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GESTURE CONTROL USING PYTHON

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ABSTRACT:

Hand gesture recognition is a system that is used to detect the gesture of hand in a real time video. The hand gesture can be restricted within a certain area of interest. In this study, designing hand gesture recognition is one of the complicated jobs that involves two major problems. Firstly, is the detection of the hand. Another problem is to create a sign that is suitable to be used one hand at a time. This project focuses on how a system could detect, recognize and interpret the hand gesture through computer vision with the challenges such as change in pose, orientation, location and scale. Different types of gestures such as numbers and sign languages need to be created in this system to perform well for developing this project. The image taken from the real time video is analyzed to detect the gesture of hand before the image processing is done. In this project, the detection of hand will be done using the theories of Region of Interest (ROI) via Python programming. The explanation of the results will be focused on the simulation part since the difference for the hardware implementation is the source code to read the real-time input video. The development of hand gesture recognition using Python and OpenCV can be implemented by applying the theories of hand segmentation and the hand detection system.

Introduction:

Hand gesture recognition is one of the systems that can detect the gesture of a hand in a real time video.Designing a system for hand gesture recognition is one of the goals of achieving the objectives of this project. The project has been made by our own efforts using Python and OpenCV. The task of recognizing hand gestures is one of the main and important issues in computer vision. With the latest advances in human interaction systems hand processing tasks such as hand detection and hand gesture recognition has evolved.Through this project we came to know about the importance of teamwork and the role of devotion towards work.

Motivation of the Project

Unlike common security measures such as passwords, security cards that can easily be lost, copied or stolen; these biometric features are unique to individuals and there is little possibility that these pictures can be replaced or altered.Among the biometric sector hand gesture recognition are gaining more and more attention because of their demand regarding security for law enforcement agency as well as in private sectors such as surveillance systems.Hand gestures are important to intelligent human and computer interaction to build fully automated systems that analyse information contained in images, fast and efficient hand gesture recognition algorithms are required.

Basic description of the Project

We've implemented our main software using OpenCV Library and Media pipe, Autopy, NumPy Modules in Python environment. No Performance Overhead at runtime. As a result, we got Real Time Tracking as fast as we need even though it's harder to implement.

Firstly, the user puts his hand in front of the camera and runs the application. Then through Image Acquisition the video stream is read frame by frame from the camera and each frame is analyzed. After this process, Image processing method and Hand Detection method is implemented and it records the gesture and is converted to grayscale. Thirdly, the computer the uses the binary image from image processing methodand finally using machine learning technique different events are performed.

1.2 Literature Review

Hand gesture recognition research is classified in three categories. First "Glove based Analysis" attaching sensor with gloves mechanical or optical to transduce flexion of fingers into electrical signals for hand posture determination and additional sensor for position of the hand. This sensor is usually an acoustic or a magnet that is attached to the glove. Look-up table software toolkit provided for some applications to recognize hand posture.

The second approach is "Vision based Analysis" in which human beings get information from their surroundings, and this is probably the most difficult approach to employ in a satisfactory way. Many different implementations have been tested so far. One is to deploy 3-D models for the human hand. Several cameras are attached to this model to determine parameters corresponding for matching images of the hand, palm orientation and joint angles to perform hand gesture classification.

The Third implementation is "Analysis of drawing gestures" using a stylus as an input device. These drawing analyses lead to recognition of written text. Mechanical sensing work has been used for hand gesture recognition at a vast level for direct and virtual environment manipulation. Mechanically sensing hand posture has many problems like electromagnetic noise, reliability and accuracy. By visual sensing gesture interaction can be made potentially practical but it is the most difficult problem for machines. Full American Sign Language recognition systems (words, phrases) incorporate data gloves. Data glove-based system could recognize 34 of the 46 Japanese gestures (user dependent) using a joint angle and hand orientation coding technique.

1.3 Languages Used

Python

Python is an interpreted, high-level, general-purpose programming language. Created by Guido van Rossum and first released in 1991.It supports multiple programming paradigms, including structured (particularly, procedural), object-oriented, and functional programming.

OpenCV

OpenCV (Open-Source Computer Vision Library) is a library of programming functions mainly aimed at real-time computer vision. Originally developed by Intel, it was later supported by Willow Garage then Itself (which was later acquired by Intel). The library is cross-platform and free for use under the open-source BSD license

AutoPY

AutoPy is a simple, cross-platform GUI automation library for Python. It includes functions for controlling the keyboard and mouse, finding colors and bitmaps on-screen, and displaying alerts. AutoPy includes a number of functions for controlling the mouse.

NumPY

Numpy is a general-purpose array-processing package. It provides a high-performance multidimensional array object, and tools for working with these arrays.

MediaPipe

MediaPipe is a framework for building multimodal (e.g., video, audio, any time series data), cross platform (i.e., Android, iOS, web, edge devices) applied ML pipelines. With MediaPipe, a perception pipeline can be built as a graph of modular components, including, for instance, inference models (e.g., TensorFlow, TFLite) and media processing functions.

1.4Project Work Description

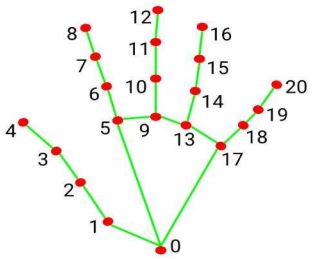
We've implemented our main software using OpenCV Library and Media pipe, Autopy, NumPy Modules in Python environment. No Performance Overhead at runtime. As a result, we got Real Time Tracking as fast as we need even though its harder to implement

The projects implementation is as follows: -

Firstly, the user puts his hand in front of the camera and runs the application.

1.4.1 Image Acquisition

Read the video stream frame by frame from the camera, continuously get each frame and analyze it.



0. WRIST
1. THUMB_CMC
2. THUMB_MCP
3. THUMB_IP
4. THUMB_TIP
5. INDEX_FINGER_MCP
6. INDEX_FINGER_PIP
7. INDEX_FINGER_DIP
8. INDEX_FINGER_TIP
9. MIDDLE_FINGER_MCP
10. MIDDLE_FINGER_PIP
11. MIDDLE_FINGER_DIP
12. MIDDLE_FINGER_TIP
13. RING_FINGER_MCP
14. RING_FINGER_PIP
15. RING_FINGER_DIP
16. RING_FINGER_TIP
17. PINKY_MCP
18. PINKY_PIP
19. PINKY_DIP
20. PINKY_TIP

1.4.2 Image processing and Hand detection

To read the gesture done by the user and convert the image to grayscale and smoothen the photo. Henceforth, threshold will be applied by the compiler and the hand will be enclosed by contours. Then the ROI (Region of Interest) the image that is captured using a web camera will be processed in a region called Region of Interest (ROI) where it acts as a region of wanted area while ignoring the outside region, called background.

1.4.1 Hand Gesture Recognition

Now the image is processed and hands are detected, ready to be recognized. The computer shall use the Binary Image resulted from image processing to recognize the gesture done by the user. Image Subtraction is used to compare gestures done by the user with the set of saved images (training set).

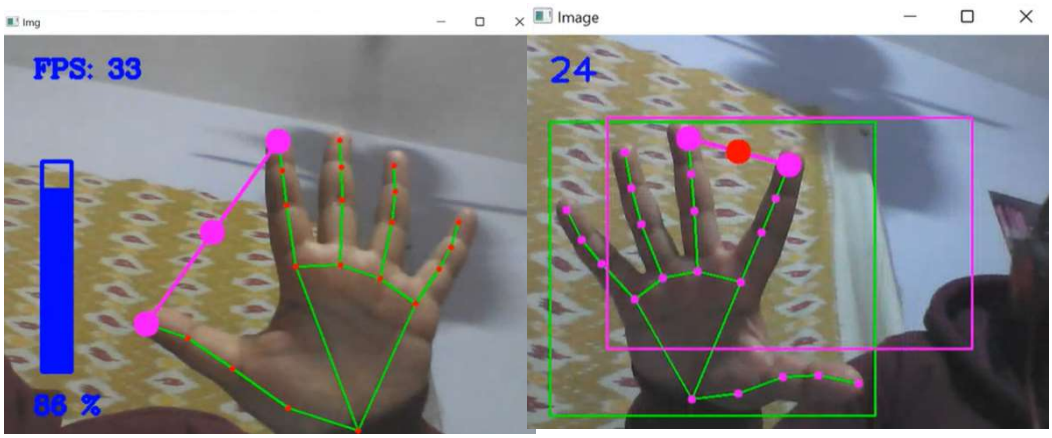
This way worked perfectly if the hand was oriented up straight without deviations. For deviated gestures, this approach failed.

In order for the program to continuously detect the hand at all times, especially when the hand is in static or not moving around, the program needs to learn the hand image. This is where machine learning comes in. In this project, the machine learning technique was performed to track the gesture of hand before the image processing is done.

1.4.1 Event Generation

i) The distance between the index finger and thumb will control the volume accordingly. If the distance is greater the volume shall increase or else decrease.

ii) The movement of the mouse was controlled by the index finger and when the index and middle finger are joined together then it will perform a double-click.



1.5 Testing

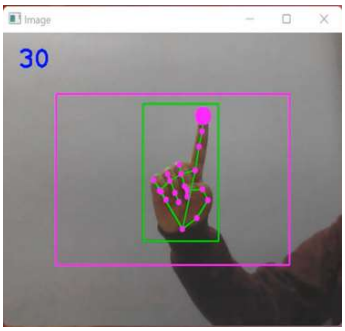
Test methodology

We propose a vision-based approach to accomplish the task of hand gesture detection. The task of hand gesture recognition with any machine learning technique suffers from the variability problem. To reduce the variability in hand recognition task we assume the following assumptions:

- Single colored camera mounted above a neutral-colored desk.
- Users will interact by gesturing in view of the camera.
- Training is must.
- Hand will not be rotated while the image is capturing.

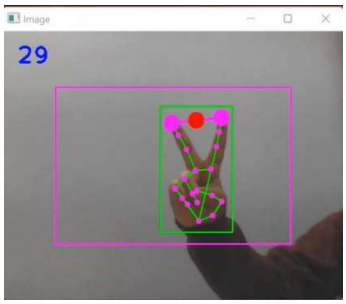
- Webcam Features-
  - Resolution: 640*680
  - Video frame rate: 30fps @ 640*480
  - Pixel Depth: Minimum 1.3 mega-pixels
  - Connection port: USB/Inbuilt

- Test Result



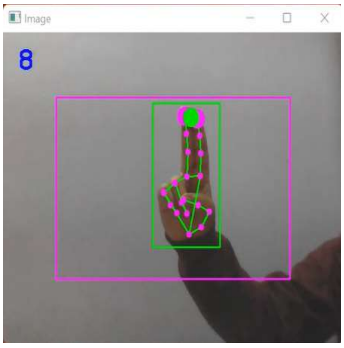
With Index Finger, we can hover the mouse

Mouse Hover



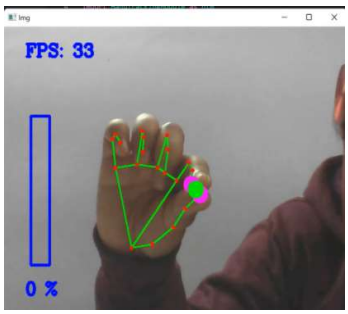
To deselect the mouse, spread the indexfinger and middle finger

Mouse Deselect



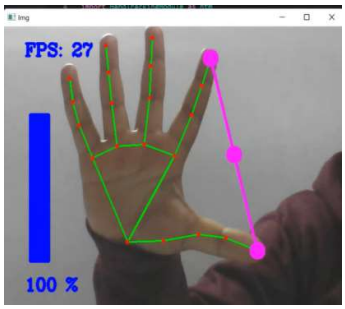
For double click, join the index finger and middle finger.

Mouse Select



The volume is minimum when the index finger and thumb are joined.

Min. Volume



The volume is maximum when the distance between the index finger and thumb is maximum.

Max. Volume

CONCLUSION:

In this work,we propose a methodology to establish a complete systemfor detecting, recognizing and interpreting hand gesture through computer vision technique. This technique is executedunder the framework of Python and OpenCV tool. Under this framework, this methodology is capable of recognizing the dynamic movements of hands up to ~30 frames per second. The training dataset contains several partial images of hands which makes this methodology more robust to recognize hand movement with minimal number of features of hands. However, this technique fails to detect hand gesture and finger positioning if the background surface has either same intensity or under low illumination condition. Despite this limitation, this computer vision technique successfully interprets sign languages using hands and fingers under dynamic conditions.

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   https://www.youtube.com/watch?v=OnhFe34iTJQ
   Al Face Body and Hand Pose Detection with Python and Mediapipe
   https://www.youtube.com/watch?v=pG4sUNDOZ.Fg
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