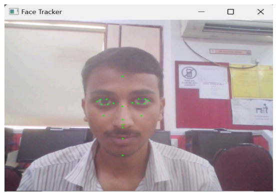
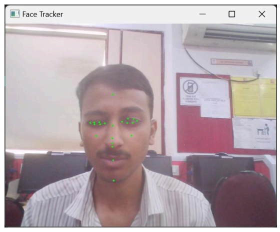
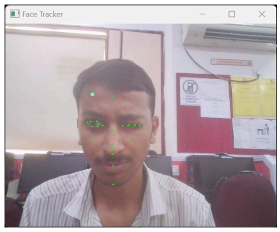
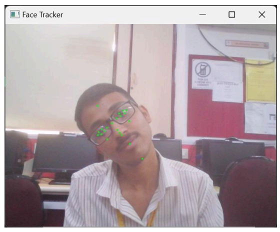
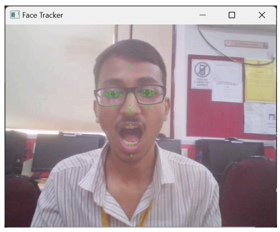
7.SpeechRecognition (Google Web Speech API)

The speech_recognition library is used to capture and convert spoken words into text. The Google Web Speech API is employed here for the actual speech-to-text conversion, meaning the program sends audio data to Google servers, where it is processed and returned as text.

IV. RESULTS





Action from User	Response in the display	Image
Nose	Cursor Movement	
Left-eye Blink	Left Click	
Right-eye Blink	Right Click	
Head Left Tilt	Scrolling Up	
Head Right Tilt	Scrolling Down	
Mouth Open	Double-click	

IV. Summary

This report presents an exploration of hands-free human-computer interaction systems, specifically designed to assist individuals with physical disabilities by using facial expressions to control computers. The study addresses challenges such as optimizing lighting conditions, device compatibility, and ensuring reliable performance for users with limited mobility. The proposed system integrates technologies like MediaPipe FaceMesh for facial landmark detection and PyAutoGUI for simulating mouse movements and actions based on the user's expressions.

The report emphasizes the importance of accessibility and inclusivity, aiming to provide disabled users with greater independence and smoother interactions with technology. While the system shows promise, it also identifies areas for improvement, including speed, accuracy, and customization. The study advocates for further research to enhance the scalability and effectiveness of such contactless interaction systems.

References

[1] Shashidhar R, Snehit K, Abhishek P K,Abhishek B Vishwagna, Pavitha N “Mouse Cursor Control Using Facial Movements - An HCI Application” Proceedings of the International Conference on Sustainable Computing and Data Communication Systems (ICSCDS-2022).

[2]Salsabiil Hasanah, Aulia Teaku Nururrahmah,Darlis Herumurti ,“Comparative Analysis of Hands-free Mouse-Controlling based on Face Tracking” 13th International Conference on Information & Communication Technology and System (ICTS) 2021.

[3] Akshada Dongre, Rodney Pinto,Ameya Patkar, Dr. Minal Lopes “Computer Cursor Control Using Eye and Face Gestures” IEEE - 49239 11th ICCCNT 2020.

[4]Vinay S Vasisht,Swaroop Joshi,Shashidahr, Shreedhar ,C Gururaj “Human computer interaction based eye controlled mouse” Proceedings of the Third International Conference on Electronics Communication and Aerospace Technology [ICECA 2019].

[5]Khushal Sancheti, Sridhar Krishnan K, Suhaas A, Suresh P “Hands-free Cursor Control using Intuitive Head Movements and Cheek Muscle Twitches” Proceedings of TENCON 2018 - 2018 IEEE Region 10 Conference (Jeju, Korea, 28-31 October 2018)

[6] Zhang Naizhong ,Wang Jun , “Hand-Free Head Mouse Control Based on Mouth Tracking” The 10th International Conference on Computer Science & Education (ICCSE 2015).