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Review of Hand Recognition Techniques

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Abstract--Gloves and sensor based trackers are cumbersome, constraining and uncomfortable to use. For this limitation of these devices the useable command set based diligences is also limited. Direct use of hands as an input device is an innovative process for providing natural Human Computer Interaction which has its inheritance from text- based interfaces through 2D graphical-based interfaces, multimedia-supported interfaces, to full-fledged multi-participant Virtual Environment systems.[5]***For conceiving a future period of human-computer interaction with the implementations of 3D application where the user may be able to move and rotate objects simply by moving and rotating his hand - all without help of any input device.***[5]

Now the research emphasizes on or we can say centralizing and focused on implementing an application that employs computer vision algorithms and gesture recognition techniques which results in developing a low cost interface device for interacting with objects in virtual environment using hand gestures. The prototype architecture of the application comprises of a central computational module that uses the camshift technique for tracking of hands and its gestures.[5] ***Haar like technique has been utilized as a classifier that is beneficial for locating hand position and classifying gestures***[5]***. The hand pattern of gestures has been done for recognition by mapping the number of defects that is formed in the hand with the assigned gestures. This will be useful in the future to promote controlling applications like virtual games etc. in virtual environment using hand gestures.***

Keyword- CAD, VOES, YUV

I. INTRODUCTION

Computer recognition of hand gestures may provide a more natural human-computer interface, allowing people to point, or rotate a CAD model by rotating their hands. Interactive computer games would be enhanced if the computer could understand players hand gestures. Gesture recognition even may be useful to control household appliances. Gestures can be classified into two categories: static and dynamic. A static gesture is a particular hand conjuration and pose, represented by a single image. A dynamic gesture is a moving gesture, represented by a sequence of images. We focus on the recognition of static gestures, although our method generalizes in a natural way to dynamic gestures. For the broadest possible application, a gesture recognition algorithm should be fast to compute. But in this we want to apply a simple pattern recognition method for hand gesture recognition. [2]

Interaction between humans comes from different sensory modes like gesture, speech, facial and body expressions. The main advantage of using hand gestures is to interact with computer without touching the interface. Whole efforts of the present researchdefines an environment where a number of challenges have been considered for obtaining the hand gesture recognition techniques in the virtual environment. Being an interesting part of the Human computer interaction hand gesture recognition needs to be vigorous for real life applications but complex structure formed by human hand presents a series of challenges for tracked and interpreted. Instead of gesture complexities such as variability and flexibility of structure of hand, the other challenges include the shape of gestures, real time application issues, presence of background noise and variations in clarification conditions. The specifications also involve accuracy of detection and recognition for real life applications [5].

The present research emphasizes on achieving the goal of developing an application using vision based hand gestures for manipulation of objects in virtual environment.With the usage of hand gestures our application presents a more effective and user friendly methods for intelligent human computer interaction. Functions of mouse such as controlling of movement of virtual object have been replaced by hand gestures. The challenges encountered are noisy environment that creates a big impingement on the detection and recognition performance of human hand gestures. The

designed applications are cost effectiveanduses low cost input tools such as webcam for capturing hand as input. Manipulation of virtual objects has been done via modeling of some predefined commands based on hand gestures. [5]

II. STATE OF ART

In earlier days hand gesture detection was done using mechanical devices to obtain information of the hand gesture [5]. One of the most extensively used and accepted examples for hand gestures recognition is data glove. Due to the evolution of computer hardware results in improving a lot in present scenario which leads to the better performance of computing. Enhancements in gesture recognition have replaced the role of data gloves to non-wearable devices due to its spontaneity without using any device. This is quite user friendly in human computer interaction. One of the majordisadvantages of data glove is that it is cumbersome with the limitation of hand movement.

Figure 1. Three common stages of gesture recognition systems

So vision based approaches are more ideal than wearable devices in hand gesture recognition. In general there are three stages in most of the gesture recognition systems have. The three stages may be enumerated as image pre –processing, tracking and recognition stage as shown in *Figure 1*.In tracking several researchers are there who have done the similar research like Viola-Jones based cascade classifier has done and which is commonly used for face tracking in quickly image processing [5]. Cascade classifiers are currently considered more robust pattern detection against the noises and lighting conditions as well [5].

For tracking several researchers including Viola-Jones have developed algorithms that are used for face tracking in rapid image processing like HAAR cascade classifier. At present this is one of the robust detection technique under different constraints like noise [5].Gesture is an input for human computer interaction based applications, which is an emerging field at which many of the researchers have worked and proposed different practical techniques. Jain implemented a vision based hand gesture pose estimation based application for mobile devices. Pavlovicetal[5] accomplished in their work that the gestures of users must be explained logically for developing a good human computer interaction based system .Though the present technologies that are used for gesture recognition are not feasible for providing the logical explanations to the human gestures. Another methods for hand gesture recognition are based on input-output Hidden Markov Models of tracking skin color blobs was proposed by Marcel et al. [5].The sign language tutoring tool studied by Aranetal. [5]his research has been designed to teaching the fundamental of the sign language in interactive way.

A technique implemented by Liu and Lovell [5] for real time tracking of hand capturing gestures via the use of a web camera, personal computer and image processing algorithms making it more users friendly. Chen et al. [5] implemented atechnique which is hidden Markov model for training the hand gesture and for recognizing the hand postures. Lee et al. [5] developed a Virtual Office Environment System (VOES), in which avatar is used to navigate and interact with other participants.

Existing works in hand gesture recognition which has been done by many researchers shows that the hand gesture system can also be practically implemented into several type of application systems and various environment. Ahmet. [5] developed an interactive way of slide show presentation system in the virtual environment. Research in hands, gestures and movement helps a lot in developing models of the human body. Due to this it is possible to solve the challenges from mathematical viewpoint. However, these techniques proposed are extremely complex and sophisticated for classic application scenarios. Generally pattern recognition methodologies are capable for solving the problem with humbler hardware and computation necessities. In the present research effort, we will consider these aspects by taking them as a reference to a smart interaction environment of virtual object manipulation and control. Here in this the user can execute different actions that are translated into a command for an intelligent system and which further execute the user requirements into practical actions.

III. APPLICATION ARCHITECTURE DESIGN

Different combinationsofcomputer vision techniques are there for hand gesture recognition which are used by different applications. Method recognizes static hand gestures. Figure 2 shows the application architecture design for manipulating virtual objects using hand gestures.

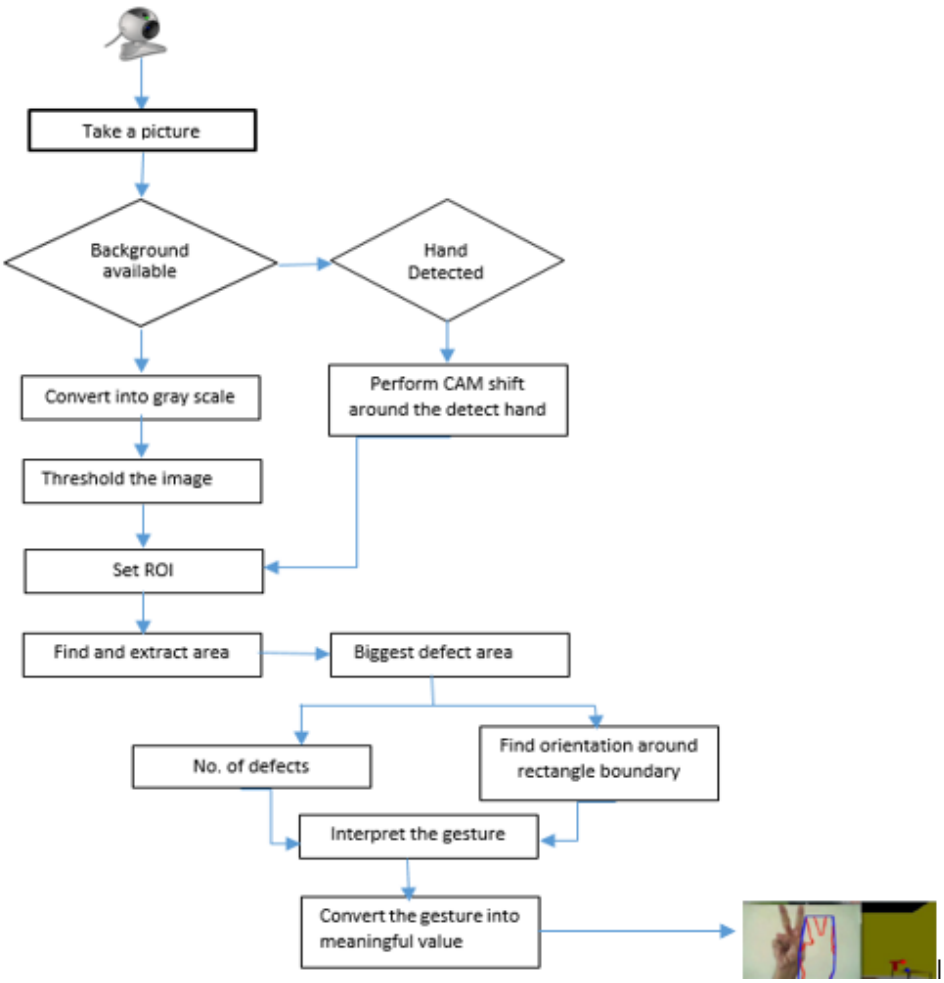

Figure 2. Application architecture design

❖ **Block Diagram**:

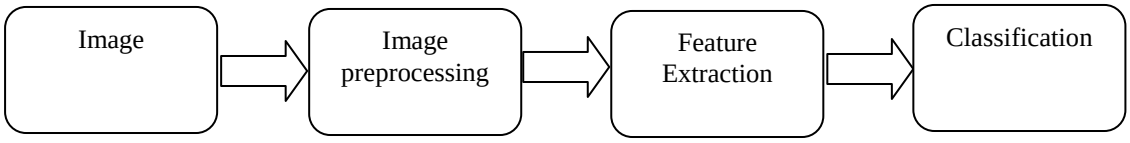

Figure 3.Block diagram of the Hand Gesture Recognition system

IV. APPLICATIONS AND ANALYSIS

a) *Virtual Reality*: Gestures for virtual and enlarged reality applications have experienced one of the greatest levels of uptake in computing. Virtual reality interactions uses gestures to enable realistic manipulations of virtual objects using one's hands, for 3D display interactions or 2D displays that simulate 3D interactions.

b) *Games*: When we look at gestures for computer games. Freeman tracked a player's hand or body position to control movement and orientation of interactive game objects such as cars. Konradetal. [5] used gestures to control the movement of avatars in a virtual world, and Play Station 2 has introduced the Eye Toy, a camera that tracks hand movements for interactive games

c) *Sign Language*: Sign language is an important case of communicative gestures. Since sign languages are highly structural, they are very suitable as test beds for vision algorithms [5]. At the same time, they can also be a good way to help the disabled to interact with computers. Sign language for the deaf (e.g. American Sign Language) is an example that has received significant attention in the gesture literature [5].

d) *Television, Mobile, laptops contro*l: Hand postures and gestures are used for controlling these devices. In a set of hand gesture, it is use 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. Similarly hand gesture is used in mobiles and laptops for controlling their functions.[3]

V. HAND GESTURE CHALLENGES

Hand gesture recognition system have various challenges: Variation of different conditions, where any change in the lighting condition affects badly on the extracted hand skin region [4].

i. Rotation problem: this problem arises when the hand region rotated in any direction in the scene [4].
ii. Background problem; refers to the complex background where there is other objects in the scene with the hand objects [18] and these objects might contain skin like color which would produce misclassification problem.
iii. Scale problem; this is the problem in which the hand style or positions have different sizes in the gesture image [4].
iv. Translation problem; the variation of hand positions in different images also leads to erroneous representation of the features.

VI. HAND RECOGNITION TECHNOLOGIES

A.YUV Color Space and CAMSHIFT Algorithm[7]

This method deals with recognition of hand gestures. It is done in the following five steps.
1. First, a digital camera records a video stream of hand gestures.
2. All the frames are taken into consideration and then using YUV color space skin color based segmentation is performed. The YUV color system is employed for separating chrominance and intensity. The symbol Y indicates intensity while UV specifies chrominance components.
3. Now the hand is separated using CAMSHIFT algorithm .Since the hand is the largest connected region, we can segment the hand from the body.
4. After this is done, the position of the hand centroid is calculated in each frame. This is done by first calculating the zeroth and first moments and then using this information the centroid is calculated.
5. Now the different centroid points are joint to form a trajectory .This trajectory shows the path of the hand movement and thus the hand tracking procedure is determined.[7]

B.Naïve Bayes' Classifier

This method is an effective and fast method for static hand gesture recognition. This method is based on classifying the different gestures according to geometric-based invariants which are obtained from image data after segmentation; thus, unlike many other recognition methods, this method is not dependent on skin color. Gestures are extracted from each frame of the video, with a static background. The segmentation is done by dynamic extraction of background pixels according to the histogram of each image. Gestures are classified using a weighted K-Nearest Neighbors Algorithm which is combined with a Naïve Bayes [6] approach to estimate the probability of each gesture type. When this method was tested in the domain of the JAST Human Robot dialog system, it classified more than 93% of the gestures correctly. This algorithm proceeds in three main steps. The first step is to segment and label the objects of interest and to extract geometric invariants from them. Next, the gestures are classified using a K-nearest neighbor algorithm with distance weighting algorithm (KNNDW) to provide suitable data for a locally weighted Naïve Bayes' classifier. The input vector for this classifier consists of invariants of each region of interest, while the output is the type of the gesture. After the gesture has been classified, the final step is to locate the specific properties of the gesture that are needed for processing in the system—for example, the fingertip for a pointing gesture or the center of the hand for a holding-out gesture.[7]

C. Fingers Recognition

In the segmentation image of fingers, the labeling algorithm is applied to mark the regions of the fingers. In the result of the labeling method, the detected regions in which the number of pixels is too small is regarded as noisy regions and discarded. Only the regions of enough sizes are regarded as fingers and remain. For each remained region, that is, a finger, the minimal bounding box is found to enclose the finger. A minimal bounding box is denoted as a red rectangle in Figure 10. Then, the center of the minimal bounding box is used to represent the center point of the finger4. [1]

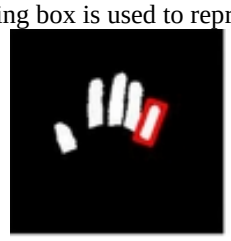

Figure 4

D. Orientation Histogram algorithm

This method is dependent on feature vector called orientation histogram for pattern recognition. The feature vector forms a histogram based on the edges of the image. The system is trained by giving hand postures as commands. First the image is captured using a webcam then again the image is converted into grey scale image .Next step is to find histogram of the image.
In the histogram 360 degrees is grouped into 36 groups with each group of ten degree, for every pixel (x,y) in an image, the gradient of the pixel is given by

$$dx=I(x,y)-I(x+1,y) \text{ and } dy=I(x,y)-I(x,y+1)$$ [6]

Gradient direction and gradient magnitude are given by arctan(dx, dy) and sqrt(dx*dx+dy*dy) respectively. If gradient magnitude is greater than threshold, the group of gradient direction is found and the frequency is incremented. Now the histogram is saved as a training pattern. Thereafter for recognition of image here are the steps i.e. capture, conversion to

grey scale and histogram calculation. Then Euclidean distance is found between the new image captured and the various patterns .The pattern with least distance is found. The advantage of this method is that it is very fast, strong and translation invariant [6].

VII. CONCLUSION

This paper consider the recent years there is a vast improvement in the human computer interaction. Technology like Hand Gesture recognition helps to interact with the machine more efficiently, and also help the physically challenged people to use this technology more efficiently.

This paper gives an overall description about the algorithms and the uses in hand gesture recognition. The proposed algorithms like camshaft, histogram hand recognition, Finger recognition, Naïve Bayes' Classifierhelps to interact with the machine accurately and more effectively. Camera which helps to sense the motion of the hand and give exact depth to recognize it. Technique like relief helps to recognize the hand gestures with the predefined vocabulary of gestures.

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