Hand Gesture Recognition: Analysis of different Techniques

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***Abstract*: Gesture recognition is a computing user interface that allows computers to capture and interpret human gestures as instructions or commands. It is an ability of a computer to understand gestures and execute commands based on those gestures. It is a kind of mathematical interpretation of human motion. A Human Computer Interaction (HCI) between computers and human understands human language and develop a user friendly interface. Gestures provides interface to HCI. The arms, body, face and hands are used for gesture recognition to perceive movement by a human. This survey paper deals with discussion of various techniques, methods and algorithms related to the gesture recognition. Comparison of various approaches related to recognition process is also included.**

***Keywords*: Gesture, Hand Segmentation, vision based, Appearance based, Orientation Histogram, Template Matching**

1. INTRODUCTION

Human gestures are expressed through face, body and hands. Among all these hand gestures are the most prominent gestures. Applications of hand gesture recognition includes video conferencing, sign language recognition, distance learning, forensic identification, teleconferencing, robotics, controlling television set remotely, enabling hand as a 3D mouse, and so on. The main objective is to build correct and effective translation between spoken language and sign language.

Gestures can be static or dynamic. Static gesture requires less computation and is not complex while dynamic gestures are difficult to capture and is more complex to compute and interpret as they may vary with context to time. The challenges in this technology include lighting conditions, skin color detection, rapid hand motions and self occlusions. Different methods have been proposed for acquiring information necessary for recognition gestures system. In some methods additional hardware are used such as data glove devices and color markers so that comprehensive description of gesture features can be extracted.

There are different types of gestures. The gestures are categorized as below:

1. Hand and arm gestures: utilizing hand and arm signals individuals can associate with virtual condition. These sorts of signals are required close by postures acknowledgment, in communications via gestures, and stimulation applications.

2. Face & head gestures: Some of the illustrations are provided here: i) head rotation; ii) head moving up and down iii) eye rotation iv) eyebrows raising v) winking the eye vi) To talk by opening the mouth, vii) flaring the nostrils; and viii) human emotions like illness, fear, disgust, misery, and so on.

3. Body gestures: Full body movement is involved in it

- Tracking interaction between people.
- Dancer movement analysis and
- Human gaits recognition for medical treatment and athletic training.

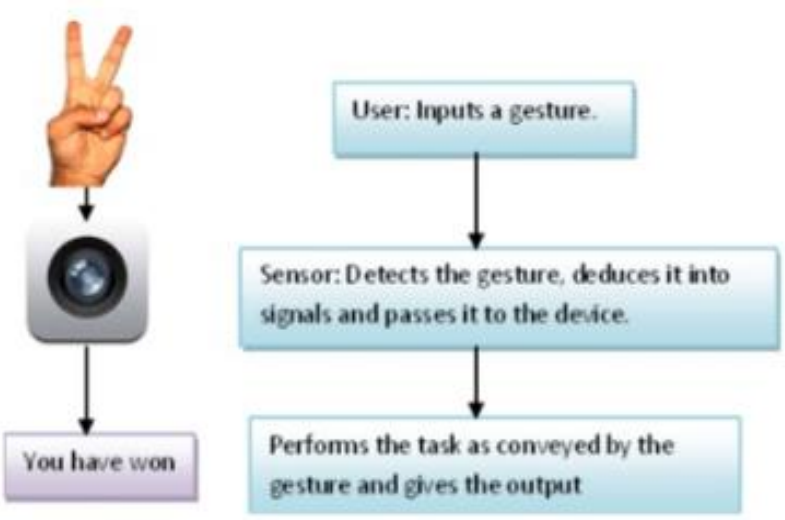


Figure 1: Working of Gesture Recognition

In gesture recognition technology, a camera reads the movements of the human body and communicates the data to a computer that uses the gestures as input to control devices. Due to this technology the use of input devices like joysticks, mice, and keyboard are eliminated. The user can directly communicate with the system by giving signals to computer through gestures.

The gestures are captured and read by the sensors attached to the system along with the cameras attached to it. Together these sensors and cameras capture the gestures and comparing it to the database interprets it into useful information. Along with hand and body gesture, facial expression, eye movements and lip reading can also be read.

2. HAND GESTURE RECOGNITION TECHNIQUES

2.1. Edges method

It is a technique for finding boundaries of the object. It detects discontinuity in brightness. The aim of this technology is to locate highest gradient in a picture. A threshold value is applied to the gradients to locate highest gradient value. With the help of correct threshold value all the low magnitude gradients will be removed. Summation of derivatives of x and y directions is considered as magnitude of gradients

2.2. Pixel to Pixel Comparison

In this method the images are compared pixel by pixel. Implementation of this technique is easy but the accuracy of this method is very low compared to other techniques. For comparing image pre- requisite image is used. The pre-requisite images are stored in database and then comparison is done with the input image. For segmentation purpose thresholding is used.

2.3 Orientation Histogram

A feature vector is calculated to decide the orientation histogram. Resultant histogram is form by edges of the images. The image is captured by a webcam and then it is converted to gray-scale image. The training phase is performed first. The grayscale images are used to create the histogram, which is used to train the machine.

Following steps are performed in recognition process:

1. Image capturing
2. Conversion to gray-scale image
3. Calculate Histogram

2.4 Template Matching

A set of store data records are used to identify and categorize the given input image. The template matching is a method to check whether a given data record can be classified as a member of a set of stored data records. The technique is divided into two parts: (a) Creating Templates by collecting data values for each posture in the posture set (b) Find the posture template most closely matching the current data record by comparing the current sensor readings with the given set.

2.5 Thinning Method

In thinning method center of image is taken as a reference to find image histogram. A window is assumed at the centre of the image. The window will be in RGB format. It is required to convert RGB into YCbCr. Specific range is decided for Cb and Cr. If pixel lies within that range, then it mark with white color and others are converted as black color. Output of this process is grey scale image and this step follow by the conversion of grey image to binary image. This conversion requires thresholding and one have to choose proper threshold.

2.6 Active Shapes Technique

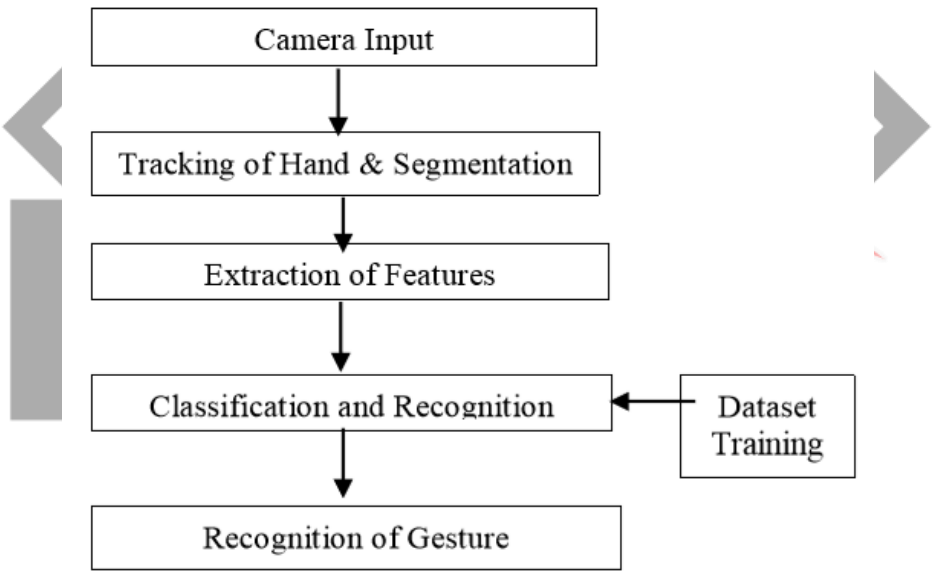
This method is also known as 'smart snake' method. Here a feature is located within a still image. A contour on the image that is roughly the shape of the feature to be tracked is used. The manipulation of contour is done by moving it iteratively toward nearby edges that deform the contour to fit the feature. Active shape model is applied to each frame and use the position of the feature in that frame as an initial approximation for the next frame.

3. HAND GESTURE RECOGNITION MODEL

Hand gestures are powerful communication mode for Human Computer. Traditional input devices are available for interaction with computer, such as keyboard, mouse, and joystick as well as touch screen; however they do not provide natural interface. The proposed system will consist of desktop or laptop interface, the hand gesture may be used by the users may need to wear any data glove, or may use the web camera for capturing the hand image.

All the algorithms follow the same step like

- Detecting hand
- Extracting features and
- Recognizing gestures



Background subtraction can also be used to increase the efficiency and accuracy level.

3.1 Hand Tracking and Segmentation

The input videos are divided into frames to get dynamic gestures. Here main objective is tracking Hand and segmenting it from other objects or from background. For this mainly two approaches of gesture recognition are used. Initial one is sensor based and the second one is vision based. In vision based technique skin detection is used. For detecting skin, conversion from RGB color model to HSV color model is compulsory. RGB color model is quite sensitive to light illumination. While in other techniques for hand detection color marker is used and one must wear data gloves. Due to this technique are very protective. Main difficulties in using glove-based input devices to collection of raw posture and gesture recognition data which is possible only by wearing the gloves by the user and attached to the computer. This will restrict freedom of movement similar to the traditional interaction methods. The number of cameras used for tracking is another important issue. The second component in a vision-based solution for hand posture and gesture recognition is to make the hands more visible to the camera for simpler extraction of hand data

3.2 Feature Extraction

The main task here is to extract the features from the captured images. Proficiency, accuracy and exactness of gesture recognition is determined by the quality of extracted features. Important factor over here is orientation, location and velocity. Most prominent factor which emphasizes more is orientation. With the help of classified feature numerous algorithms are utilized to compute impeccability of orientation [21]. According to [21], feature pints are extracted using Camshift algorithm. Finger position and orientation are used to create feature points in model-based approach. They are extracted from image [21].

3.3 Gesture Recognition

Hand models of captured images are created for Hand gestures recognition. This hand model contains a number of defects in capture images. A prototype model is compared with hand model. In the bag of features method only regions which contain a hand portion is considered, so size of the capture image is reduced. Key points are extracted from this hand image. SIFT algorithm used that point for further tasks. Detection of the object which have same orientations and views are performed using Scale Invariance Feature Transform (SIFT). K-means clustering algorithm is used to find a match between key points and the Key points of the bag of Features algorithm. In some contexts, regions with contours of hand are also used for recognition of gestures.

4. CONCLUSION

Human machine interaction process works very smoothly just because of gesture recognition. The importance of gesture recognition lies in building efficient human machine interaction. The issues related with these recognition techniques are what technology to use for collecting raw data. Generally, two types of technologies are available for collecting this raw data. The first one is a glove input device, which measures a number of joint angles in the hand. Accuracy of a glove input device depends on the type of bend sensor technology used; usually, the more accurate the glove is, the more expensive it is. The second way of collecting raw data is to use computer vision. In a vision-based solution, one or more camera's placed in the environment record hand movement. Both approaches have their own advantages and limitation. Recognition process includes tracking hand and segmenting it from background, then features are extracted using various techniques and finally, after applying classification gestures are recognized.

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