Machine Learning Approach for Facial Landmark Dynamics in Contactless Computing

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ABSTRACT

This project presents a hands-free computer control system that interprets facial expressions and head movements to operate a virtual mouse. Using **Dlib's HOG-based face detector** and a **68-point facial landmark model**, the system tracks key facial features such as the eyes, mouth, and nose. Metrics like the **Eye Aspect Ratio (EAR)** and **Mouth Aspect Ratio (MAR)** are computed in real-time to detect gestures like blinking and mouth opening, mapped to actions such as cursor movement, clicks, and scrolling.
This enables intuitive, contactless interaction especially for individuals with **mobility impairments** promoting accessibility through machine learning and computer vision.

OBJECTIVES

- ❑ Enable **hands-free computer control** using facial gestures.
- ❑ Provide **accessibility** for users with physical disabilities.
- ❑ Implement **real-time gesture recognition** using Dlib and OpenCV. 68-point facial landmark
- ❑ Map facial movements to **mouse actions** such as click, scroll, and cursor motion.
- ❑ Reduce reliance on **physical input devices** through computer vision

MATERIALS & METHODS

- ➢ **Tools Used:** Python, OpenCV, Dlib, NumPy, PyAutoGUI
- ➢ **Hardware:** Standard webcam, minimum 4GB RAM, dual-core CPU

❖ **Key Algorithms:**

- Facial Landmark Detection
- Eye Aspect Ratio (EAR) for blink/wink detection
- Mouth Aspect Ratio (MAR) for input mode activation
- Nose Tracking for cursor navigation

❖ **Workflow:**

1.Capture live video stream.

2.Detect facial landmarks using Dlib.

3.Compute EAR & MAR for gesture recognition.

4.Translate gestures → mouse events.

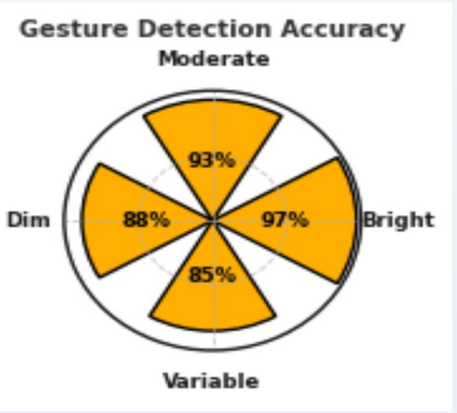
RESULTS

The proposed system achieved efficient and real-time facial gesture detection.

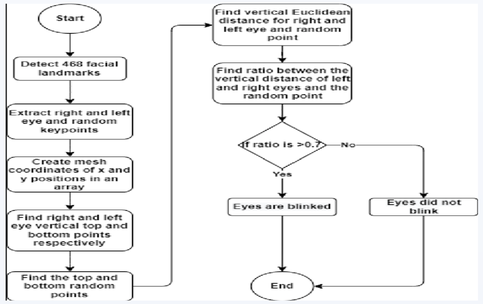
❖ **Key gestures recognized:**

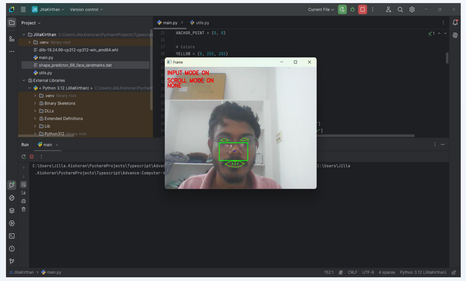
- ▪ **Blink/Wink:** Left or right click
- ▪ **Mouth Open:** Activate input mode
- ▪ **Nose Movement:** Cursor navigation
- ▪ **Long Blink:** Scroll mode toggle

Accuracy improved under stable lighting and proper webcam resolution. The system effectively enabled **hands-free control**, offering smooth interaction.



RESULTS





Action	Function
 Opening Mouth	Activate / Deactivate Mouse Control
 Right Eye Wink	Right Click
 Left Eye Wink	Left Click
 Squinting Eyes	Activate / Deactivate Scrolling
 Head Movements (Pitch and Yaw)	Scrolling / Cursor Movement

CONCLUSIONS

The project successfully demonstrates that **machine learning** and **computer vision** can enable **hands-free computing** through facial gesture detection. It enhances accessibility, usability, and interaction for disabled users. Future improvements include deep learning integration (CNNs) for gesture accuracy and **voice/eye-tracking hybrid control** for better adaptability.

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CONTACT

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