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Gesture Recognition Based Virtual Mouse and Keyboard

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Abstract - Nowadays computer vision has reached its pinnacle, where a computer can identify its owner using a simple program of image processing. In this stage of development, people are using this vision in many aspects of day to day life, like Face Recognition, Color detection, Automatic car, etc. In this project, computer vision is used in creating an Optical mouse and keyboard using hand gestures. The camera of the computer will read the image of different gestures performed by a person's hand and according to the movement of the gestures the Mouse or the cursor of the computer will move, even perform right and left clicks using different gestures. Similarly, the keyboard functions may be used with some different gestures, like using one finger gesture for alphabet select and four-figure gesture to swipe left and right. It will act as a virtual mouse and keyboard with no wire or external devices. The only hardware aspect of the project is a web-cam and the coding is done on python using Anaconda platform. Here the Convex hull defects are first generated and then using the defect calculations an algorithm is generated and mapping the mouse and keyboard functions with the defects. Mapping a couple of them with the mouse and keyboard, the computer will understand the gesture shown by the user and act accordingly.

Keywords: Convex Hull, Defects, Image Processing, Frame Extraction

1. Introduction

The Computer webcam is capturing the video of the person sitting in front of the computer, there will be a small green box which will be generated in the middle of the screen. In that green box, the objects shown will be processed by the code and matched with it if it matches then a red colored border will be generated, which means the computer has identified the object and then by moving the object the mouse cursor can be moved. This will not only help in the security of the computer but also help in generating a virtual computational experience. Here in the place of different objects, using hand gestures one gesture will be moving the cursor, the different gesture will be used for right click and different for left click, similarly with a simple gesture can do the keyboard functions virtually that may have been done on some keyboard as a physical aspect. It the gesture does not match the box will show an only green box when the known gesture is observed a red border will occur.

2. Literature Survey

Sixth Sense technology is a gesture based wearable interface that links the digital information around us with the physical world and it allows us to use our natural hand gestures to communicate or interact with the digital information. Several approaches have been presented on the concept of virtual mouse with different ideas. The approaches were done in which involved the concept of Image Processing and Image Acquisition. According to the study, the motto is to make a virtual mouse which is mainly useful for saving manual work. The future modification can use complex mouse workings using this simple image processing technique. By this concept real world is interacting and getting well with the digital world using the concept of this technology known to be as Sixth Sense.[6] Many works are done using Sixth sense technology some even uses IOT interaction with it as the use of RFID tags and image processing for potholes detection to overcome accidents that's a main problem in many parts of the world[6]. Another work that is done in the[7] similar domain is that train autonomous cars using block chain methods for faster and safer experience, the autonomous cars can use a review or ratting system which can help them to stack up which road is safe and shortest, this way a healthy route can be created for the autonomous industry be it cars or other autonomous vehicles[7] .[8] Image base one time password is also a factor nowadays to enhance the security of One Time Passwords it also includes machine learning algorithms for detection of image OTP's [8] .[9] Smart Image attendance based systems are also in use now a days which makes the attendance system more error free and less time consuming image processing tools and algorithm are used for student face detection[9] .[10] In the field of medical science the use of machine learning and Artificial Intelligence is growing at an extraordinary pace image processing are used to classify heart attack traits and diabetes traits even using skin images the type of infection or malignancy can be tested [10] . The many works that have been done on this Sixth Sense Technology also included use of mouse by colour recognition, that is working of the mouse with colour coordinated finger caps the image captures the colour and coordinates or maps the mouse with its position

with respect with the location of the finger caps. The only problem was that the right click and left click functions were very much difficult using this process.

3. Objective

The basic objective is to develop a virtual mouse and keyboard using the concepts of hand gesture recognition and image processing which will ultimately move the mouse pointer according to the hand gestures, similarly with the help of the gesture can use keyboard functions which will be defined as per the convenience of the user. Reducing the cost of hardware.

This approach will make tasks trickier and more easier like creating 3D models ,browsing the imaginary part in medical world during surgery and one best thing is that without touching anything it can work even in architectural designs and in automated building.

4. Proposed System

Mouse

The Mouse uses a convex hull process for its working, defects are captured or read, using this defects the functions of the mouse are mapped. The process of this image recognition process solely focuses on defects and conditional statements, the convex hull takes the gap of the fingers as defects, so it can be used for multiple gestures and mapping commands. The following steps are followed for the use for gesture recognition and its mouse functions **:**

- In the first step , the web cam will start and the video and what is present in front of the camera can be seen.
- In the next step the user has to keep their hand in the required border made on the screen.
- In this step the different hand gestures will be shown by the user, these gestures will be not any kind of a gesture but those which have been trained to the computer from the beginning.
- If the gesture matches then a green coloured border will be generated and by moving the hand the mouse cursor will also move.
- There are total four different kind of gesture, one is used to move the cursor, another one is used to do the right click , another one is used for left click , and another gesture for scrolling up and down.
- When no hand is placed in the bordered region a comment will show that there is no object placed.
- The similar gestures may not match sometime this is due to the reason that the user is not showing the gesture accurately or there are a few noise which are affecting the inputs.
- The gestures count the defect using Convex Hull method and relates with the object used for mapping.
- The gesture hence shows the defects which in turn help in left and right click options defect=5 then right click, defect=3 then left click.

Key Board

The process used for this keyboard function is a bit different than the Convex hull process, here the hand position system is used that is, the video that is capturing used the position of the hand is captured by the computer. In the open video window a miniature virtual keyboard is mapped. Using the hand position technique the keyboard functions can be selected which have been mapped and using this process the keyboard function executed, a math function is used to judge the position of the hand and turn it into a matrix location which makes the position recognisable for the computer. The following steps are followed for the use for gesture and its Keyboard functions **:**

- In the first step the web cam will open and the user can see the camera window.
- The alphabets and other keyboard essentials are seen in the red borders .
- With proper hand gesture the alphabets of the keyboard can be moved and do computer functions also.
- With a open palm the keyboard can be moved left to right to get all the alphabets and keyboard functions.
- By putting the finger over the designated key they can type the required alphabet or keyboard functions.
- The printed alphabets will be seen on the camera window as shown in (Fig 6) .

5. Flow Diagram

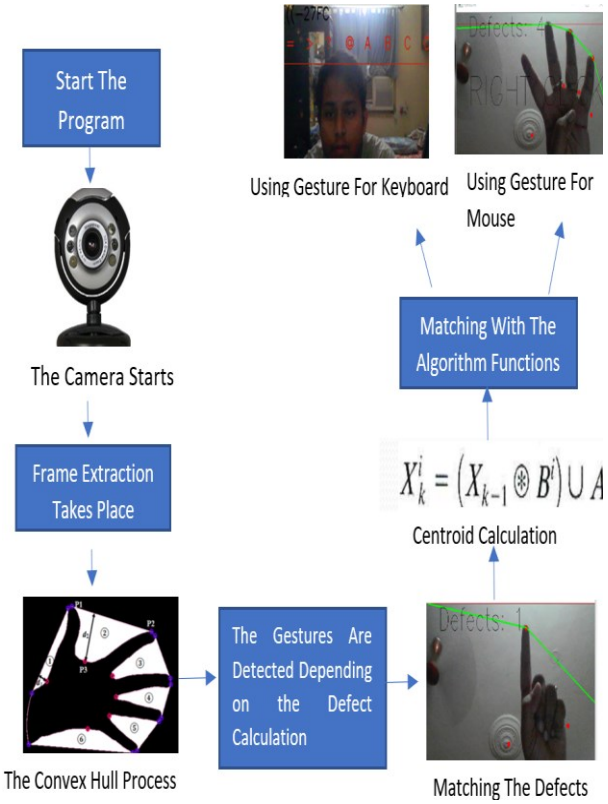

Fig.1.The Flow Diagram

The camera starts and starts detecting any object with its color close to skin color of human being. The video captured is then compared with the module and the code written, if the code says the shown object captured by the computer camera resembles human hand then it moves on to the next step that is Convex Hull detection. The process of Convex hull then decides whether the shown object is a hand or not, if so then it will count the number of defects. Similarly after the process ends the code is written in such a way that the number of errors detected is counted and a conditional statement is created. This conditional statement is mounted with the or it is better to say mapped with the mouse to derive a perfect mapping of the mouse functions with the defects counted the examples are shown in Fig 1, Fig 4 and Fig 5.

Similarly for the keyboard, but there is a slight difference in the approach of the keyboard in terms of the mouse. The keyboard uses precision and hand position interface, it detects the keyboard function in terms of the hand position and does the function that the hand position fixes upon. The scrolling function is done as the movement of the hand position from right to left. The hands position is detected only by the texture and color of the individuals hand and its quite accurate in terms of color and texture detection. The simplicity of this project is that it requires none hardware or external device to be connected the only device needed in this process is a web-cam. The software properties that are used for this project includes Python on Anaconda platform.

6.Defect Calculation(Convex Hull Detect)

The convex Hull is a process which is required for any computer application relating with human skin colour or as can be said as interaction with human hand. It calculates the contour or say it does the contour analysis for detecting the fingertips. It grasp the location of our fingertip based on the various geometric features of contour which are present ,such as fingertip edge detection. Method. This paper is based on fingertip detection based on convex hull approach.

The convex hull contour is the convex polygon surrounded by all the convex vertices in gesture contour, as shown in figure (a), the polygon composed by red curve is the convex hull of gesture, and (b) is the separated convex hull extracted from (a).

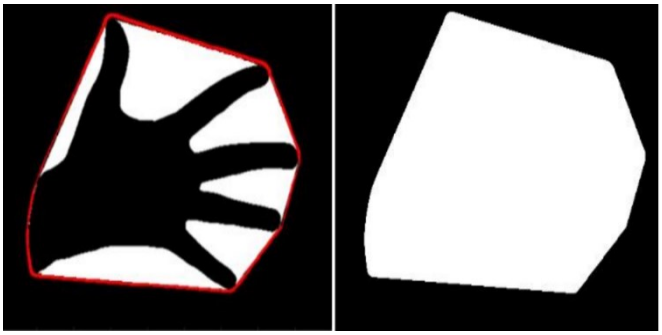

Fig.2(a).Polygon composed by red curve; (b) Extracted Convex Hull

6.1 Convex defect

Difference in between gesture convex hull and contour defined to be as convex defect. As shown in the figure 3, the white areas from 1 to 6 are all the defects. This Convex defects contains three main components first one is start contour point, second one is end contour point and the last one is concave contour point.

Formula For Convex Hull Defect :

$$\delta = \frac{contourArea}{hullArea}$$

Here The tightness of the convex hull can be depicted using the symbol (δ). Hull Area is the area of the hull and contour Area is the area of the contour and can get the value of δ and determine the gesture.

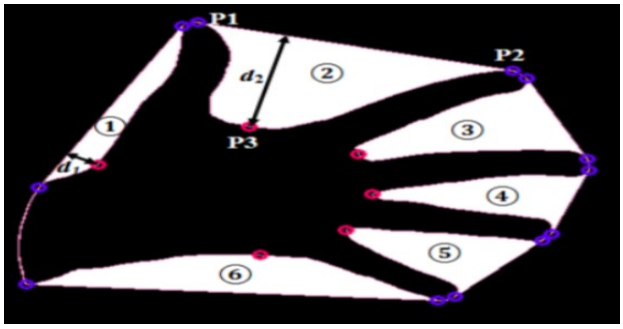

Fig.3.The Defect Count in Convex Hull

Now let's see an example to understand it better as you can see the figure for convex defect 2, P1 which is thumb is its start contour point from where the defect is started, P2 is its end contour point which is the point of termination of the defect or can say the defect terminated, and as you can see the point P3 is the concave point which is the furthest point away from the convex hull, and the depth of convex defect is find by that furthest point distance.

7.Results and Discussion

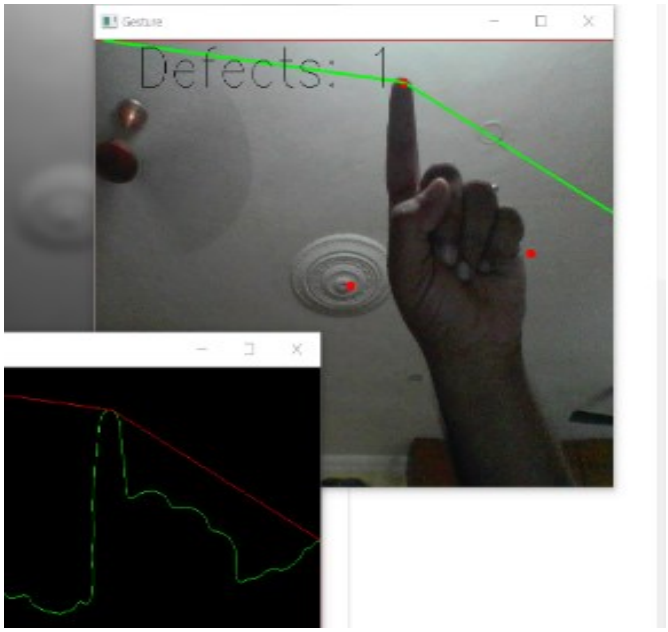

Fig.4. Counting Defects to Understand the Gestures

The above figure Fig4. depicts the use of convex hull process here the defect count is one, in the algorithm have conditioned that if the defect count comes to one then the position of the mouse has to change with respect with the location of the defect or location on the finger, as can see the red dot in the index finger it maps the location with the required cursor.

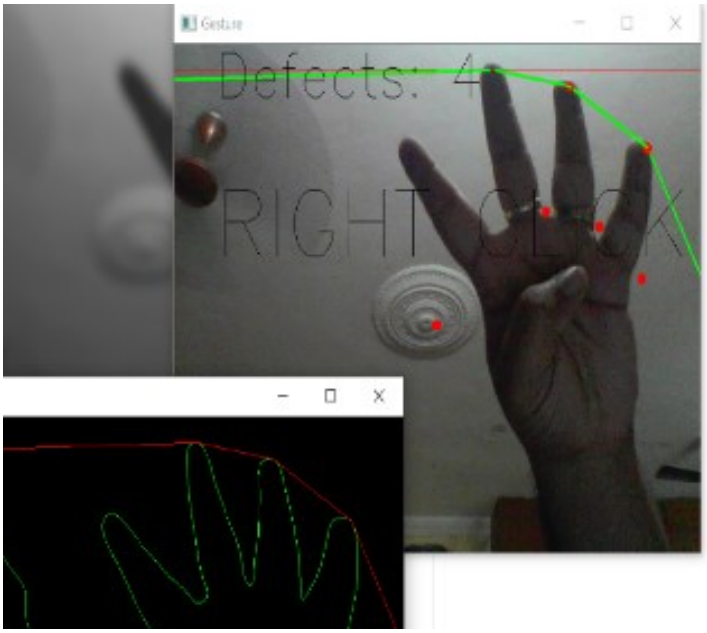

Fig.5. Doing the Right click function using five Defect object detection

The above figure Fig5. convex hull process being used, as the previous figure the defect count is 4, in the algorithm have conditioned that if the defect is four then right click will occur as per the mouse functions. Similarly if the defect count is 5 the left click function will take place.

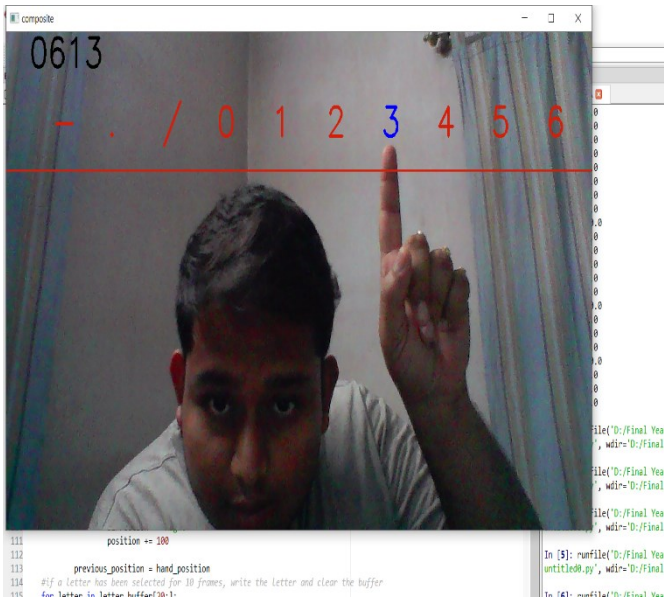

Fig.6.Using the Keyboard with the one figure gesture and printing onscreen

The above figure Fig6. using the hand position system that is, the video that is capturing used the position of the hand is captured by the computer. In the open video window a miniature virtual keyboard have been mapped. The miniature keyboard is red in colour and is easily accessible. By putting the figure parallelly with the digits or alphabets the keyboard functions will take place.

Sudden Movements:

During any sudden movement of the hand or object in front of the camera the program will not consider it as a detectable object as a 1 second delay is given in terms of the program to decide that if it is a detectable object or not. So sudden movement won't be considered as an input. In terms of printing an alphabet twice use gesture for once then give an 1 second delay and then show the similar gesture again, this will not confuse the program that it's a similar input and would prohibit the program in taking it as a garbage value. .

Conclusion

This paper is proposing a system to recognize the hand gesture and replace the mouse and keyboard function. That includes the movement of the mouse cursor, the drag and click with the keyboard features like printing alphabets and other keyboard functions. The process of skin segmentation is utilized to separate the colour/image of hand with its background. Remove arm method, which effectively solves the situation of taking into the whole body into the camera. In general, the proposed algorithm can detect and recognize hand gesture so that it can operate mouse and keyboard features and also create a real world user interface. 3d printing, Architectural drawings and even doing medical operations from anywhere to everywhere. This project can be easily applied and its application can be very vast in medical science where computation is required but couldn't fully be implemented due to lack of human computer interaction.

Limitations

- Present application seems more feasible and user friendly.
- The Convex Hull algorithm can cause problem if another external noise or defect is detected in the working domain of webcam.
- An attempt to make input mode less constraints dependent for the users hand gestures has been preferred.
- Limited number of defects are there in a person's hand with five finger so limited gestures can be adopted.
- The keyboard has limited user functions.
- The click functions could have been more prominent.

Future Enhancements

The system works well for the simple pointing and pinching gestures, there is still room for many improvement. Currently the system uses a static background, but it would be very desirable and important to use this hand tracking system in a world of augmented reality setting it in a way where a user, wearing a head-mount display, could interact with virtual 3D objects in the real-world. For this scenario, more than one layer of capturing ability is needed, that is need multi-dimensional camera angel capturing the hand gestures. There will be requiring of 3-axis that is cameras on 3-axis, X axis, Y axis, Z axis. On the basis of the camera recordings the 3-D image will be captured or recorded and the defects count will get more accurate and it will be easier for the computer to read the image and defecate the defects.

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