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A Real Time Virtual Mouse Conformation by Hand Gesture Tracking using Open CV for HCI

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ABSTRACT

As the Technology grown up day by day, the communication between human and machine turned spectacular and touch-less. There are various methods through which a human-computer interface can built such as – mouse interaction, touch-screen and gesture control. But now a virtual mouse pointer using hand tracking may influence the way of interfacing machines. Trending machines only follows certain distinct gestures to address the command for operating machines or computer. The proposed system is able to recognize hand-made mouse gesture and track it as per hand movements. Computer System or device detects hand at real time and works with complex background where a conventional way does not work. Virtual mouse using hand gesture tracking works exactly as traditional mouse which allows clicks, movements, drag and drop. System uses OpenCV (Open Source Computer Vision) library for real time interaction and python IDE (Integrated Development Environment) as platform. There are various packages available through which an intelligent computer vision can be implemented that help in the field of robotics. The HCI (Human Computer Interface) can be developed using color classification, gesture recognition & tracking as well as contour threshold.

Keywords: HCI, OpenCV, Virtual Mouse, Hand Tracking, IDLE, Python, Hand Gesture Recognition, Artificial Intelligence.

1. INTRODUCTION

Computer expertise has grown significantly in the last decades and has become an essential part of everyday life. The primary computer companion mouse for human computer interaction (HCI) is the mouse. The mouse is not suitable for HCI in some real life situations, such as Human Robot Interaction (HRI). There has been numerous researches on alternate methods of computer mouse for HCI. The most natural and perceptual technique for HCI, which is a viable substitute for computer mouse, is with the use of hand gestures. Therefore, the purpose of this system is to test and develop computer control (CC) system using hand gestures.

Fig. 1.1 Hang Gesture Key Points [1]

Fig.1.1 shows virtual mouse conformation using finger gesture tracking. It can be achieved through OpenCV (Open Source Computer Vision), it is a library of programming functions mainly aimed at real-time computer vision.

Gesture recognition is an issue in computer science with the target of interpreting human gestures through mathematical algorithms. Gestures can start with any physical motion or state, but usually get out of hand. Users can interact with devices without controlling them or using physical gestures without touching them physically. To understand the language of the human body, the gesture for the computer can be seen as recognition. It is possible to point fingers to the computer screen, so that the cursor will run accordingly. It can make an estimated input device like mouse, keyboard and even touch-screen redundant.

2. RELATED WORKS

Zhi-hua Chen et al. [3] proposed a system which is based on OpenCV library by segmenting palm and fingers to recognize gesture. The structure employed by the system uses background subtraction technique to take out the region of hands only. Segmentation of palm and finger separately took place through which gesture can be recognized through finger by wrist pointing and palm masking. To identify the tags of hand gesture, rule classifier was used. But this system also requires plain background for segmentation and recognition; it does not work correctly in non-plain background as the performance of the system which has been proposed typically relied on the outcomes of hand identification. Fig. 2.1 shows hand recognition which can direct mouse pointer virtually.

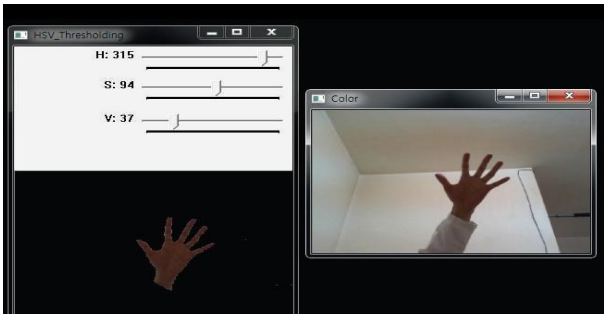

Fig.2.1 Hand Detection [3]

Atharv Ajit et al. [4] proposed a system that is based on Microsoft Kinetic Sensor, which is a physical sensor through which the gesture of the hand separates and later matches the directory to identify the input structure. Microsoft is using infrared for dynamic sensor input data. To determine the position of the palm, the system calculates centrifide point in the palm. The system is slightly expensive due to the sensor and uses hand geometry to identify the gesture, which can have a higher error rate with less accuracy. The method, in which the system has been estimated, provides an application that can be used to monitor and offer surveillance related to old people and human-computer communication. Information obtained from Kinetic sensors used to detect the viability of gesture recognition the method uses the palm of the curve and lines and understands the form made by hands using the Dynamic Time Wiring (DTW) method. With the technique of geometric attributes on the palms, the curves and lines of the palm are extracted. Marco et al. [5] proposed a system which has been proposed which is based on MYO armband which can analyze or detect muscle activity and on the basis of which gesture has been recognized. The MYO armband is expensive and can detect some gestures only. When applying a particular gesture, muscles are stirred or muscles are stretched and MYO armband can recognize that gesture and act accordingly. What is proposed in the system, it calculates the surface electromyography i.e. data received by EMG on the front-side muscles using the MO armband. Pei Xu et al. [7] has introduced a system in the paper, which is also based on the conformable neural network, but with the pen filter, which is capable of estimating the position of the hand. Here, the system is controlling the mouse events in the variety of a virtual mouse using the hand gesture. This system separates the palm and finger to identify a finger-based identity. There are three different factors on which the overall functionality of the system developed depends, i.e. hand detection, the identification of gesture and the interaction between human and computer. Ashani Haria et al. [9] introduced a system that depends on contour extraction to create virtual icons through which special applications can be controlled. The purpose of this system is to develop a strong hand gesture detection technique, in which the ability to recognize the gesture created by hand is whether it can be stable or dynamic. The system is trained to act on the basis of various gestures.

Fig.2.2 Static Gestures Used In Gesture Recognition System [9]

Peijun Bao et al. [6] developed a system which is based on convolutional neural network where hand segmentation is not prefered, instead of that a network has been trained which is able to recognize hand gesture. Method which has been proposed in the paper exploits the convolutional neural networks to straightly categorize the gestures made by hands in the extracted image. System didn't use any typical sets of process for recognition like process of segmentation,

preprocessing which have the feature to dispose any unrelated area which does not contain any portion of hand. Since the intended system which contains the network of recognition process, categorized seven different forms of gestures made by hands which is not dependent not the user. System didn't induce any framework selection of the extracted image to recognize the formed gestures. Method which has been proposed exploited deep CNN process for the recognition purpose. It has been stated in the paper, that the proposed system can recognize the gesture in any background. But it can be observed in the image mentioned below, that frames formed by the proposed system and the actual hands are at different places.

3. PROBLEM STATEMENTS

Most current systems are based on MYO Armbands in which the system is trained according to the muscle activity of any kind of gesture manually. Since muscle activity is different in every gesture, the system limits the form of gestures made by hands for identification. Because the system needs to be trained about muscle activity to analyze the formed gesture, it will restrict their investigation. The technology used also increases the outlay of the system. Some systems are based on the conversion neural network, where hand gesture detection is very accurate, but to maintain accuracy, it is necessary to make the background used as plain, because the system requires non-plain background and gestures The middle becomes confused. In those systems, it becomes problematic to correctly indicate positions and gestures in a complex background. Some systems are based on contour extraction where the same problem suffers from background complexity. It is necessary to develop a system that can work in a complex background with high level accuracy, through which communication with the computer will be easy and effective [1-9] There are lots of disadvantages of the previously proposed system - uneven mouse cursor movements, mouse pointer flickering, limited ROI, random clicks and operations and many more.

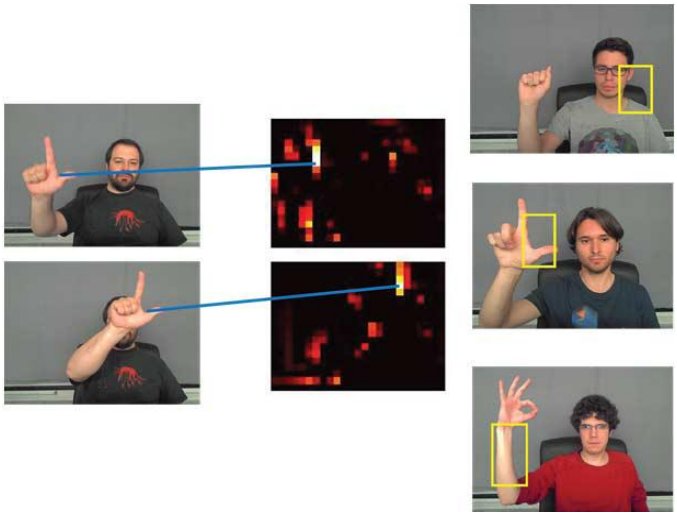

Fig.3.1 Gesture Tracking Control over Plain Background [6]

Fig.3.1 shows the simple gesture recognition mouse conformation that can work well with non-plain backgrounds with limited and inaccurate operations.

4. PROPOSED WORK

Here the system has been proposed which is able to validate a virtual mouse having clicking and dragging abilities. System uses chroma feature for finger gesture recognition i.e. green piece of paper that possesses negligible cost. System can track green pieces of papers which have been traced on fingers that control mouse cursor and operations.

Fig. 4.1 Proposed Virtual Mouse Movements

Proposed system is able to work in non-plain background because of limiting detection with green color only like chroma key. Low light does not affect the performance of the system.

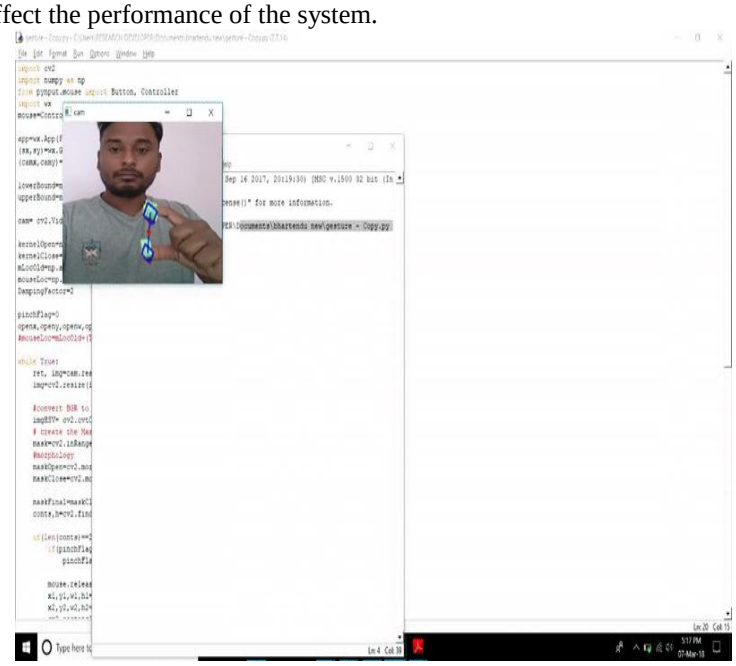

Fig. 4.2 Proposed Virtual Mouse Text Selection

Let it be more precise with flow chart, where system recognizes two contours for chroma key. System does not work with one contour, it can be consider as no virtual mouse detected. If system detects two chroma key contours then the length of the contours will be calculated and if length of the contours is equal to 2 that means virtual mouse recognize with movements as per tracking position. But if length of the contours is not equal to 2 then it will further validate the length of the contours and if it is equal to 1 it means that it is a click otherwise keep calculating or comparing the length for real time actions. Virtual mouse conforms with 2 chroma keys that pertains various operations such as clicks, movements and selections.

5. PROPOSED METHODOLOGY

Here the system uses morphological operations for eliminating noises and enhances the performance of contour extraction. Morphological operations are the set of actions performed on the images to process it based on their shapes. These operations are intended to eliminate noise and maintain the perfection of the image. There are two types of operations i.e. erosion and dilation.

5.1 Dilation – This process helps to enhance the size of the brighten region which will increase the size of the image dilation operation can be used by the syntax- dilate() method of the imgproc class.

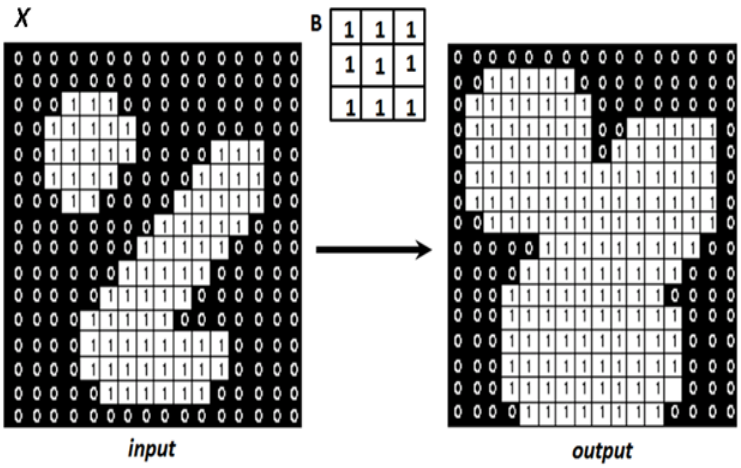

Fig. 5.1 Dilation [10]

5.2 Erosion–The procedure of erosion is alike dilation. The process includes the enhancement of the area consists of dark region in size and decreases the area of brighter regions. Erosion operation on an image can be performed by using erode() method of the imgproc class. It uses to remove small holes (dark regions).

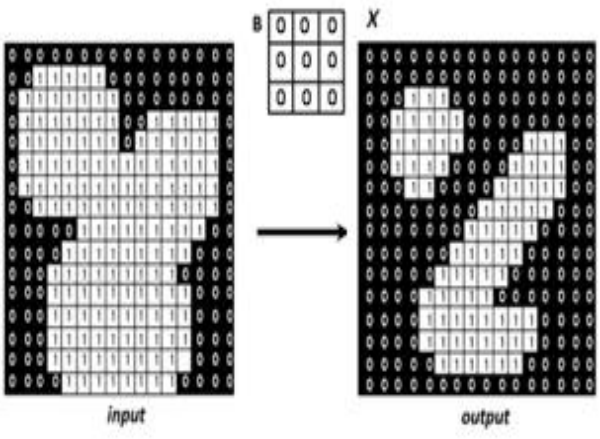

Fig. 5.2 Erosion [11]

Let it be more precise with an algorithm.

5.3 CC (Chroma Contouring) Algorithm -

Initialize: Upper Object O_A, Lower Object O_B, Upper Contour Object – O_1, Lower Contour Object – O_2, Distance between O_1 & O_2 – L_n, Flag = 0 for mouse release, Flag = 1 for mouse click, Mouse lock position – M_c.

1: **while** (O_1 & O_2) get recognized **do**
Calculate the length of O_1 & O_2
$L_n \leftarrow$ Length
end while

2: **if** (O_A & O_B) contains small spaces **then**
Transformation ← open (src, element) ← dilate (erode (src, elements));
elseif (O_A & O_B) contains small holes **then**
Transformation ←close (src, element) ← erode (dilate (src, elements));
else (No Transformation Required);
end else
end elseif
end if

3: **if** (L_n == 2) **then**
Move mouse without click;
Flag =0;
elseif (L_n ==1) **then**
Press Mouse Click;
Flag = 1;
M_c = Current Position;
end elseif
end if

4: End

5.4 System Requirements-

5.4.1 Software Interface –

- Operating System – Windows 7 or above
- Python 2.7.14 or above
- Python IDE
- Supporting webcam driver

5.4.2 Python Packages-

- Numpy – Numerical Python
- WX - Windows Cross Platform
- Python (IDE)
- Pynput – Python Input
- OpenCV 2.4.9

5.4.3 Hardware Interface –

- Hard disk minimum of 20 GB
- RAM minimum of 2 GB
- Integrated webcam or external webcam

6. RESULT ANALYSIS

Table No. 6.1 Result Analysis I

User	Total no. of Attempts	Movement (Successful Attempt)	Click (Successful Attempt)	Drag (Successful Attempt)
U_1	10	10	9	10
U_2	10	10	10	10
U_3	10	9	10	9
U_4	10	10	9	10
U_5	10	10	10	10
U_6	10	10	10	10
U_7	10	10	10	9
U_8	10	10	10	10
U_9	10	9	10	10
U_{10}	10	10	8	10
U_{11}	10	10	10	9
U_{12}	10	10	10	8
U_{13}	10	10	10	10
U_{14}	10	9	9	9
U_{15}	10	10	10	10
U_{16}	10	10	10	10
U_{17}	10	10	9	10
U_{18}	10	10	10	9
U_{19}	10	10	10	10
U_{20}	10	9	10	10
Total	200	196	194	193

Table No. 6.2 Result Analysis II

Proposed	Trails	Success Counts	Accuracy %
Click using	200	194	97
Drag using	200	193	96.5
Mouse Movement	200	196	98

There are total number of 20 users performed the operation 10 times and examined for the movement of cursor, mouse clicks and dragging file from one location to another. So, the accuracy for mouse movement is 98%, for clicks it is 97% and 96.5% for drag & drop.

Table No. 6.3 Comparison on the basis of background complexity

	Accuracy in %
Accuracy with plain background in previous work [9]	92.28
Accuracy with non-plain background in previous work [9]	64.85
Accuracy with non-plain background in proposed work	97.16

7. CONCLUSION & FUTURE SCOPE

The virtual mouse conformation controls using chroma key tracking is effective for non-plain backgrounds with high level of precision. Proposed system provides smooth cursor movements, perfect clicks and proper drag and drop items. System enhances the image processing approach by using morphological technique, numerical python, OpenCV libraries, etc. The current proposed concept of virtual mouse using hand gesture recognition and tracking can be improved in future by implementing fully virtual control system with high level of accuracy along with plain and non-plain backgrounds. The modern systems rise towards virtual reality with high level of accuracy.

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