Event Triggering Using Hand Gesture Using Open CV

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Abstract: *Gesture recognition and pattern recognition are advancing at an exponential rate in the passing years. Hand gesture recognition has been a fascinating research area. Hand gesture recognition system provides us a novel, natural, innovative user friendly way of communication with the computers. Gesture recognition has varied area of application including human computer interaction, sign language, game playing etc. Hand gesture recognition have enormous in human computer interaction and robotic machineries. Today interfaces between human and computer are mouse and keyboard are but in near future hand and eye gestures would replace it. Through this application we can identify the number of fingers of our hand. We can trigger on event using predefined gesture scenarios. Hand gesture recognition also provides a low cost interfaces device for interacting with objects in virtual environment using hand gestures.*
Keywords: Event triggering, Hand Gesture Recognition, OpenCV, HCI(Human Computer Intraction).

1. Introduction

Hand gesture recognition is identifying expressions which are meaningful of the hand or hand in motion. Hand gestures are used in our daily life as a nonverbal method of communication. Gestures are actions that contain some meaningful messages. There are number of systems used in input system for computer interaction such as mouse, keyboard. But in early years there were number of techniques for gesture recognition on tracking such as instrumental glows and optical markers etc. But the most efficient way is to identify hand gestures via webcam. This paper introduces hand gestures recognition system which uses hand gestures for computer interaction. We are using OpenCV image processing and C++ for pre-processing, hand detection, hand tracking and event triggering. In feature extraction we will use Euclidean distances for counting fingers at the centroid of the image. We are considering a single hand gestures. The algorithm proposed is first Choose search window size and location and then Track the hand and extract hand based on colour of the hand (colour based hand segment) after that Gesture recognition classification of gestures with max probability. The main parts of system are hand detection, finger detection, finger count and event triggering. Hand detection is the inception that involves hand segmentation. It is a colour based hand gestures recognition so, different hand gesture colour are first taken and then threshold is set manually. Finger identification involves identification of two types of points identified as convex points are defect points. Convex null points are used to detect the fingers. Finger count is performed with the convex hull points. When we are using our full hand there are convexity defects so we need defect points to find center of hand and detect the index finger. Events triggering involves triggering an event when predefined number of fingers are detected.

2. Related Work

In recent years many researchers have made noteworthy contributions on hand gestures for human computer interaction using OpenCV and Matlab. There are some comparisons made among the several papers on hand gesture recognition. In paper [1], the image of hand gestures is taken as input. This image is in rgb format which is converted into binary image by image transformations via ycbcr image. Edge detection is used to segment hand from the image and identify hand orientation. Features like peaks are identified using peak detection then uses Euclidean distance for figure and thumb detection. That is first bit represents whether the thumb is present or not. If it is present, the bit is given as 1 else 0. Remaining four bits represents the four fingers. The success rate is 92% with computation time 2.76 seconds. The algorithm is implemented in MATLAB. In paper [2], K-means clustering algorithm is used for partition the input image for segmentation. The bounding box is used to find the orientation. Features like centroid, Euclidean distance are measured for detection. Hand is represented by making use of seven bits. First bit represents the orientation of the hand. Second bit is for presence of thumb in the figure. And next three bits are for presenting number of fingers raised. Last two bits for differentiating in the gestures which have equal number of fingers. This algorithm has success rate of 94% with computation time 0.60 seconds. The algorithm is implemented in MATLAB.

In paper [3], K-means clustering algorithm for segmentation of the image. They make use of bounding box to find the orientation. Features like centroid, Euclidean distance are measured for detection. Hand is represented by making use of five bits. First bit represents the presence of thumb in the hand gesture. Remaining four bits represents the four fingers. This algorithm has recognition rate of

94%. The algorithm is implemented in MATLAB.

In paper [4], this paper gives an algorithm for non-uniform background or 3D complex space. Here author will make use of HMM based method to recognize the hand gestures with non-uniform background. The input images are taken by a camera. Skin color is used for segmentation. The gestures are separated by making use of spotting algorithm. They use data aligning algorithm to align features with success rate of 100%.

In paper [5], the author presents number of methods for segmenting an image and thresholding with and without background. Author presented tutorial on openCV.

3. Implemented Algorithm

3.1 Hand segmentation

Hand segmentation is used to extract hand from image. There are several different methods for hand segmentation. The main steps in segmentation are thresholds and transfomals. To obtain meaningful information from the image and obtain area of interest to extract the features proper hand segmentation is vital.
If hand is found

IF $F(x,y) > T$ then $f(x,y)=0$

Else $f(xy)= 255$

Where T=20, 50 or 70

INPUT IMAGE

Pre-processing and Segmentation

Feature Extraction

Finger count

Triggering an event

3.2 Hand Detection

In our system, we have input image from webcam which is fetching at the speed of 20 frames per second. The distance between hand and camera should be in the range of 30 to 100 cm. The video input is stored frame by frame into a matrix after preprocessing. For faster processing we use skin color to detect the variants and hand area. Hand gestures are meaningful continuous hand action. The image sequences captured by webcam contains garbage gestures which need to be removed by counter tracing algorithm.

a) **Counters**

Counters are continuous parts of hand along the boundary with same color and intensity. It is found after threshold.

b) **Convex Hull**

It is a set of continuous points in the Euclidian space that endorses the counters.

c) **Convexity defects**

When the convex hull is drawn around the contour of the hand, it fits set of contour points of the hand within the hull. It uses minimum points to form the hull to include all contour points inside or on the hull and maintain the property of convexity. This causes the formation of defects in the convex hull with respect to the contour drawn on hand.

3.3 Feature Extraction

a) Centroid

On basis of image intensities we divide image into two parts one with hand and other with non-hand region part. The centroid divides this two halves at its geometric center. Centroid is the center of mass of an object which is calculated using image movement. Image moment, which is the weighted average of pixel's intensities of the image.

b) Thumb detection

Thumb is important in hand detection and a finger counting. The presence of thumb defines a set of gestures while absence defines other set. The thumb is on the corner of the box so we can identify which hand is there right or left hand using thumb detection.

c) Euclidean distance

Calculate the distance between all tip of the fingers and centroid using euclidean distance formula that is mentioned below

$$(a, b) = \{(x_a - x_b)^2 + (y_a - y_b)^2 \}^{1/2}$$

Where a and b are the are figure tips. This distance is used to

remove redundant fingers. If there are two fingers at a closer distance they shouldn't be considered in figure count.

3.4 Finger Count

In this method, the number of fingers present in the hand gesture is determined by making use of defect points present in the hand gesture.

3.5 Triggering an event

It triggers an event when the predefined gestures are detected in the application. We can also open and close multiple application through this predefined gestures. We can open chorme via gesture 3, notepad via gesture of four.
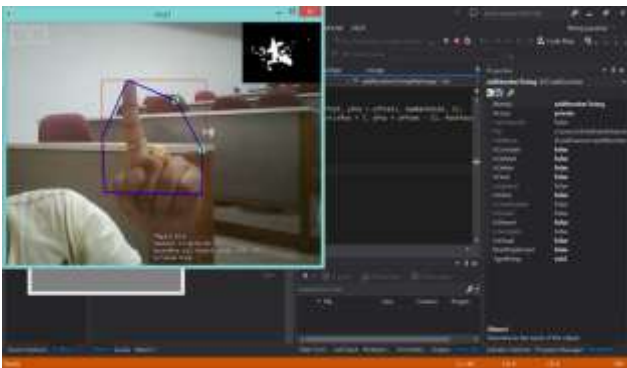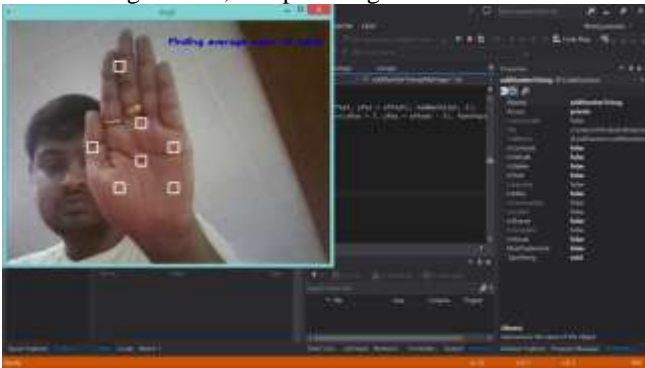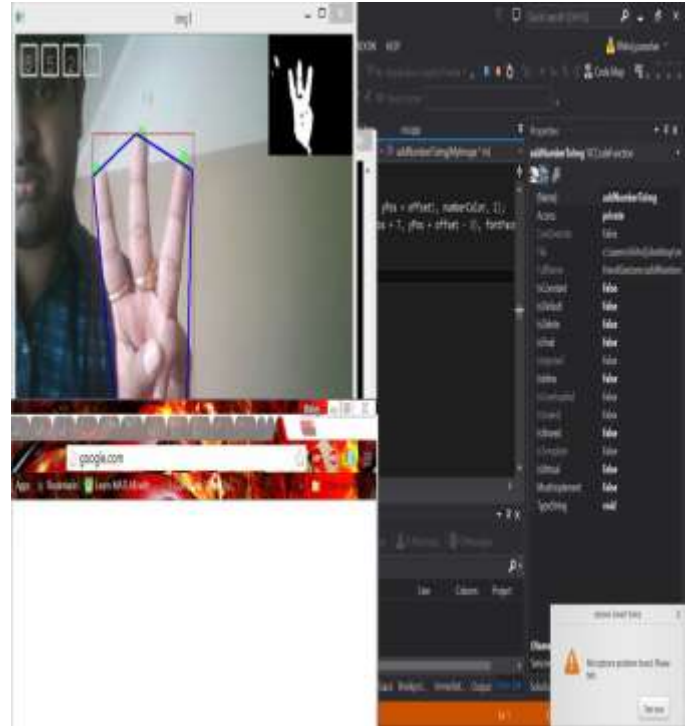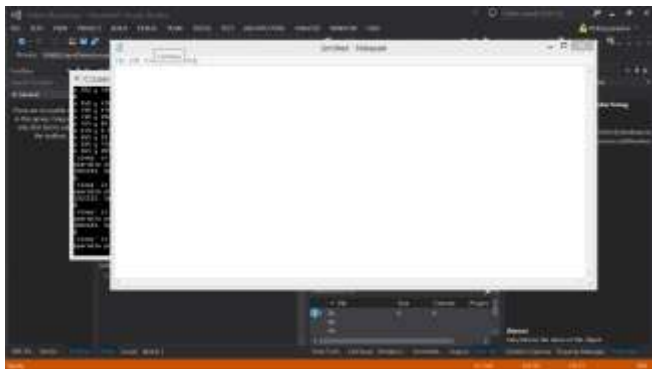
On pressing 3 we open google chrome.

4. TECHNOLOGIES USED

a) OPEN CV:

Open CV (open source computer version library) is a library which explicitly focuses on computer version and real time CV. It is available free for everyone. It is compatible with C++, python, java and supports windows, Linux, mac OS and android. Open CV was designed for relative applications. It has above 2000 optimized algorithms and comprehensive set of art CV and ML algorithms.

5. CONCLUSION

The system is built to recognize gestures and trigger event based on it. We can also identify the number of fingers in our hand. This can be used to control a robot or to interact with computer replacing mouse and keyboard. This can also be used to set a numeric password for a lock in computer. The result show a significant high accuracy. Currently the system is in two dimensions we also plan to implement in three dimension making depth as the third parameter.

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Taro Denshi received the B.S. and M.S. degrees in Electrical Engineering from Shibaura Institute of Technology in 1997 and 1999, respectively. During 1997-1999, he stayed in Communications Research Laboratory (CRL), Ministry of Posts and Telecommunications of Japan to study digital beam forming antennas, mobile satellite communication systems, and wireless access network using stratospheric platforms. He now with DDI Tokyo Pocket Telephone, Inc.