International Journal of Recent Development in Engineering and Technology
Website: www.ijrdet.com (ISSN 2347 - 6435 (Online) Volume 2, Issue 5, May 2014)

Implentation of Hand Gesture Recognition Technique for HCI Using Open CV

Nayana P B[1], Sanjeev Kubakaddi[2]

[1]*PG Scholar, Electronics & communication department, Reva ITM, Bangalore-64,*
[2]*CEO, ITIE Knowledge Solutions, Bangalore-10*

***Abstract*— The computer industry is getting advanced. In a short span of years the industry is growing high with advanced techniques. This paper introduces a technique for human computer interaction using open source like python and openCV. The proposed algorithm consists of pre processing, segmentation and feature extraction. Here we calculate features like moments of the image, centroid of the image and Euclidean distance. The hand gesture images are taken by a camera. That is used as the input to the algorithm. The proposed algorithm is able to recognize the number of fingers present in the hand gesture.**

***Keywords*— Computer vision, openCV, python, hand gesture, human computer interaction(HCI), Euclidean distance, contour, convex hull, convexity defects**

I. INTRODUCTION

Hand gestures are routinely used in daily life and they are natural, innovative for non verbal communication. Gestures are the actions that convey the meaningful messages. It is more convenient and comfortable way of communication.

Number of systems provides techniques for human computer interaction, most commonly used input systems are mouse, keyboard etc. From past three decades we are using the same techniques from communicating with the computer system. In early years, there were numerous techniques used for gesture recognition and tracking. For example, instrumented gloves, optical markers etc. These techniques have there own advantages and drawbacks. The instrumented gloves contain number of sensors in it, which gives the information about hand location, orientation and finger tips. They have high accuracy. But, they are too expensive and they need wired connection. Optical markers works with infrared light, which is the complex process. These systems require complex configuration.This paper introduces a hand gesture recognition system which uses only hand gestures to communicate with the computer system. This algorithm divided into three parts: pre processing, segmentation and feature extraction.

In feature extraction, we will find moments of the gesture image, centroid of the image and Euclidean distance to find finger count. We make use of contours, convex hull and convexity defects to find the hand gesture.[1][5]

II. RELATED WORK

Over the last few years, number of researches is conducted on hand gesture recognition for human computer interaction using MATLAB and openCV. Several performance comparisons are conducted to improve the technique. Here is the survey on few papers.

In paper [1], the hand gestures are taken by a camera. Image transformations are carried out on the rgb image to convert into ycbcr image. The ycbcr image transformed into binary image. This algorithm needs uniform and plane background. Edge detection algorithm is used to find the edges in the image. By making use of edge detection the orientation of hand is detected. The features like centroid, peaks detection, Euclidean distance and thumb detection are found. In this paper, they have considered five bits to represent the hand image. 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], here the author make use of K-means clustering algorithm to partition the input image for segmentation. They make use of bounding box to find the orientation. Features like centroid, Euclidean distance are measured for detection. Here the 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.

International Journal of Recent Development in Engineering and Technology
Website: www.ijrdet.com (ISSN 2347 - 6435 (Online) Volume 2, Issue 5, May 2014)

In paper [3], the author will make use of 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. Here the 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 splitted 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 with out background. Author presented tutorial on openCV for hand detection.

III. Technologies Used

A. Open CV

OpenCV (Open Source Computer Vision Library) is a library which mainly focuses at real-time computer vision. It is free for both academic and commercial use. It has C++, C, Python and Java interfaces and supports Windows, Linux, Mac OS, iOS and Android. OpenCV was designed for computational efficiency and with a strong focus on real-time applications. The library has more than 2500 optimized algorithms, which includes a comprehensive set of both classic and state-of-the-art computer vision and machine learning algorithms. It provides basic data structures for image processing with efficient optimizations.[5]

B. Python

Python is an easy to learn, powerful programming language. It has efficient high-level data structures and a simple but effective approach to object-oriented programming. The Python interpreter is easily extended with new functions and data types implemented in C or C++ (or other languages callable from C). Python is also suitable as an extension language for customizable applications.

IV. Implementation

C. Hand segmentation

In this algorithm, hand segmentation is used to extract the hand image from the background. There are several methods for segmentation. The important step in segmentation is transformation and thresholding. Segmentation partitions an image into distinct regions containing each pixel with similar attributes. To be meaningful and useful for image analysis and interpretation, the regions should strongly relate to depicted objects or features of interest.

In this algorithm, the BGR image taken by a camera is considered as input to the algorithm. The BGR image is transformed into gray scale image. The gray scale image is blurred to get the exact boundary. The blurred image is threshold to the particular value.

$$\text{If } \begin{cases} f(x,y) > T & \text{then } f(x,y) = 0 \\ \text{Else} & f(x,y) = 255 \end{cases}$$

Where, T= 20 , 50 or 70 (Threshold value)

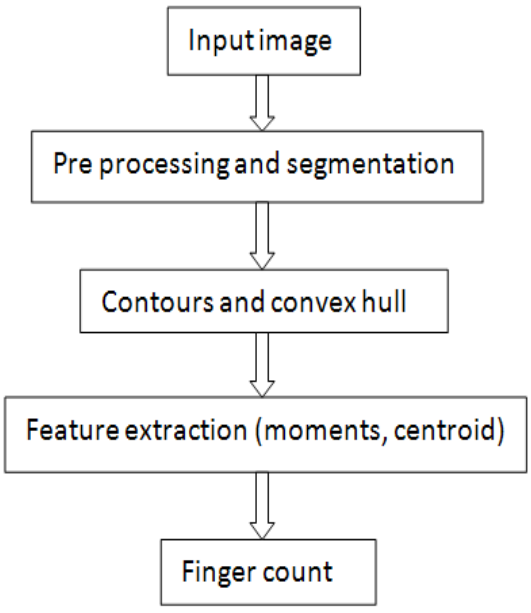


Figure 1 : The flow chart of the implemented algorithm

International Journal of Recent Development in Engineering and Technology
Website: www.ijrdet.com (ISSN 2347 - 6435 (Online) Volume 2, Issue 5, May 2014)

Figure 2: input image and gray image

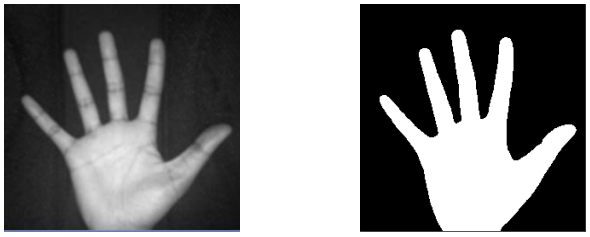


Figure 3: blurred image and threshold image

D. HAND DETECTION

CONTOURS

Contours are the curves joining all the continuous points along the boundary, having same color or intensity. The contours are a useful tool for shape analysis and object detection and recognition. The contour is drawn along the boundary of the hand image which is found after thresholding.

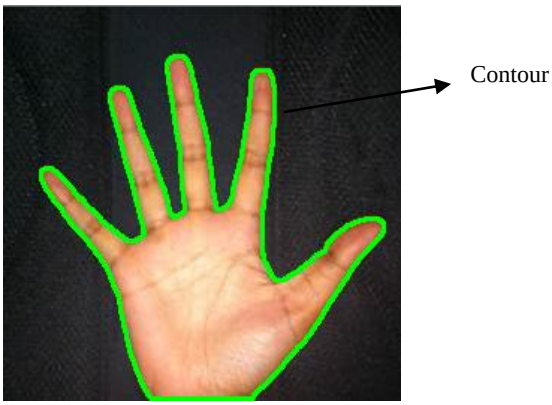


Figure 4: detected contour of the image

CONVEX HULL

The convex hull is the set of continuous points in the Euclidean space that is connected to contours. Convex hull is drawn around the contour. Contour points within the convex hull. Convex hull works as an envelope around the hand.

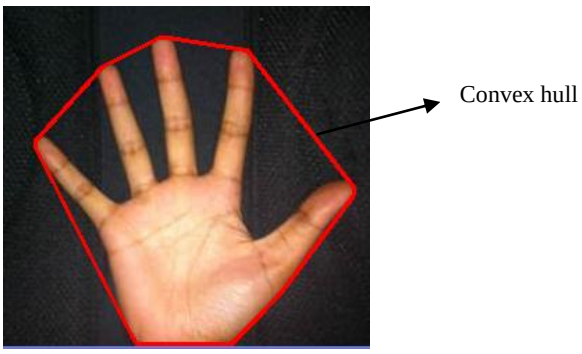


Figure 5: convex hull of the image

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.

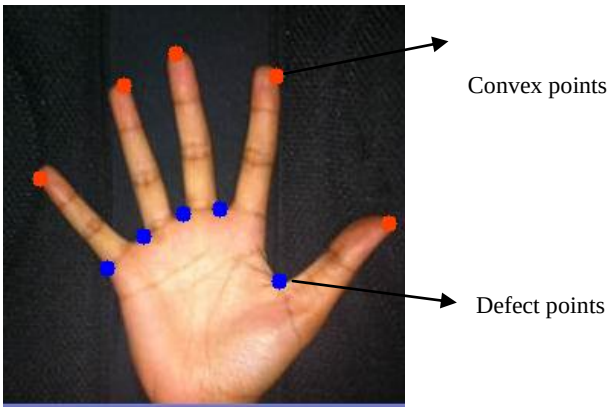
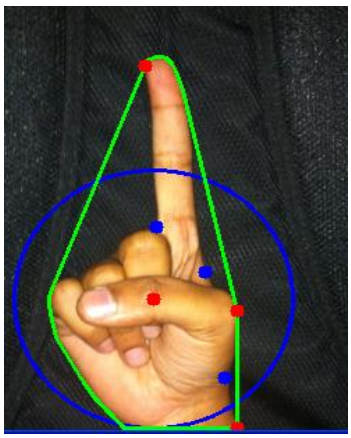


Figure 6: convexity defects in the image

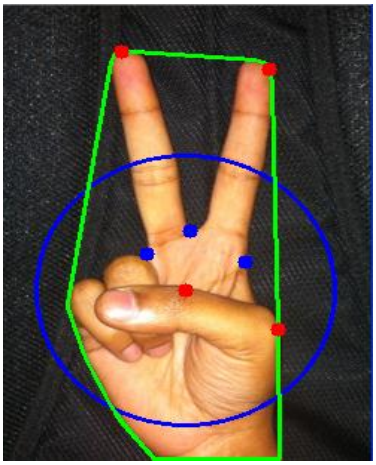
FINGER COUNT

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.

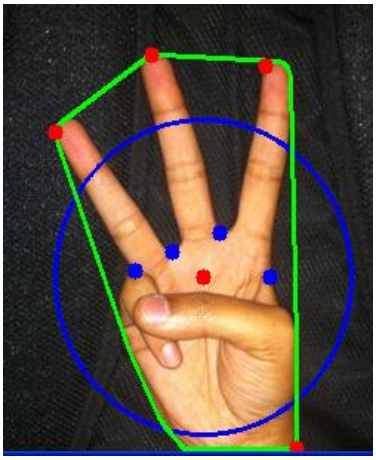
International Journal of Recent Development in Engineering and Technology
Website: www.ijrdet.com (ISSN 2347 - 6435 (Online) Volume 2, Issue 5, May 2014)



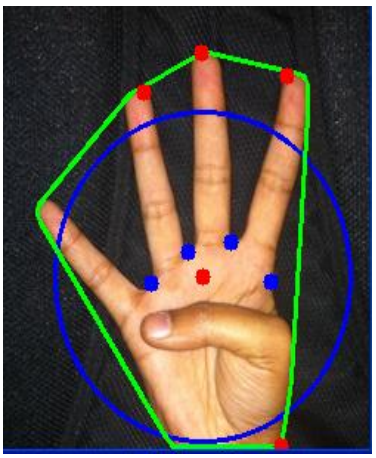
Count 1



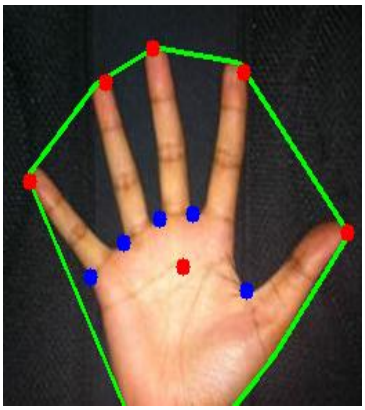
Count 2



Count 3



Count 4



Count 5

Figure 7: finger count of the image

V. Applications

- Hand gesture controlled robot for physically challenged.
- Hand gesture controlled doors and vehicles.
- Hand gesture controlled keyboard and mouse to interact with computer.
- Gesture controlled appliances like air conditioner.

VI. Conclusion

This paper presented a technique to find the number of fingers present in the hand gesture. They are used in numerous applications. The further research studies are going on about this topic to obtain the necessary requirement.

REFERENCES

[1] Meenakshi Panwar and Pawan Singh Mehra , "Hand Gesture Recognition for Human Computer Interaction", in Proceedings of IEEE International Conference on Image Information Processing(ICIIP 2011), Waknaghat, India, November 2011.

[2] Meenakshi Panwar, "Hand Gesture Recognition based on Shape Parameters".

[3] Meenakshi Panwar, "Hand Gesture based Interface for Aiding Visually Impaired".

[4] Zhong Yang, Yi Li, Weidong Chen, Yang Zheng, "Dynamic Hand Gesture Recognition Using Hidden Markov Models", in Proceedings of 7th International Conference on Computer Science & Education (ICCSE 2012) July 14-17, 2012. Melbourne, Australia

[5] Amiraj Dhawan, Vipul Honrao"implementation of hand detection based techniques for human computer interaction", in International Journal of Computer Applications (0975 – 8887)

[6] Amornched Jinda-apiraksa, Warong Pongstiensak, and Toshiaki Kondo, "A Simple Shape Based Approach to Hand Gesture Recognition", in Proceedings of IEEE International Conference on Electrical Engineering/Electronics Computer Telecommunications and Information Technology (ECTI-CON), Pathumthani, Thailand , pages 851-855, May 2010

[7] L. R. Rabiner, A tutorial on hidden Markov models and selected applications in speech recognition, Proceedings of The IEEE 77 (2), 1989, pp.257–285.

[8] OpenCV usage documentationhttp://docs.opencv.org

[9] OpenCV-Python TutorialsDocumentation, Alexande Mordvintsev & Abid K

[10] www.mathworks.in/discovery/image-segmentation.html

[11] www.cse.unr.edu/~bebis/CS791E/Notes/Thresholding.pdf

[12] www.ieeeexplore.com

[13] www.google.com