Hand Gesture Recognition System with Real-Time Palm Tracking Using American Sign Language

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Abstract— A primary purpose of gesture recognition is to create a system that able to recognize specific human gestures and use that for conveying information for controlling the device. Real-time gesture recognition is implemented and a user can control a computer by doing a specific gesture in front of a video camera linked to the computer. Gesture recognition is with ASL (American Sign Language) is interpreted and the communication with the computer is possible for Deaf and Dumb people and sign language is used for communication. PCA is mainly used to differ the same images precisely.

Keywords: American Sign Language, Image Processing

I. INTRODUCTION

Static gestures are the gestures, where the user assumes a certain type of pose or configuration or dynamic gestures defined by movement. After that hand Gesture can be subdivided into two types, firstly global motion where the entire hand moves whereas in the second one that is local motion (or posture) only the fingers move. Again a sign language is a language where people use gestures instead of speech to communicate with others [1].

In Human-computer interface (HCI), the communication is possible without the need of any physical device. The advantage of using HCI is no any communication media or device is required. This can be achieved by removing input devices like joysticks, mouse, keyboards etc and permitting the body to give signals to the computer through gestures [2]. As Compared to voice commands, hand gestures have various advantages in some situations like noisy environments, sound prohibited areas etc. as well as for spatial relationships and to transfer quantitative information.

American Sign Language (ASL) is a complete sign language that is widely used by deaf people in the United States and the English-speaking part of Canada. ASL speakers can communicate with each other conveniently by using hand gestures [2]. However, communicating with deaf people is a problem for sign language speakers. There are some professional interpreters that can able to solve deaf people problem by real-time sign language interpreting, but the cost is usually high. But, such interpreters are rarely available. Therefore, an automatic ASL recognition system is highly desirable.

II. METHODOLOGY

Here, we have proposed accurate palm and fingertip position estimation based on the contour of hand which is a method for various bare hand posture recognition. Including Forearm can also be to the contour and the system has a good toleration against rotation and siltation of hand. We have taken into consideration that PCA to distinguish similar types of gesture. Optical flow algorithm is used to minimize the effect of movement epenthesis. Approach for Gesture Recognition of an input pattern and provides a confirmation mechanism for the matching gesture patterns. The threshold model is a weak model for all trained gestures. Its likelihood is smaller than that of the dedicated gesture model for a given gesture. Also in the Hand Gesture Recognition Using Principal Component Analysis, which includes detecting and tracking bare hand in the cluttered background where skin detection and hand postures contours comparison algorithm after face subtraction, and recognizing hand gestures using Principle Components Analysis (PCA).

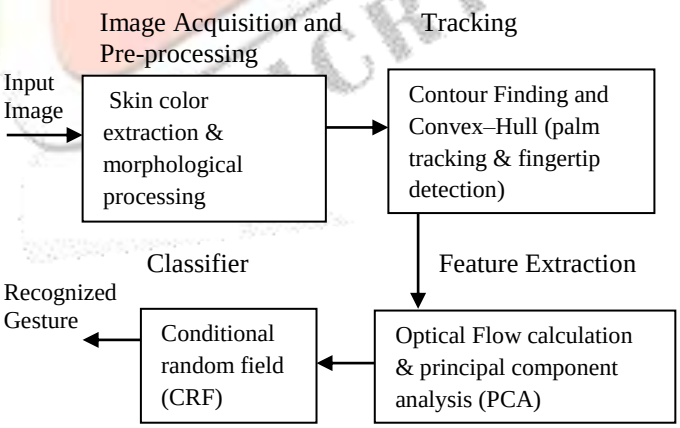

Figure 1 Block Diagram

1. Image Acquisition & pre-processing (Skin color extraction & Morphological processing):-

The input gesture is the RGB images captured by a web camera, from which we extract skin colored region using HSV color model by setting upper and lower bound thresholds for H, S, and V. To make the system a real-time processing and trying for adapting to the environments, we have used HSV color model algorithm to extract skin color regions. These skin color regions are converted to binary images. After that

morphological operations such as erosion and dilation are performed. Noises are eliminated by erosion and the contour of skin color area is smoothed by dilation [2]

2. Tracking:-

2.1 Contour finding: -A contour can be defined as a series of points where the boundary pixels of a region. The white pixel region of the image represents the skin color area. The contour of this region is found out by comparing the length of all that contours so that we can ignore that small area and we give the attention on forearm area. For that, we have used The Pavlidis Algorithm which is able to find out only boundary pixels to find contours and gives not only low cost but also gives the contour information that we need.

2.2 Convex-Hull: - From the convex hull of the forearm contour we calculate the convexity defect as it can show many of complicated contours. In general, the portion of the hand is more convex and it concaving that contours rather than arm part and it has the information that we have to need. After comparing that forearm contour and its convex hull, we can able to find out the convexity defects around the palm area. From this, we are able to calculate the depth point in each convexity defect. These depth points are found to be on the edge of palm portion since the convexity defects are around the palm area. Again as the forearm is relatively smooth, the defect of neighbor does not create a point which has the longest distance to the convex hull on the arm contour. By all these points, we can properly search the position of palm area even when the forearm is included in the input contour.

2.3 Palm Tracking: - All the depth points that appear in the area of palm. They distribute the same palm center; the minimum enclosing circle of the depth points indicates a good palm position [5].

2.4 Fingertip detection: - We can differentiate the fingertip points by considering the endpoints from a series of contour points and a sharp shape of fingertips. Fingertips have marked the contour by calculating the angle of each point [5].

3. Feature Extraction:-

3.1 Optical Flow calculation: - Optical flow working on some assumptions. The pixel intensities of an object are stable between consecutive frames and motions of neighboring pixels are similar. Consider a pixel I (x*;* y*;* t) the first frame that moving by distance (dx, dy) in next frame, taken in the interval of dt time. Optical flow equation can be calculated as, $f_x\ u + f_y\ v + f_t = 0$ [5].

Where fx, fu is image gradients and ft is the gradient along time.

3.2 Principal Component Analysis (PCA):- PCA is used to convert possible correlated values to uncorrelated values. Principal components, a variety of components always less than or equal to the number of original variables. The transformation is making such that the first value is the largest and after that, each succeeding component, in turn, has the highest variance possible under the condition. It should be orthogonal that is uncorrelated with the preceding components [3].

4. Classifier (Conditional Random Field CRF):-

CRF's are useful in pattern recognition and machine learning applications and it is a method of statistical modeling. The main advantage of CRF is that it takes the neighboring samples also while an ordinary classifier predicting only one sample. By using CRF model, some hand gesture data are trained and tested. The classifier divides all the gestures into different blocks. They must have to be trained using some features and after that test the system with that trained classifier for acquiring the classified output [4].

III. EXPERIMENTAL RESULTS

Figure 2 Y Alphabet [5]

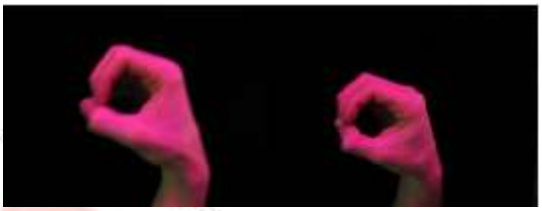

Figure 3 O Alphabets [5]

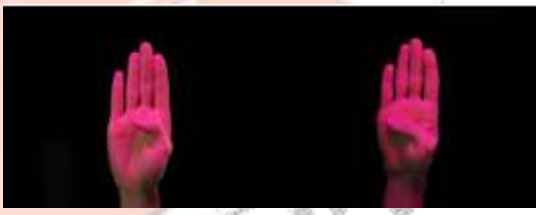

Figure 4 B Alphabets [5]

Figure 5 I Alphabet [5]

Figure 6 C Alphabet [5]

Figure 7 X Alphabet [5]

Figure 8 Z Alphabets [5]

Figure 9 W Alphabets [5]

IV. CONCLUSION

It is the easiest way to interact with computers without any mechanical device and this interface makes human users be able to control smart environments by hand gestures and the system is easily interpreted using image processing. Hence here we are recognized alphabets and numbers and interpreted total sign language.

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