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Virtual Mouse Implementation Using OpenCV, ML, Python

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Abstract: *The implementation of a virtual mouse using OpenCV, Machine Learning (ML), and Python aims to create a system that allows users to control their computer cursor without a physical mouse. This project leverages computer vision techniques from the OpenCV library for hand gesture recognition and machine learning algorithms for accurate cursor control. Through advanced image processing algorithms, the system accurately captures and analyzes hand movements. The virtual mouse system enhances accessibility for individuals with physical disabilities and offers a novel and intuitive way of interacting with computers. The integration of machine learning (ML) and computer vision technologies has paved the way for innovative human computer interaction methods. This paper presents an abstract overview of the development and implementation of a virtual mouse system, leveraging ML techniques, the OpenCV library, and the Python programming language. The proposed system aims to enable users to control the computer mouse pointer through hand gestures, providing an intuitive and hands-free interface.*

Keywords: Computer Vision, OpenCV(Computer Vision Library), Machine Learning, Gesture Recognition, Image Processing

I. INTRODUCTION

In Human Computer Interaction (HCI), the finest invention is the mouse. Even though a wireless mouse or the Bluetooth mouse is in demand today, it still lacks in many fields like cost and power. This project, therefore, puts forward a modern approach to regulate the mouse movements using a real-time camera with the help of the hand. Our System aims to improve the recognition of human hand postures in a Human Computer Interaction application, reduce the time spent computing and improve user comfort related to human hand postures. We have developed an application for computer mouse control. Based on the proposed algorithm and selected hand feature, the application has good time-based performance. The user finds it easier to operate the system due to the proposed hand postures in combination with the voice assistant.

Gesture Controlled Virtual Mouse makes human-computer interaction simple by making use of Hand Gestures and Voice Commands. The computer requires almost No direct contact. All input and Output operations can be virtually controlled by using Static and dynamic hand gestures along with a voice assistant. This project makes use of state-of-art Machine Learning Hand Gesture Recognition in the field of Human Computer Interactions is more pertinent today than ever before. In an era characterized by rapid technological advancements and a constant quest for user-friendly interfaces, Hand Gesture Recognition emerges as a vital and cutting-edge method to facilitate Seamless control over computer systems.

Problem Statement

To Develop a hand gesture recognition system that utilizes computer vision techniques, specifically OpenCV to detect and track hand gestures captured by a system's webcam. The system should be able to recognize specific gestures and translate them into mouse movements, allowing users to control their computer without physical input devices.

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II. LITERATURE REVIEW

Sr.No.	Paper Title	Journal Author	Technology used	Remark
1.	Virtual Mouse, 12th march 2015	AshishMhetar, B. K. Srioop, Kavya AGC, Ramnath Nayak, Ravilumarjavali, Suma KV	IR Camera USB-HID, IR Pen Teensy (ARM M4)	They use Hardware Devices and cost is more “Our project addresses this problem by implementing hand gestures for system control”
2.	Hand Gesture Virtual Mouse For Human Computer interaction. 2018	SherinMohamad, V H preetha	Matalab S/W, Two Cameras	Used two cameras and It’s cost is more "In our project, we utilize the system's built-in webcam for tracking hand movements, reducing the cost and complexity"
3.	Design and Development of Virtual mouse, 2019	KabidShibly, SamratDey, Aminulislam, ShahriarShowraw	HCL Technology	In this System ,performance is affected by the amount of light in the environment we have taken measures to improve the system's robustness under varying lighting conditions
4.	Virtual Mouse Implementation using Open CV, 2019	KolliparaSai Varun, I. Puneeth, Dr. T. Prem Jacob	OpenCV, Deep Learning, pyatogui, NumPy, Anaconda	Complex to use. To address this complexity issue, our project focuses on simplifying the user experience. implementing user friendly features

As the technology increase everything becomes virtualized such as speech recognition. Speech Recognition is used for recognition and translation of the spoken language into text. Thus, Speech Recognition can replace keyboards in the future, Similarly Hand Gestures Tracking which is used to control the mouse pointer with the help of our hand. Hand Gestures Tracking can replace mouse in the future. Gestures can be in any form like hand image or pixel image or any human given pose that require less computational difficulty or power for making the devices required for the recognitions to make work. This involves processing of a running video using image processing algorithms and then track the fingers. Different techniques are being proposed by the companies for gaining necessary information/data for recognition handmade gestures recognition models

Objective

The targets are as follows:

- Review existing research on hand gesture-controlled virtual mouse to understand the field's current trends.
- Develop a system that replaces traditional mouse functions using a computer's built-in camera.
- Create a user-friendly Human-Computer Interaction (HCI) solely through the computer's in-built camera.
- To validate the result.

III. METHODOLOGY

Machine Learning Classification Techniques used for the mode

OpenCV:

Open CV (Open Source Computer Vision Library) is an open library of python that is mainly aimed at real-timecomputer-vision. It is also available in C++ and Java. It is an open source machine learning software library. It makes use of Numpy, which is a python library that is used for implementing multi-dimensional arrays and matrices along with high-levelmathematical operations on these arrays. OpenCV is mainly used to capture data from a live video hence it is mainly focuses on image processing and video capture. In this paper OpenCV is focused mainly on video capture. OpenCV is also used for applications such as face detection, OCR, Vision-guided robotics surgery, 3D human organ reconstruction, QR code Scanner etc.UsingOpenCV we can perform detection of specific objects such as eyes,

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faces etc., we can also analyze videos such as estimating the motion in the video or subtracting the background from the video, and tracking objects in it.

OpenCV covers the basic data structures such as Scalar, point etc. that are used for building OpenCV applications. OpenCVlibrary is imported into the python using the code 'import cv2'.

Anaconda:

Anaconda is an opensource platform for python and R programming Language which is used specifically for data science, Machine Learning, Data Processing, Predictive Analysis, etc., Anaconda consists of desktop GUI application called Anaconda Navigator and Anaconda prompt which is a command prompt for Anaconda. Anaconda Navigator is used to launch applications and manage Anaconda packages without using command-line commands. Anaconda Prompt is used for launching applications and manage Anaconda packages with the help of command-line commands. The default applications that are available in Anaconda are Jupyter Lab, Jupyter Notebook, Qt Console, Spyder, Glue viz, Orange, R studio, and Visual Studio. Anaconda also has a cloud called Anaconda Cloud. It is a package management service provided by Anaconda where we can access, store and share private and public notebooks, environments and various anaconda and PyPI packages.

IV. SYSTEM ARCHITECTURE

The system working conditions are based on Anaconda Environment interface design, with OpenCV, wx, Numpy libraries and some of the sub packages of these libraries. Camera resolution is 1920*1080 and with fps of 40 (Default System Camera). While the device is ON and when the model is run. The model will open a tab of the camera which takes input from the user. The model is designed for the recognition and further working is done by the commands given to the system and how the user wants the gestures to make recognize. At the same time, the mouse pointer movement will be captured and made operate without any human interaction.

Model Understanding

The main thing we need to identify are the applications the model is going to develop so the development of the mouse movement without using the system mouse, the model is developed using computer vision where the color variation is used for the mouse identification and movement. To identify the color variation / color detection that helps with the main part of our problem. There we are identifying the color required for the user by using the range of green by using the color values in RGB image and highlighting them from HSV image and converting them into Black and White and display it in the mask which is system understandable image representation. The code when a single input is given and the operating that are performed. When a single figure is given there will be moving mouse which is depending on the figure which is not applicable for clicking / selection processes. So the developed code is again given in where the code is giving that a point is formed which is used for the movement and without adding / changing the code if we join the two fingers click can be formed by inversing the rectangle into circle that will identification for the system.

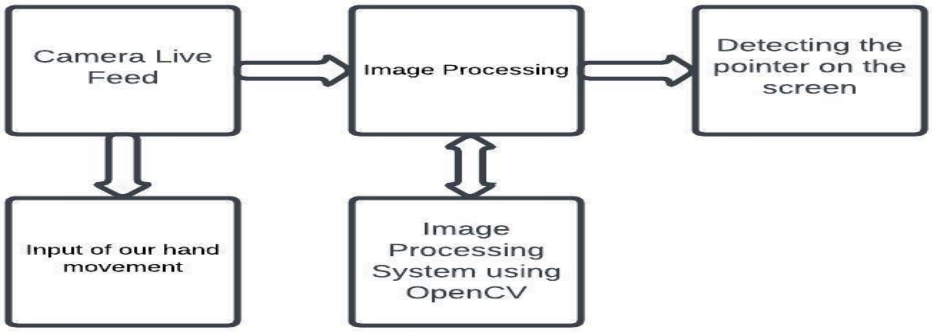

Fig. System Architecture

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V. CONCLUSION

In summary, the "Virtual Mouse Implementation Using OpenCV, ML, Python" project is all about making computer interaction better. By using cool technologies like OpenCV, machine learning, and Python, we want to create a virtual mouse that's easy to use. Our goals and how we plan to build it lay the groundwork for a system that makes it easier for people to use computers. Just like how AI can improve job interviews, we believe our project can change how people use computers, giving them a simpler and better way to control things.

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