A Survey of Vision-Based Hand Gesture Recognition System

Anirudha Kadam[1], Suvarna Potdukhe[2]

P.G. Student, Department of Information Technology, RMD Sinhgad College of Engineering, Warje, Pune, India[1]

Assistant Professor, Department of Information Technology, RMD Sinhgad College of Engineering, Warje, Pune, India[2]

ABSTRACT: The task of hand gesture recognition is highly challenging due to complex background (i.e. disturbance), presence of non-gesture hand motions, and various illumination environments. The proposed techniques begin by detecting the hand, tracking the hands movements and analysing the variations in the hand locations (i.e. Motion detection), and finally recognizing the appropriate gesture. Since the introduction of new gesture recognition technologies, interactive hand-gesture devices (such as smart televisions and displays) have been rapidly emerging.

KEYWORDS: Hand-gesture interaction, gesture elicitation study, preferences and attitudes, gesture set, human-computer interaction.

I. INTRODUCTION

Gestures are expressions, meaningful body motions involving physical movements of the fingers, hands, arms, head, face, or body with the implication of: 1) conveying meaningful information or 2) interacting with the other people. Gestures can be either static or dynamic, but some gestures also have both static and dynamic elements, as in sign languages. A dynamic gesture changes over period of time perhaps a static gestures can be observed at the quantum of time. A waving hand means goodbye is an example of dynamic gesture whereas; the stop sign is an example of static gesture. To understand the complete message, it is necessary to encode and decode all the static and dynamic gestures over time. This complex process is called as gesture recognition. Gesture recognition is a task of recognizing and interpreting multiple streams of continuous frames from the given set of input data [1].

Gestures represent a space of motion expressed by the body, face, and hands. Among a variety of gestures hand gesture is the most expressive and the most often used. This kind of human-machine interfaces would allow users to control a huge variety of devices through gestures [5], especially hand gestures.

Recognizing hand gestures for interaction can help in achieving ease of access desired for human computer interaction. Humans usually use hand gestures for expression of their feelings or to notify their thoughts [2].

II. RELATED WORK

The user interface (UI) of the personal computer has evolved from a command line interface to a graphical user interface using keyboard and mouse inputs. However, they are inconvenient and unnatural. The use of hand gestures will provide an attractive alternative to these cumbersome interface devices for human-computer interaction (HCI) [2]. User's usually use hand gestures for expression of their feelings and notifications of their thoughts. The visual interpretation of hand gestures can help in achieving the ease and naturalness desired for HCI [2]. Vision has the potential of carrying a wealth of information in a non-intrusive manner and at a low cost [1].

The Vision-based interaction system can be easily adapted to differentiate multiple scales of applications. For example, the base of Vision-based interaction should be the same for desktops, Hand Sign Language Recognition,

robot navigation and also for VE [2]. Most of the know systems rely on the idea of detecting and segmenting the hand gestures from the background using motion detection or skin color detection [1]. The proper selection of features and their combinations with appropriate recognition algorithms, may affect the success of any existing and future work in the field of Human Computer interface using hand gestures [2].

Selecting features is crucial to gesture recognition, hand gestures are very rich in shape variation, and they may vary from different motion and textures [3]. For static hand gesture recognition, although it is possible to recognize hand gesture by extracting some geometric features such as fingertips, finger directions and hand positions, some features may not always be available and reliable due to self-occlusion and lighting conditions [2]. There are also many other non-geometric features such as colors, Silhouette and textures, however, they may be inadequate in recognition. It is not easy to specify features explicitly. The entire image or transformed image is then taken as input and features are calculated implicitly and automatically by the recognition algorithm [4].

   In vision based hand gesture recognition system, the motion of hand is captured by the video camera. This input video is an encapsulation of set of features taking individual frames into account [3]. Filtering may also be performed on the frames to remove the unrequired data, and highlight the necessary components [4]. For example, the hand is isolated from other body parts and other background objects. The isolated hand is recognized for different postures. Since, gestures are nothing but a sequence of hand positions are connected by continuous motion, a recognizer must be trained against the possible grammar [3]. Hand gestures can be specified as building of a set of hand postures in various ways of composition. For example, phrases are built up by words [3].The recognized gestures can be used to drive a variety of applications (Fig. 1).
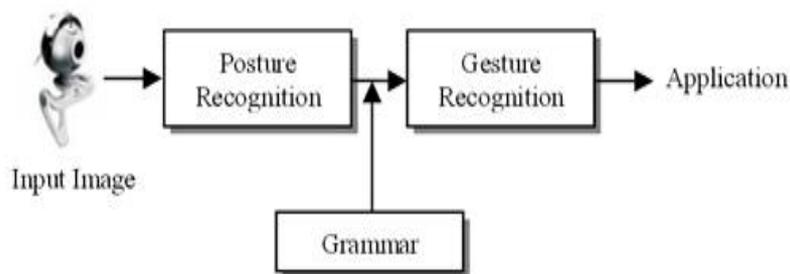

Fig.1. Hand Gesture Recognition Process

III. **APPROACHES USED**

A. **Hand detection in an image frame**

Skin tone detection: palm skin can be easily detected using the color tone information, as shown in figure 2 [5]. RGB based color is classified as palm skin if:

$$0.08 < 3*B*R^2/(R+G+B)^3 < 0.12$$
$$1.5 < R*B*G^2/G*B < 1.8$$
$$R+G+B/3*R+R+G+B/R-G < 1.4$$

Extracting hand region: Extraction of hand by skin color tracking, we draw on ideas from robust measurements and probability distribution filters for finding a fast, simple algorithm for basic tracking [3]. This paper identifies image regions corresponding to human skin by binarizing(RGB values) the input image with a proper threshold values, then by removing small regions from the binarized image by applying a median operator to distinguish the palm of hand, as shown in figure 2 [4].

Finding a palm's centre and hand roll calculation:In this paper, the centre of user's hand is given a first moment of the 2-D probability distribution during the process of hand tracking operation, where (x, y) range over the search

window [4]. Here, the palms center coordinates (i.e. x and y coordinates) is obtained by,
Centre x = width /2,

Centre y = height /2.

Fig.2. Orientation of the flesh probability distribution marked on the source video image from CCD camera.

B. HAND GESTURE TRAJECTORY (MOVEMENT) TRACKING

The proposed mechanism for hand motion tracking has two stages: 1) focuses on the motion information and stores the latest 10 transitions of the defined central points on queue as shown in Figure 3 & 4, 2) focuses on analysing and processing these points as follows:

Select point x from centroid p(x, y) and store it in X-array and repeat this work for Y as Y-array. With neglecting the value of the point at P (0,0) at Table 1 & 2 [5].

(a)

(b)
Fig. 3 (a),(b) illustrate the latest manipulated points

X	2	3	0	6	9	11	0	14
Y	183	178	0	170	168	164	0	161

Table 1 The original array

X	2	3	6	6	9	11	11	14
Y	183	178	178	170	168	164	164	161

Table 2 the processed array with P(0,0) elimination

It is impossible for a person to make more than 25 gestures in only one second; it is feasible to consider only 10 frames per second. A tracking system should be implemented in order to avoid complete analysis of each frame [5].

C. Hand Gesture Recognition

The gesture processing is done dynamically; we need a mechanism to recognize gestures using their axial motion of the palm. The proposed system must be robust and should demonstrate variations in the attributes of a gesture [4].

Below algorithm Gesture recognition demonstrates recognition of four gestures viz, Left to right, Right to left, Up to down, Down to up [5].

if -15 < θ <15 then
rtl ← rtl + 1
Sum_rtl ← Sum_rtl + d
else if 75 < θ <105 then
utd ← utd + 1
Sum_utd ← Sum_utd + d
else if 165 < θ <195 then
ltr ← ltr + 1
Sum_ltr ← Sum_ltr + d
else if 255 < θ < 285 then
dtu ← dtu + 1
Sum_dtu ← Sum_dtu + d
end if
end for

IV. PROPOSED WORK

Most of the HCI systems, such as surface, mobile, and hands-free computing, integrate gestures created by system design experts. The system design experts develop the gesture vocabulary which favours various gestures which result into

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better performance of the recognition engines over users comfort and preferences. It might be ideal for the system designer, but harder for the users [1].

The hand detection is a sophisticated task. The task of hand recognition is performed using the below approach.

For hand detection image is captured from video camera. Proposed system takes the video stream as input. These images are processed by the system. The operators used for image processing must be low time consuming in order to obtain the fast processing rate in order to achieve real time speed [6].

There are various approaches for hand detection. The simple way to detect hand is to capture image and search for skin color region in the image but skin color region detection is difficult because it may detect background color and other body parts from image as palm skin. The camera is used to track the hand movements [6].

After recognition of hand the gesture recognition is a vast task considering computers. This task of gesture recognition is performed by below approach.

Hand gesture can be obtained by detecting the hand gesture from the image and distinguishing hand from the background from the unwanted objects. Skin color provides an effective and efficient Method for hand detection. Segmentation based skin color method applied for hand locating. Recognition process is affected by the proper selection of gesture parameters of features and the accuracy of its classification. For example, edge detection and counter are not suitable for gesture recognition since it might lead to misclassification. Edge detection algorithm is applied on the image captured by camera. The proposed algorithms detect which gesture is selected [6].

V.   CONCLUSION

Construction of an efficient hand gesture recognition system is an important aspect for an ease of interaction between human and machine. The proposed system recognizes hand by skin tone of the palm and recognizes the gesture by the motion of hand. The system uses the proposed approaches for Hand gesture recognition.

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