

## International Journal of Computer Science and Mobile Computing



A Monthly Journal of Computer Science and Information Technology

ISSN 2320-088X

*IJCSMC, Vol. 4, Issue. 1, January 2015, pg.51 – 57*

### **RESEARCH ARTICLE**

# Study on Hand Gesture Recognition

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**Abstract**— *To access any information user has to repeat keyboard and mouse actions which results in waste of time and it is inconvenient to use. So hand gesture recognition has received attention in the recent years. Using hand gesture we can easily interact with any device robustly. In this paper we have surveyed methods of hand gesture recognition like coloured glove, vision based depth camera etc. This paper focuses advantages and disadvantages of all these methods, and process of segmentation, thresholding which are required for hand gesture recognition methodology. We also present the applications from robot control to sign language recognition of hand gesture are studied.*

**Keywords**— *HCI, Kinect, Computer Vision, Robot Control, Threshold*

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## I. INTRODUCTION

To access any type of information we use mouse, keyboard which results in waste of time and it is inconvenient to handle. So importance of hand gesture recognition increases. It creates the natural interaction between computer and human [1]. Keyboard and mouse has been replaced by hand, face like gestures. Natural input devices like these attract more attention because it is powerful, more effective, and does not require extra connection [2] than any other devices.

Hand gesture recognition is used in TV controlling, robot control, human computer interaction (HCI), education, daily information retrieval etc. Hand Gesture can be classified as static and dynamic (means run time) [6]. Static movement means hold the hand [1] with a specific pose e.g. a victory sign, thumbs up. Static hand gesture recognition requires training and it has less computational complexity than dynamic hand gesture. Whereas dynamic hand gesture requires no training, it recognizes the hand gesture dynamically [2]. Dynamic hand gesture is more complex but it is more useful than static hand gesture. The purpose of this paper is to present a survey on different hand gesture recognition approaches with advantages, disadvantages and recognition methodology of hand gesture recognition. Although a Lot of work has been done on hand gesture recognition and recognition methodology, this paper focuses on the advancement of gesture recognition system. It is up to date and represents a good point for investigators in hand gesture recognition area.

## II. HAND GESTURE RECOGNITION APPROACHES

To design or implement any application data gathering is initial step. It is also necessary in what way we collect the data to complete the task. Recognizing the hand gesture and posture we collect the data from coloured glove, data glove, vision based, and depth camera.

### A. Coloured Glove:

Coloured gloves are also known as marked gloves. For recognition the hand, tracking and locating the hand, palm, and fingers user has to worn the colour glove. At the recognition time we set some threshold value of that colour because of that we can easily recognize the hand gesture. In a typical colour gloves with twenty patches coloured at random with a set of ten distinct colours. Due to shadow and complex background hand gesture cannot recognize all of those colours [17]. For recognition purpose choose a few large patches rather than small patches because small patches are less robust.



**Fig 1:** Glove design consisting of patches [3]

#### Advantages-

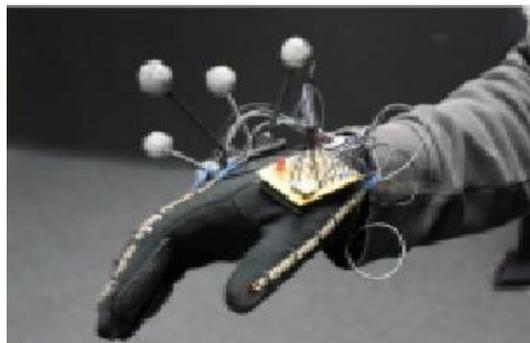
1. Colour gloves are inexpensive and no sensors are embedded in or outside the gloves [4].
2. It is robust method for hand gesture recognition.

#### Disadvantages-

1. To recognize the hand every time user has to wear the glove so it is inconvenient.

### B. Data Glove:

Data glove are also known as Instrumented glove. For recognizing and tracking the hand user has to worn the data gloves. These gloves consist of sensor device to capture hand position and motion. Data glove can easily provide exact coordinates of palm and fingers location [3], orientation and hand configuration. It reduces the natural level of interaction with the computer. These devices are quite expensive because of sensor node which is used in data glove [2].



**Fig 2:** Data glove [2]

Disadvantage-

1. Data gloves are expensive because of sensor node.

C. Vision Based:

In vision based approach needs only high quality camera to capture the images does not require any external device or hardware [5]. It deals with texture and colour properties. The image gives the natural interaction between human and computer. This approach is simple but raised many challenges such as complex background [7], number of camera used by those techniques can be different, speed and latency, lighting condition and skin colour objects with the hand object, system requirements such as velocity, recognition time, robustness and computational efficiency.



Fig 3: Vision Based [5]

Advantage-

1. It is robust method for hand gesture recognition.

Disadvantage-

1. Easily affected by complex background.

D. Depth Camera:

Depth camera is also called kinect. Kinect is nothing but RGB-Depth sensor introduced by Microsoft [10] for human computer interaction. Kinect is used in many applications like video games, virtual reality. In RGB camera we only recognized the gesture whereas in kinect we can recognize the depth of gesture [13]. Because of kinect we recognize the hand gesture robustly.



Fig 4: Using kinect recognized hand gesture (Measure the depth) [10]

Advantage-

1. Robust than any other approach because it can measure the depth.

Disadvantage-

1. Kinect device costs more than any other devices.

### III. RECOGNITION SYSTEM METHODOLOGY

Gesture recognition system includes different phases. These phases are pre-processing, feature detection, segmentation, lastly the classification and recognizing the gesture. After recognizing the gesture certain actions are performed depending on gesture movement [1][14].

Input data is acquired from camera, coloured glove or any other devices. Then pre-processing is applied, to remove noise. Then segmentation, after that classification and recognition algorithm are applied.

Methods of object segmentation depends on RGB colour model, HSV colour model [18] or YCbCr colour space [9] which deals with the skin colour of the human hand [8]. Samples are directly proportional to accuracy so number of samples is taken for checking the accuracy.

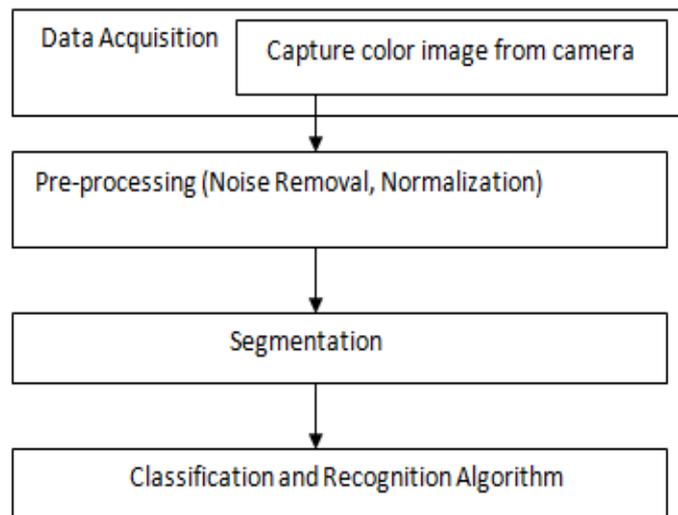


Fig 5: Flow of gesture recognition [14]

Gesture recognition steps are illustrated as follows:

#### 1. Pre-processing:

In pre-processing main steps are noise removal, edge enhancement, and normalization of the image [8].

**Noise Removal:** In any image noise occurs so using blurring technique we remove the noise

Common type of noise:

1. Salt and pepper noise: Contains random occurrences of black and white pixels
2. Impulse noise: Contains random occurrences of white pixels
- 3 Gaussian noises: Variations in intensity from a normal distribution

After the noise is removed image is soften, after that enhancing the image structure which is blurred and then image is normalized.

#### 2. Segmentation:

Segmentation phase has an important role in the gesture recognition [18]. In segmentation image is extracted from foreground to background. For segmentation thresholding is used.

Segmentation algorithms [19] can be classified into two types according to image gray level properties as-

#### A. Discontinuity:

Finding the dissimilarity between the images and changes in image intensity which detects the object edges.

#### B. Similarity:

Finding the similar properties that join one region to another which is commonly the color value in image.

For more reliable segmentation minimize the effects of lighting condition and complex background. These factors limit the performance of good segmentation.

#### **Thresholding:**

Thresholding is the simplest method of image segmentation. From a greyscale image convert it into binary image.i.e. image with only black or white colours. It is usually used for feature extraction where required features of image are converted to white and everything else to black. During the thresholding process, individual pixels in an image are marked as "object" pixels if their value is greater than some thresholding value (assuming an object to be brighter than the background) and as "background" pixels otherwise. Typically, an object pixel is given a value of 1 while a background pixel is given a value of 0. Finally a binary image is created by coloured each pixel white or black, depending on a pixel's labels.

### **3. Recognition**

In recognition system methodology last phase is gesture recognition. Hand gestures can be classified into two approaches [14]:

#### **I. Rule based Approach:**

In rule based approach input features is encoded manually and the gesture is the one that matched with the encoded rules [19]. Main problem of this technique is that the human ability is limits for encoding the rules.

**II. Machine Learning based Approach:** The machine learning base approach considered the gesture as result of some stochastic process [14], most of the problems that based on machine learning approach have been addressed based on the statistical modelling, such as PCA [20], FSM [21] Hidden Markov Models (HMMs) [22] have been paid attention by many researchers, kalman filtering [19], Artificial Neural networks (ANN) [23][24] which have been utilized in gesture recognition.

## **IV. APPLICATIONS**

In various field hand gestures recognition is used. This section gives a brief overview of some gesture recognition application areas. Reduces the cost of processor, use of hardware minimizes can play a major factor in gesture recognition. Researchers do great emphasis on human computer interaction because it gives easy and natural communication to human. Gesture recognition has wide ranging applications such as the following:

#### **1. Robot Control:**

Using gesture recognition we can control the robot easily. After hand gesture is recognized for performing the certain actions set the particular movement of robot for particular movement of hand or finger count of hand for e.g. "one" means "move forward", "five" means "stop", and so on.

#### **2. Television Control:**

Hand postures and gestures are used for controlling the Television device. In a set of hand gesture or particular count of finger are used to control the TV activities, such as turning the TV on and off, increasing and decreasing the volume, muting the sound, and changing the channel using open and close hand [11].

#### **3. Desktop and Tablet PC Applications:**

In desktop computing and PC applications, gestures can provide an alternative solution to the mouse and keyboard. Many gestures for desktop computing tasks involve manipulating graphics, or annotating and editing documents using pen-based gestures [28].

#### **4. Games:**

Gesture is used for computer games. Using gesture we can easily interact with computer. In video game using gesture track and control the player's movement or recognize the position of players [29]. Using gestures control the movement of avatars in a virtual world, and play station.

### **5. Sign Language:**

Sign language is an important part of communicative gestures. Sign languages are highly structural; they are very suitable for vision algorithms [16]. At the same time, they can also be a good way to help the disabled people to interact with computers. Sign language for the deaf people has received significant attention in the gesture literature [27].

### **6. Healthcare & Medical Assistance:**

In healthcare and medical field also gesture technology is used. Using gesture patients can control the instrument which they require for their exercise. Gesture based tool used for sterile browsing of radiology images. Also researcher developed a wheelchair with intelligent HCI [26].

### **7. Daily Information Retrieval:**

Researchers implemented an approach that provides daily information retrieved from Internet, where users can operate this system with his hands' movements [25].

### **8. Education:**

In Education system we also used hand gesture recognition system. Example of a such system is using hand gesture control the power point presentations [12].

## **V. CONCLUSION**

Developing an efficient human machine interaction is an important task in gesture recognition system. Hand gesture can be recognized easily, and actions performed depends on gesture movement are the primary focus of many researchers. Various methods were discussed such as coloured glove, data glove, kinect for acquiring the input image data. And these methods have their own advantages and disadvantages. Recognition system methodology includes the pre-processing, segmentation, and recognition method. Various applications of gesture recognition from robot control to Daily information retrieval were also presented.

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