

A Review on Gesture Recognition Techniques

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Abstract- Communication helps to build the human relationship. It enables easy exchange of ideas, emotions, feelings and expressing sentiments to other human beings. The modes of communication are of two types: verbal and non-verbal communication. Verbal communication consists of exchange of information face to face or through telephone, TV etc and non-verbal is conveyed through sign language & gestures for the deaf people. It is also used for gaming, surveying etc. Gesture recognition is a process in which the posture of human body parts are identified and are used to communicate, control computers and other electronic appliances. Hence it plays an important role. Today gesture recognition technology is growing very fast in the field of image processing and artificial technology. It enhances the communication path between human and computer called HCI (Human Computer Interface). In this paper the basic steps used to recognize a gesture along with the types of gesture recognition will be discussed.

Keywords- Segmentation, Preprocessing, feature extraction, Classification, Types of Gesture recognition etc.

I. INTRODUCTION

The communication system deals with the process of exchanging messages which is formulated and transmitted eg. Playing, singing, talking etc. This technology has been embedded into are day to day life. It makes work easy and saves time .It has high accuracy , stability, security and good comfort level .However the disadvantage may be that it has a distance limit while controlling a certain device , Line of sight communication as transmitters and receivers must be almost directly aligned (i.e. able to see each other) to communicate also comparatively it may have a slow data rate than transmission through wire. Some of the basic types of gestures are:

- 1) Offline gesture: Interaction of the user with the object done through gestures and processed after the interaction is known as offline gesture. Eg. 'C' is drawn to activate the camera.
- 2) Online gesture: Direct manipulation of gestures. Here the user acts upon the displayed objects using some actions and the effect of this is immediately visible on the screen. Eg. Scaling or rotating an tangible

object, zooming into your photo to check out your expression.

Another type of classification with respect to time is:

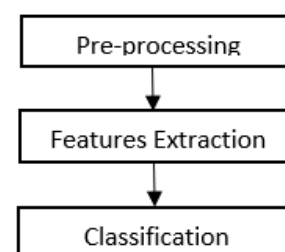
- 1) Static gestures: Here the recognition appeals that at the time of gesture period the hand position still remains constant. It is based on the shape and flexural angles of the hand. Eg. When a person instructs a machine using a hand gesture, the image of the hand is captured, analysed and the meaning is interpreted.
- 2) Dynamic gestures: Dynamic gesture refers that at the time of gesturing period when the hand position changes continuously. Here there is continuous motion of the body part Eg A waving hand.

This techniques is used in home automation, gaming, automotive sector, defence, sign language interpretation, consumer electronics sector and many more. Companies working on this technology are omek, Cognitec, Point grab, SoftKinetic etc. Vision-based recognition systems is one of the upcoming advanced gesture recognition technique.

II. STEPS FOLLOWED IN GESTURE RECOGNITION

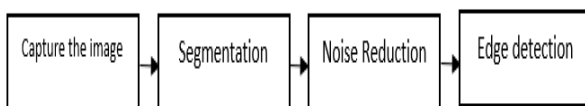
Broadly the steps that are followed to interrupt a gesture are given as follows:

Block diagram [1] :



- **Pre-processing:** After capturing the image some operations are performed to extract the hand gesture from the background. Segmentation is the first process for recognizing hand gesture. It is the process of dividing the input image into

regions separated by boundaries [1]. The segmentation is based on 2 gestures ie: static and dynamic. For an static image the input has to be only segmented but if it is a dynamic gesture it has to be located and tracked. It is located by bounding box that depends on the skin colour. For tracking the video is divided into frames and each frame is processed and then segmented. Another method for tracking is by using some tracking information like shape, skin colour using some tools such as Kalman filter [1]. The whole process may be summarized by the following block diagram.



2) Features Extraction: This method is valid for a static gesture. It is a part of data reduction process. Here the exact feature that is needed to recognize a gesture is extracted. A good segmentation will further lead to perfect feature extraction. There are various methods to extract features. Some methods use geometric features like the shape of the hand while others utilize figure tips ,positions,plam center etc [1]. The goal of feature extraction is to find the most discriminate information in the recorded images [4]. Feature is an n-dimensional vector that is analysed using image processing. For analysing these n components we need to consider some visual cues like colour,texture,shape , brightness etc .Each visual cue is thoroughly analysed and the n components of a feature are likewise computed . They may need one visual cue or composite cue such as colour and shape together. Hence selecting a right feature in order to extract the meaning of a gesture is essential. The main problem of a 2D object recognition are the size changing, translation of position, and rotation by angle from the principle axes [4].When the hand contour is treated as a geometric feature it treats the method of resizing and translation . The hand complex moments feature teats the rotation problem along with the above problems. The final stage is the Neural network that is usually responsible to recognize and classify which class the gesture belongs to. Namely there are two methods of neural network : neural network with hand contour and neural network with hand complex moments [4].

3) Classification: Gesture classification method is used to recognize the gesture after modeling and analysis of the input hand image. Recognition process is affected with the proper selection of features parameters and suitable classification algorithm [1]. Suitable method must be selected for gesture recognition. Statistical tools are used for this some of the

examples are: Vector Quantization, HMM tools, Finite state machine, Principle component analysis etc. Neural Network is another advanced technology for gesture reorganization. Other soft computing tools are effective in this field as well, such as Fuzzy C Means clustering.

III. TECHNIQUES USED FOR HAND GESTURE

Broadly the hand gesture techniques may be classified as:

- 1) Glove/Sensor based
- 2) Vision based
- 3) Depth based

◆ Glove/Sensor based :

- 1) Glove based gesture recognition: Hand movement, position and figure bending can be detected 3D hand motion tracking and gesture recognition is done by data glove. It consists of three accelerometer sensors, one controller and one Bluetooth. Due to hand motion wearing the gloves, the signals are captured and recognized. Eg. KHU-1 data glove.



Fig 1: Data Glove [2]

- 2) Sensor based gesture reorganization: Sensors used may be mount based, multitouch screen or vision based sensor. Example Accelerometer and WMG sensor, Strain gauge sensor etc.

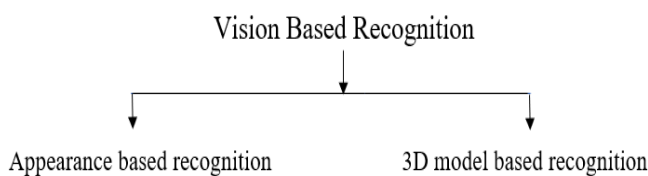
The advantage of this method is that it gives high accuracy and fast reaction speed. The disadvantage of using glove is that it has to be worn every time when a gesture is to be recognized.

- #### ◆ Vision based recognition:
- This is the most convenient type as the recognition can be done with naked hands. Here digital cameras are used to capture the image. The various types of cameras can be used, i.e. monocular, fish eye, time of flight and infrared cameras etc [2]. In stereo cameras a 3D image can be

formed by using two cameras, capturing image and approximating them to form one 3D image. The relation between the two cameras is known. A single standard 2D camera can also be used for effectively detecting gestures. The disadvantage may be the background noise that occurs may affect the recognition process. Camera quality and resolution also may be taken into account. The illumination change, background cluster, partial or full occlusions are the several other challenges that are to be addressed. Kinect cameras are one of the most advanced type. It was developed by Microsoft for Xbox 360 video games. It enables the user to interact with the computer through a natural user interface using gestures and spoken commands.



Fig 2: Kinect Camera



1) **Appearance based recognition:** This method includes extracting features from the input image and comparing it with predefined templates. It gives good real time performance and can be easily compared with the 3D model approach. Algorithms like Adaboost learning algorithm can be used for identifying points and portions of the hand. Different skin colours can also be detected by this method. It also helps to overcome the problem of occlusion. Appearance based recognition is further classified into Motion based recognition and colour based recognition.

➤ **Motion based recognition:** Motion based models are used for the object recognition or its motion based on

the object motion in sequence of the image [2]. Here a sequence contains a large number of frames. These frames are used to extract motion information. Motions like walking, running are considered to be higher level motions and can be detected if the sequence is long. For the learning action model, Adaboost framework uses for the local motion histogram object detection, object description, motion modelling, pattern recognition is required for the gesture recognition and it is complex in nature [2].

➤ **Color based recognition:** Here the motion of the hand is tracked by different coloured markers. It is used to interact with virtual model as and also provides functionalities such as draw, move, zoom, write on virtual keyboards.



Fig 3: Color based recognition [2]

2) **3D based recognition:** A 3D description of the hand image is given by this method. As in 2D some of the parameters are lost. Hence depth factor is added to it. The parameters of the real target are computed by matching the spatial description and then during the recognition process motion of the hand will be followed. It updates the parameters of the model as it checks to match the transition in the temporal model [2]. Further the 3D model is classified as: volumetric, Geometric and skeletal model.

➤ **3D volumetric based recognition:** It represents the hand in the form of a 3D model. Highest details of the human skin and skeleton can be got from this method. It is a real time application also called as 3D textured kinematic. The volumetric based approach can be further divided as objects that have same geometric structure but are categorized into different sub classes [3]. While designing these models they have some constraints.

➤ **3D Geometric based recognition:** It gives more information about the skeleton and less information about the skin. It is less precise compared to

volumetric analysis. The hand geometry and matrix like figure length, width and other attributes are determined. Hand image segmentation is an important step in this method [4].

- **Skeletal based Recognition:** The limitations that occur in volumetric based recognition have been overcome by this method. For higher efficiency Sparse coding is used. It is a complex feature optimization. To recover the sparse signal from few observations, the compressive sensing is used and it helps to reduce the resource consumption [5].



Fig 4 : Skeleton based recognition

- ◆ **Depth based recognition:** Depth based recognition played a very important role in the advancement of gesture recognition. For 3D based recognition the depth based camera is used. These are powerful cameras that capture the 3D image directly. illumination, shadow and colour will not affect this approach. Only with visible light it is possible to separate covered object and different parts of the same object. Eg. Kinect Camera developed by Microsoft.

IV. CONCLUSION

The world is going digital. Gesture recognition technology has its application in almost all fields. Advancement in this technology is progressing day by day. We have discussed the method used to identify a gesture and various techniques in it. The problems occurring are being irradiated by plenty of research. Hence this technology is being used for the betterment of human life.

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