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Survey on Hand Gesture Recognition Technology

Chinmay Joshi[1], Amit Maddhali[2], Mahesh Kalkute[3], Anand Kamale[4]

[1,2,3,4] *Department of Computer Engineering*
Sinhgad Institute of Technology, Lonavala-410401, Maharashtra
Prof. A. V. Sagare, Dept. of Computer Engineering, SIT Lonavala, Maharashtra,

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Abstract - *Interfacing with computer using Hand gestures based human computer interaction (HCI) is a very user friendly, most intuitive and natural way to interact. Hand gesture has been used since very old time not only by physically challenged people but normal people to communicate effectively. Gesture based interfaces promises to increase the efficiency and simplicity to interact with system. Gesture commonly originates from face or hand that includes emotion recognition from faces and hand gesture recognition. This paper includes journey of hand recognition based system and the methods used to implement those systems like glove-based and depth-based recognition. In the end we discuss the application prospective of hand gesture recognition.*

***Key Words*: HCI Hand Gesture Recognition Segmentation**

1. INTRODUCTION

Hand gesture provides a natural and intuitive communication mode for human dialog. Gestures are the movement of any body part used to convey the meaningful information. In the present scenario of intelligent computing, an efficient human-computer interaction (HCI) human alternative and augmentative communication (HAAC) are assumed of supreme importance in our daily lives. Generally speaking, two methods for hand gesture recognition are accepted by us which are static hand gesture and another one is dynamic hand gesture recognition [2]. Static hand gesture recognition uses the pre-installed hand gesture to interpret relevant user made gesture and its associated command for the system to execute. But we could get a clear meaning by the gesture act in the method of dynamic hand gesture recognition [1]. It's not easy to implement accurate dynamic hand gesture recognition system as there are various difficulties. Static gesture refers to still and fixed body posture while dynamic refer to movement of body part and varying position.

Researchers have developed three widely used ways to achieve hand gesture which are Vision-based, glove-based and depth-based [1]. But the recognition method based on vision is hard to work in a bad condition which is a major drawback of this method. Glove-based method needs gloves which are loaded with effective sensors for calculating leap points. Although this method has advantages of less input data, much high speed and getting 3D information about hands or finger movement there is embarrassing situation. Depth -based method is used with depth-images, either sensed directly with depth cameras such as the Microsoft Kinect, ASUS Xtion, or Mesa Swiss Ranger or extracted from stereo video cameras [3].

2. METHODOLOGY

In this section we will discuss proposed [1] methodology Step by step. Fig 2 shows the flow of proposed Methodology. It is divided into four parts as shown in Fig 3.

2.1 Camera/Sensors

The very basic need of any vision system is camera or sensors (Glove, 3D ring etc.) so as to capture the gesture made by humans.

2.2 Image Acquisition

The first stage of any vision system is the image acquisition stage. After the image has been obtained, various methods of processing can be applied to the image to perform many different vision tasks required.

2.3 Extract Leap Point

It extracts the points associated with our hand i.e. Points for our fingers and one point for palm point.
Then it calculates the distance between each point so as to match with stored pattern.

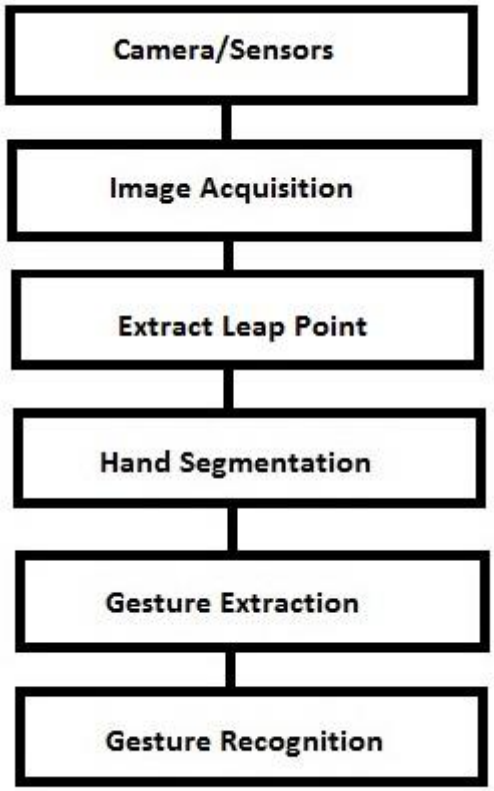

Fig -3: Flow Diagram of Proposed Methodology

2.4 Hand Segmentation

Hand-object interaction is important for many applications such as augmented reality, medical application, and human-robot interaction. To understand hand-object interaction, hand segmentation is a necessary pre-process. There are many steps of Hand Segmentation like conversion of RCB to YCbCr.
e.g.

- Convert the color space[1] from RCB to YCbCr
  Y = 0.299R + 0.587G + 0.114 B
  Cb = (B - Y) * 0.564 + 128
  Cr = (R - Y) * 0.713 + 128

2.5 Gesture Extraction and Recognition

The very important and final stage of recognition is gesture matching in which we have predefined template and those templates are already stored in our database. This stage includes matching of extracted gesture with stored template if it matches then associated action gets executed.

3. Algorithms

Here we will take a look at few possible algorithms that can be used for Hand Gesture Recognition.

3.1 Euclidean

$$\text{2D: } distance = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$
$$\text{3D: } distance = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2 + (z_2 - z_1)^2}$$

3.2 Jaccard

$$jac(x, y) = \frac{|x \cap y|}{|X| + |y| - |x \cap y|}$$

3.3 Dice Coefficient

$$DC(Q_1, Q_2) = \frac{2|Q_1 \cap Q_2|}{|Q_1| + |Q_2|} \quad (1)$$

$$CS(Q_1, Q_2) = \frac{|Q_1 \cap Q_2|}{\sqrt{|Q_1| \times |Q_2|}} \quad (2)$$

4. HARDWARE

Different hardware can be used to achieve hand gesture recognition. We will take a look at them.

4.1 Kinect

Kinect is a motion sensing input device by Microsoft for Xbox 360 and Xbox One video game console and windows pc. Based around a webcam style add-on peripheral, it enables users to control and interact with their console/computer and eliminates the need for a game controller through a natural user interface using gestures and spoken commands. Now it can be used in advanced hand gesture recognition systems to interact in a very natural way even with complicated system. The first generation Kinect was first introduced in November 2010 in an attempt to broaden Xbox 360's audience beyond its typical gamer base.

Fig -1: Microsoft Kinect

Kinect is built on software technology developed internally by Rare, a subsidiary of Microsoft game studios owned by Microsoft, and on range camera technology by Israeli developer PrimeSense, which developed a system that can interpret specific gestures, making completely hands-free control of electronic device possible by using an infrared projector and camera and a special microchip to track the movement of objects and individuals in three dimensions. This 3D scanner system called Light Coding employs a variant of image based 3D construction.

4.2 Wired gloves

These can provide input to the computer about the position and rotation of the hands using magnetic or inertial tracking devices. Furthermore, some gloves can detect finger bending with a high degree of accuracy, or even provide haptic feedback to the user, which is a simulation of the sense of touch.

4.3 Single camera

A standard 2D camera can be used for gesture recognition where the resource/environment would not be convenient for other forms of image-based recognition. Earlier it was thought that single camera may not be as effective as stereo or depth aware cameras, but some companies are challenging this theory. Software –based gesture recognition technology using a standard 2D camera that can detect robust hand gestures.

Fig -2: Simple 2D Camera

4.4 Leap Motion Controller

This is a Controller having sensors and camera inbuilt, developed by Leap Motion, Inc. It supports hand and finger motions as input. It is a small USB peripheral device, needs no hand contact. It captures 3D image of hand, calculating leap points.

Fig -3: Leap Motion Controller

5. CONCLUSIONS

Hand recognition is a challenging problem in the field of image processing and computer vision. In this paper different hand gesture pre-processing techniques, gesture matching, gesture extracting are explained. Also we explained proposed methodology for hand gesture recognition which is step by step procedure.
The paper also explains different hardware required for hand gesture recognition like 3D camera, Glove.

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