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A Survey on Virtual Mouse Using Hand Movements

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ABSTRACT : In today's world, we are witnessing great developments in the field of technology. Today's technology is combined with a technique called artificial intelligence. This project is also based on a small part AI. This project presents the detection of finger movement gestures in our computer window using the camera and the control of the whole system by just moving one finger. With the development technologies in the fields of augmented reality and the devices we use in our daily life, these devices are becoming compact in the form of Bluetooth or wireless technologies. This paper proposes an artificial intelligence virtual mouse system that uses hand gestures and hand tip detection to perform computer mouse functions using computer vision. The main goal of the proposed system is to perform computer mouse cursor functions and scrolling functions using a web camera or a computer built-in camera instead of using a traditional mouse. Hand and tip hand gesture detection using computer vision is used as HCI [1] with a computer. Using the AI virtual mouse system, we can use the built-in camera or webcam to track the fingertip gesture and play with it. When using a wireless or Bluetooth mouse, some devices are used, such as a mouse, a dongle to connect to the computer, and also a battery to power the mouse, but in this article, the user uses their built-in camera. or web camera and uses hand gestures to control computer mouse operations. In the proposed system, the web camera captures and then processes the images that have been captured, and then recognizes various hand gestures and hand tip gestures, and then performs a specific mouse function. Keywords: Mediapipe, PyAutoGUI, gesture recognition

1. INTRODUCTION

Gesture recognition is a topic in computer science and language technology with the aim of interpreting human gestures using mathematical algorithms. It is a sub-discipline of computer vision. Gestures can come from any bodily movement or state, but commonly come from the face or hand. Current focus in this area includes facial emotion recognition and hand gesture recognition. Users can use simple gestures to control or interact with devices without physically touching them. Many approaches have been developed to interpret sign language using cameras and computer vision algorithms. Gesture recognition can be seen as a way for computers to begin to understand human body language, creating a better bridge between machines and humans than older text-based user interfaces or even GUIs (graphical user interfaces) that still limit most keyboard input. and mice and communicate naturally without any mechanical devices.

What is a virtual mouse? A virtual mouse provides infrastructure between the user and the system using only a camera. It allows users to interact with machines without the use of mechanical or physical devices and even control mouse functions.

- User makes designated hand gestures

which is captured by the camera.

- Object recognition techniques are used to extract information from the capture.
- This is then translated into some meaningful event on the screen.
- Beats the use of physical device.

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1.1 Problem Statement

The proposed artificial intelligence virtual mouse system can be used to overcome real-world problems such as situations where there is no space to use a physical mouse, as well as for people who have hand problems and are unable to control a physical mouse. In the middle of the situation of COVID-19, it is also not safe to use the device by touch because it may result in a possible situation of spreading the virus by touching the device, so the proposed AI virtual mouse can be used to overcome these problems because the detection of hand gestures and the tip of the hand is used to control the functions computer mouse using a webcam or built-in camera.

1.2 Literature Survey

From the point of view of computer technology, a mouse is a pointing device that detects two-dimensional movements relative to a surface. This movement is translated into the movement of a pointer on the display, which allows controlling the graphical user interface (GUI) on the computer platform. There are many different types of mice that already exist in modern technology, there is a mechanical mouse that determines movements with a hard rubber ball that rolls as the mouse moves. A few years later, the optical mouse was introduced, replacing the hard rubber ball with an LED sensor that detects the movement of the table top and then sends the information to the computer for processing. In 2004, a laser mouse was then introduced, which improved movement accuracy with the slightest movement of the hand, overcoming the limitations of an optical mouse, which is the difficulty of tracking on highly glossy surfaces. However, no matter how accurate it can be, there are still limitations within the mouse itself, both physically and technically. For example, a computer mouse is a consumable hardware device because it requires a long-term replacement, either the mouse buttons have become degraded, causing inappropriate clicking, or the computer itself has no longer recognized the entire mouse.

Therefore, an alternative way of touch screen can be a virtual human computer interaction device that replaces the physical mouse or keyboard using a web camera or any other image capturing device. This device, which is a web camera, will be constantly used by software that monitors the gestures given by the user to process them and translate them into moving points, similar to a physical mouse.

A virtual mouse system based on human-computer interaction using computer vision and hand gestures. Gestures captured by the built-in camera or web camera and processed by segmentation and color detection techniques. Many approaches to human-computer interaction are presented here

One approach reported by Erdem et al uses fingertip tracking to control mouse movement. Mouse control was implemented by defining the screen so that mouse control was initiated when the user's hand passed over the area.

Another approach developed by Chu-Feng Lien, the concept uses fingertips to control mouse operations. In this, the mouse operations are based on the density of the image, where the person is required to hold the cursor at the desired location for a certain period of time.

In yet another approach developed by Paul et al, thumb movement is used to indicate a click event. Hand gestures are used to control the mouse. In his approach, a colored pointer is used for object tracking and recognition. A left click is implemented by calculating the distance between the thumb and the index finger, while the right click event is implemented by calculating the distance between the thumb and the middle finger

Video Based Hand Detection System using Machine Learning Authors: Manjunath R Kounte, E Niveditha, A Sai Sudeshna, Kalaigar Afrose Publisher: International Journal of Advance Science and Technology 2020 Paper Summary: · CNN and Machine Learning · For faster neural network computations, they used nano nvidia jetson suite. · A project focused on speed and efficiency. · Hardware efficient dynamic gesture detection system.

II. METHODOLOGY

A. Camera Settings

Operational operations are controlled by the web camera of a connected laptop or desktop computer. In order to capture video, we need to create a Video Capture object. We could also apply color detection techniques to any image by making simple modifications in the code.

B. Capturing frames

An infinite loop is used to keep the web cam taking pictures in every case and open for the duration of the program. We capture the live stream, frame by frame. We then process each captured image that is in the RGB (default) color space to the HSV color space. More than 150 color space conversion methods are available in OpenCV. But we will only look at the two most used, BGR to Gray and BGR to HSV.

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C. Mouse Movement

First, we need to calculate the center of both detected red objects, which is easily done by taking the average of the maximum and minimum points of the bounding boxes. now we have 2 coordinates from the center of the 2 objects, find their diameter and get the red point shown in the picture. We convert the detected coordinate from the camera resolution to the actual screen resolution. Then we set the location as mouse_position. but it will take some time to move the mouse pointer. So we have to wait until the mouse pointer reaches that point. So we've started a loop and we're not doing anything there, just waiting to see if the current mouse location is the same as the assigned mouse location. This is for an open gesture.

D. Clicking

The next step is to implement the close gesture. The operation is performed by clicking on the object and dragging it. It's similar to the open gesture, but the difference is that here we only have one object, so we only need to calculate its center. And that will be placed where we place the mouse pointer. Instead of a mouse release operation, we perform a mouse press operation.

2.1 Packages used:

Mediapipe :

It is the most widely used cross-platform solution for building a multi-modal machine learning pipeline and is open source by Google. The MediaPipe framework is very useful for cross-platform development work because this framework is based on statistical data. MediaPipe frames are multimodal, which means they apply to face tracking, face meshing, iris scanner, location tracking, hand tracking, hand tracking, segmentation objects, hair, motion tracking, and opposition. . MediaPipe Framework is the best option for a developer to create, analyze and design system performance in the form of diagrams and has also been used to develop various applications and systems on multiple platforms (Android, IOS, Web, Devices). The steps of the system we propose use the MediaPipe platform as the configuration of the pipeline structure. This pipeline framework is built and runs on a variety of platforms, allowing for scalability across mobile and desktop systems. The MediaPipe package gives us three reliabilities, namely performance, evaluation and development, which takes data from the sensor and uses a number of components. Mediapipe processing within the diagram that defines packet flow between nodes.

PyAutoGUI:

PyAutoGUI allows Python scripts to control the mouse and keyboard to automate interactions with other applications. The API should be simple. PyAutoGUI works on Windows, macOS and Linux and works on Python 2 and 3. PyAutoGUI has several functions: · Move the mouse and click in other application windows. · Send keystrokes to applications (e.g. to fill out forms). Take screenshots and get an image (like a button or checkbox) and find it on the screen. · Find an application window and move, resize or close it (currently Windows only). · Display of warning windows and messages.

OpenCV:

OpenCV (Open Source Computer Vision Library) is an open source computer vision and machine learning software library. OpenCV was developed to provide a common infrastructure for computer vision applications and to accelerate the use of machine vision in commercial products.As an Apache 2 licensed product, OpenCV allows companies to easily use and modify the code. The library contains over 2500 optimized algorithms, including a full set of classic and cutting-edge computer vision and machine learning algorithms. these algorithms may be used to detect and apprehend faces, discover items, classify human actions in films, tune digital camera movements, music shifting gadgets, extract three-D models of objects, create 3D factor clouds from stereo cameras and integrate pictures to create high-resolution pix. an entire scene, find similar images in the image bank, remove red-eye from flash photos, track eye movements, recognize landscapes and set markers to overlay augmented reality and much more. OpenCV has a community of over 47,000 users and an estimated download count of over 18 million. The library is used extensively in companies, research groups and government agencies.Besides established companies like Google, Yahoo, Microsoft, Intel, IBM, Sony, Honda, Toyota using the library, many startups like Applied Minds, VideoSurf and Zeitera use OpenCV extensively. OpenCV's deployed applications range from Street View image fusion, intrusion detection in surveillance videos in Israel, monitoring of mining equipment in China, use of robots to navigate and pick up objects in the Willow Garage, accidental drowning detection in pools in Europe, interactive art in Spain and New York, searching for debris on runways in Turkey, checking product labels in factories around the world, to high-speed facial recognition in Japan. The software provides interfaces for C++, Python, Java, and MATLAB programming languages and is compatible with operating systems such as Windows, Linux, Android, and Mac OS. OpenCV relies heavily on real-time vision applications and uses MMX and SSE instructions where available. Full CUDA and OpenCL interfaces

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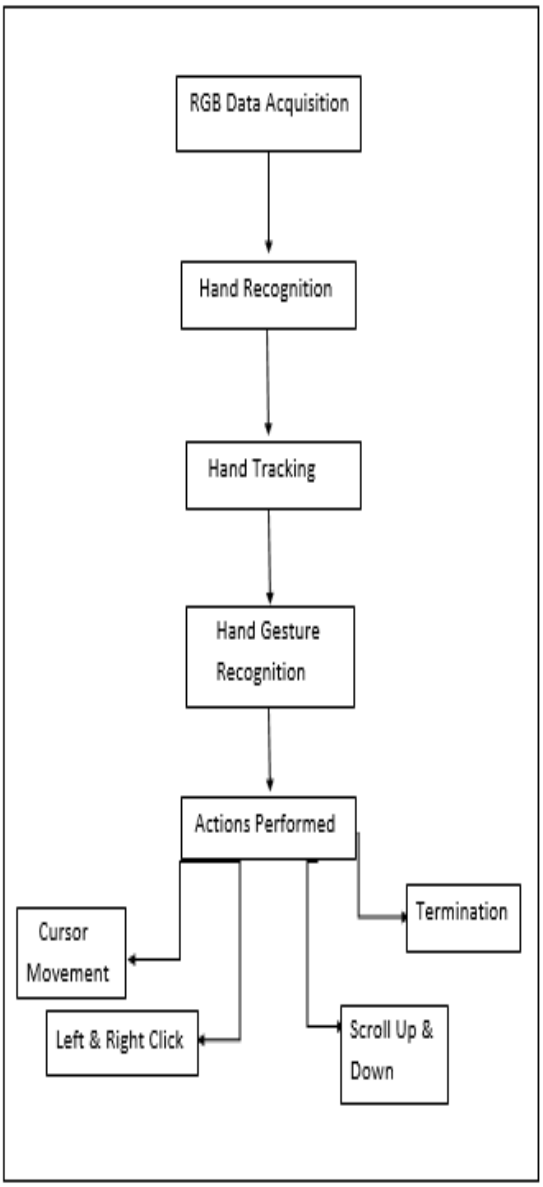
are currently being actively developed. There are over 500 algorithms and about 10 times as many functions that create or support those algorithms. OpenCV is natively written in C++ and has a templated interface that works great with STL containers.

Matplotlib:
Matplotlib is a comprehensive library for creating static, animated, and interactive visualizations in Python. Matplotlib makes simple things easy and difficult things possible.Matplotlib is a cross-platform data plotting and visualization library for Python and its numerical extension NumPy. As such, it offers a great open source alternative to MATLAB. Developers can also use Matplotlib API (Application Programming Interface) to integrate charts into GUI applications.

2.2 UML Diagram



III. CONCLUSION

This project presented a brand new AI virtual mouse method using OpenCv, autopy and mediapipe by the help of fingertip movement interacted with the computer in front of camera without using any physical device. The approach

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demonstrated high accuracy and highly accurate gesture eliminates in practical applications. The proposed method overcomes the limitations of already existing virtual mouse systems. It has many advantages, e.g., working well in low light as well as changing light condition with complex background, and fingertip tracking of different shape and size of finger with same accuracy. The experimental results shows that the approaching system can perform very well in real-time applications. We also intend to add new gesture on it to handle the system more easily and interact with other smart systems. It is possible to enrich the tracking system by using machine learning algorithm like Open pose. It is also possible to including body, hand and facial key points for different gestures.

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