

# REVIEW OF HAND GESTURE RECOGNITION SYSTEM FOR DEVICE CONTROL

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**Abstract:** The primary goal of Gesture Recognition is to create a system which can recognize specific human gestures and can be used to convey information or for device control. This paper gives an overview of different methods for recognizing hand gesture for controlling the device. With this survey, the challenges for image based Hand Gesture Recognition (HGR) can be observed which may help to design the better system for device control.

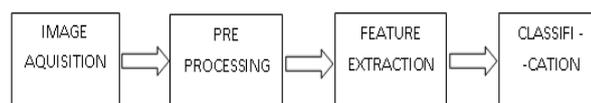
**Keywords:** Hand Gesture Recognition, HGR based device control.

## I. INTRODUCTION

Gesture is a form of nonverbal communication or non vocal communication in which visible bodily movement communicate particular messages. Gesture includes movement of hands, face or other parts of the body. A Gesture is categorized into two distinctive categories Dynamic and Static. Dynamic gesture is intended to change over a period of time where as a static gesture is observed at the spurt time. Static (posture or certain pose) requires less computational complexity. Dynamic (Sequence of postures) are more complex but suitable for real time environments. Two approaches are commonly used for acquiring information necessary for gesture recognition system.

1.Methods which use Data gloves: mechanical or optical sensors are attached to a glove that transduces finger flexions into electrical signals for determining the hand posture. This approach forces the user to carry a load of cables which are connected to the computer and hinders the ease and naturalness of the user interaction.

2.Methods which are Vision Based: This method is based on the appearance of hand using skin color to segment the hand and extract necessary features. This is easy, natural, non invasive and less cost compared to other method.



**Figure - 1:** Block diagram of HGR System

Image acquisition is followed by pre processing and then feature extraction succeeded finally by the classification stage. In image acquisition, the input image of the hand gesture is acquiesced by camera. Pre processing includes noise filtering, RGB to Gray scale conversion, etc. feature extraction includes background separation, image enhancement, converting to binary image, edge detection etc. depending on the algorithm used for classification, features of the image is extracted. Recognition or classification is a process of identifying the gesture, for which different algorithms like k-curvature, SVM, HMM etc algorithms can be used depending on the application.

After the recognition of the gesture, the command signal is generated according to the sign and it can be passed to the device for controlling.

The main applications are Robot control, Television control, 3D modelling, Virtual Environments, Graphic Editor Control etc.

The goal of this paper is to review the different methods of hand gesture recognition, which can motivate to create a system which can identify specific hand gestures and use them for device control by overcoming few constraints which occur in the existing methods.

## II. RELATED WORK AND CONTRIBUTIONS

Jean-Francois collumeau *et al.* introduced the simulation of gesture based remote control interface intended for operating rooms. They have explained the video processing chain in three steps, Detection, Segmentation, and Recognition. Detection is roughly marking the hand's spatial location using viola-Jones cascade classifiers. Haar features are extracted, it allows reduced processing time in situations where no hand is present in the image, and unnecessary image processing is skipped. Single classifiers have been trained for each of the six postures. For segmentation, three algorithms they have considered: K-Means method (K-Ms), Watershed algorithm and GrabCut (GC), concluded that K-Means algorithm yields the best result. Hand posture recognition is achieved by linear SVM classifier fed with feature vectors gathering the object characterization. Different techniques can be used for this description step. Geometric hand descriptor, HU's geometric invariant moments, Histogram of Oriented Gradients (HOG), Lowe's Scale Invariant Feature transform (SIFT). Among which it is concluded that HOG features are

best in recognizing hands from data base closely followed by geometric descriptor. The video processing chain which includes detection, segmentation & recognition is implemented in OpenCV and LIBSVM libraries. Databases have been created for target application. CATIA V5 (Computer Aided Three dimensional Interactive Application) has been used. Viola-Jones cascade classifier is used for modeling the complex 3D geometries constituting the arm. A complete vision-based surgeon-computer interaction simulator has been introduced in this paper. System consists of a software image processing chain coupled with a virtual surgical lighting arm and a graphical interface [1].

Harish Kumar Kaura *et al.* implemented a system through which the user can give command to a wireless robot using gestures. Through this method, the user can control or navigate the robot by using gestures of his/her palm, there by interacting with the robotic system. Technologies used are C++ with Open CV and Arduino Duemilanove. After pre processing, the Convex Hull method is used for recognition. The drawback of this method is for finger count one, there is no large depth so it is difficult to recognize as it is count one or there is no such count so counts from two to five are used as command signal. Wi-Fi shield connects Arduino to a Wi-Fi connection. Implementation makes use of periodic polling from WiFly to the web server to access the command signal in real time. This method of periodic polling may overload the server [2].

Asanterabi Malima *et al.* developed an algorithm for recognizing a limited set of gestures from hand images for a robot control application. It involves segmenting the hand based on skin color statistics as well as size constraints. Then centroid or Centre Of Gravity (COG) of hand and farthest point from the COG is found. Circle with radius 0.7 of farthest distance from the COG is drawn. 1D binary signal is extracted by tracking the circle. By counting number of zero to one transition in this 1D signal and subtracting one leads to the estimated number of fingers active in the gesture. This algorithm is possible to count the number of active fingers without regard to which particular fingers are active. Also it is scale invariant, rotation invariant and translation invariant. This technique does not require the storage of a hand gesture database in the robot's memory [3].

Nancy *et al.* has done the analysis of Hand Gesture recognition technique using finger movement detection based on color marker. This approach is based on red color marker detection. Red color marker on fingertip of user's hand wearing white cloth glove is used. The system would only detect the red color marker and it makes possible to point a finger having red color marker. In this paper, they have used a pointed gesture with the help of red color marker, only the finger wearing red color marker is detected and it is used for pointing on the computer screen. The pointed thing is selected on the basis of spoken commands they have created microphone sensitivity in MATLAB. In this approach, user can interact with the computer remotely through speech and gesture recognition. GUI of keyboard design is created in MATLAB. The inconvenience of placing markers on the user's hand makes this approach infeasible in practice [4].

Yikai Fang *et al.* proposed a real time hand gesture recognition method. Gesture recognition process they followed is as follows

- Firstly, Hand detection with Adaboost is used to trigger tracking and recognition.
- Then adaptive hand segmentation is executed during detection and tracking with motion and color cues.
- Finally, scale space features detection is applied to find palm-like and finger-like structures. Hand gesture type is determined by palm-finger configuration.

In this method, they reduced the computation expense by detect multi-scale feature across binary image and make hand gesture interface more practical by combine this feature detection with hand tracking and segmentation. Altogether this method combines fast hand tracking, hand segmentation and multi-scale feature extraction to develop an accurate and robust hand gesture recognition method [5].

Tasnuva Ahmed presented a neural network based real time hand gesture recognition system. They have explained the whole system of hand gesture recognition in four phases. Image acquisition; Image processing, Feature Extraction and HGR.

- They have used Kodak-easyshare-c340 digital camera to capture the desk area where the hand is located. The background of the image is taken as black with good lighting system.
- The algorithms sequentially used in this phase are graying, normalizing and histogram equalizing.
- 33 features are extracted for hand gesture. Feature 1: Relation between the height and the width of the hand gesture. Feature 2-25: These features check how the black pixels are distributed in the image. Feature 26: calculate average distance between all the black pixels and the central point that invariant object rotation. Feature 27-33: calculate the central moments of hand gesture
- They used a feed-forward multilayer Artificial Neural Networks for HGR.

Feature of input image based on moment feature extraction method is used. So that the system can recognize hand gestures captured in different angle or orientation or size. As Artificial Neural Network is used to recognize the hand gesture, even it is rotation, translation, scaling and orientation independent, the delay occurs due to training needed for artificial neural network and switching delay between the nodes [6].

Mithun G Jacob *et al.* presented a method for surgical instrument handling and retrieval in Operating Room with a multimodal Robotic assistant. They have used a Microsoft Kinect sensor to acquire depth information used to segment the hand and localize the fingertips. 3D trajectory of the fingertips is used to classify the dynamic gesture, smoothed with Kalman filters and then quantized for classification with a set of Hidden Markov Models (HMM) and they have used a microphone with the CMU Sphinx to recognize speech commands. The command is sent to robotic arm across the network to deliver the instrument. Here, each HMM is trained to obtain the parameters for recognition. A FANUC LR Mate 200iC robotic arm was used to deliver the instruments. For retrieval and disposing the instruments from the surgical site, the background/foreground segmentation is achieved using a GMM "with memory". The silhouette of each instrument is represented using 7 invariant Hu moments. For classification, a SVM is trained with a database of surgical instruments in various configurations and scales. They concluded that the multimodal system with modality training which employs both speech and gesture was shown to be 14.9% faster than the speech-only system on average [7].

Amiraj Dhawan & Vipul Honrao introduced methods for Human Computer Interaction using the user's hand. In this paper, they have compared the different methods for all the preprocessing tasks required and then created a pipeline of these preprocessing tasks and then used the detected hand as an interaction device for HCI applications.

They have explained two types of hand segmentation, with background constraint and relaxed background constraint. With background constraint includes the methods static threshold value, incremental thresholding value, thresholding using Ostu's method, and dynamic thresholding using color at real time. Relaxed background constraints include the methods color based thresholding, background subtraction. They explained hand detection can be done by drawing contours, convex hull method and convexity defect is found. They proposed three techniques for interaction finger counting, hand orientation, and finger tracking [8].

Shwetha K. Yewale *et al.* presented an overview of different methods for recognizing the hand gestures using MATLAB. They explained edge detection using canny edge detection algorithm and skin detection using hue and saturation values of various possible skin tones can be used for hand gesture recognition. ANN algorithm is used to train the system and concluded that edge detection and ANN provides good solution for hand gesture recognition using MATLAB [9].

### III. CONCLUSION

This paper describes a brief comprehensive study of the strategies and recent developments in Hand gesture recognition system for device control including detection, feature extraction, and recognition methods in different algorithms.

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