Hand Gesture Recognition

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***Abstract*—Gesture recognition is a topic in computer science and language technology with the goal of interpreting human gestures via mathematical algorithms. Gestures can originate from any bodily motion or state but commonly originate from the face or hand. Current focuses in the field include emotion recognition from the face and hand gesture recognition. Many approaches have been made using cameras and computer vision algorithms to interpret sign language. However, the identification and recognition of posture, gait, proxemics, and human behaviors is also the subject of gesture recognition techniques. Gesture recognition can be seen as a way for computers to begin to understand human body language, thus building a richer bridge between machines and humans than primitive text user interfaces or even GUIs (graphical user interfaces), which still limit the majority of input to keyboard and mouse. Among us, there are some people who do not have the voice to express, and sometimes, the capability to hear. The deaf and dumb sign language was developed to aid the communication for such people. Our idea is to create a user-friendly interface which could help them communicate, to give them a voice.**

Keywords: Contours, Hull Convex Algorithm, Segmentation, Gesture Recognition, Human Computer Interaction (HCI)

I. Introduction

A gesture is a spatiotemporal pattern which may be static, dynamic or both,[1] and is a form of non-verbal communication in which bodily motions convey information. Gestures include motion of head, hands, fingers or other body parts.[2] Gesture Recognition collectively refers to the whole process of tracking human gestures , to their representation and conversion to semantically meaningful commands.[3] Gesture Recognition and more specifically hand gesture recognition can be used to enhance Human Computer Interaction (HCI) and improve the effective utilisation of the available information flow.[3] In this section we discuss the motivation for this project, the aims and objectives of the project and the overview of this report.

A. Motivation

This project is related to two significant fields , computer vision and machine learning. Both of these field are of immense importance in contemporary times due to their widespread use in various disciplines. Computer vision can be defined as a field that incorporates methods for acquiring, processing, understanding and using images and in general any high dimensional real world data in order to produce useful information. This project focuses on gesture recognition and it uses computer vision and machine learning techniques to achieve this goal. We can use various body parts like hand, fingers, head and other objects to perform gestures, but this project focuses on hand gestures because as shown in figure 1 hands are used for performing 21 % of gestures and along with other body parts they are used in a majority of the gesture performed.

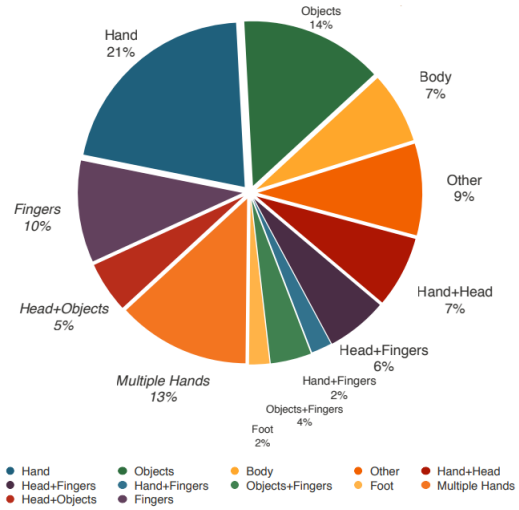

Figure 1: Body Parts used for gesturing

In this project we focus on using a normal web camera as they are ubiquitous and therefore provide better chances of acceptance by the general public. Generally, Hand Gesture Recognition involves three major steps; the first step is hand detection and tracking which involves capturing the image/video then performing some preprocessing to enable us to detect the hand in the frame and then using other techniques to track the hand in consecutive frames and throughout the video, the next step is feature extraction which involves extracting features from the image that represents important properties of hand gestures and then we use machine learning techniques to use the extracted features to classify the hand gestures.The techniques used in these steps have usage in various other fields like image processing, Data analysis, prediction based applications, image reconstruction etc, so working with these techniques can help in understanding and improving other applications too.

B. Objectives

We can divide the project into three major steps which represent the major objectives in the project.

Hand Detection and Tracking
This step deals with detection of hand in the frame and tracking it through the video, our objective in this step is to create a robust system that can detect and track hands of different skin colours in varying light conditions with different but simple background.

Feature Extraction
This step deals with extracting important features that represent important characteristics of the gesture throughout the video and then storing these features. Our objective in this step is to find features that represent shape, motion, size, reflectivity and other important properties. We want features that are generative and not discriminative as this will allow multiple gestures to be recognised with limited

features.

Recognition

This step deals with recognising and classifying the performed gesture.It has two phases , the training phase which involves training the system on datasets and the classification phase which involves classifying the performed gestures, our objective in this step is to obtain classification with high accuracy within minimum time.

II. Literature Review

A) Hand Gesture Recognition: A Literature Review - 2012

In this paper, they did literature review on hand gesture system with its aim as well as they explained advantages and disadvantages of system. They also presented key issues with its challenges. Review methods of recent postures and gestures recognition system presented as well. Different standard dictionaries used by various experts in this field was an important finding from this paper.

B) Hand-gesture recognition using computer-vision techniques - 2013

In this paper, they presented method to detect hand gestures based on computer-vision techniques, an implementation works in real time six gestures captured through an ordinary webcam. Method combines skincolor filtering, edge detection, convex-hull computation, and a rule-based reasoning with the depths of the convexity defects. Hull convex algorithm was an important finding from this paper for tracking the fingers in order to overcome the drawbacks of transformation.

III. Algorithm

The major task is to perform robust skin segmentation which will help in background separation. This will lead to a model which will be robust to changing illumination and it will ignore the minor movements in the background.

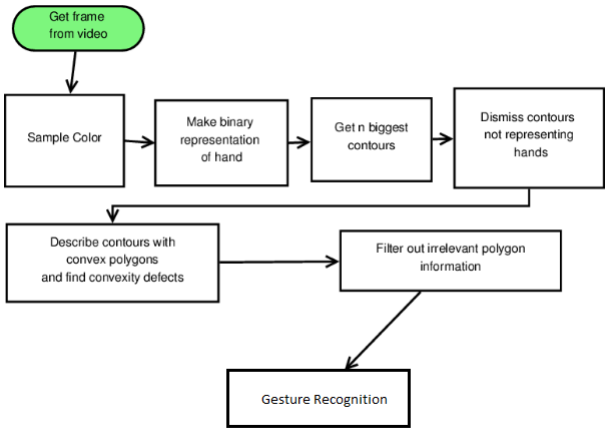

Figure 2: Flowchart Representation

Step 1: Input video Stream.
Step 2: Pre-processing the frame to get binary representation.
Step 3: Performing thresholding to get a filtered frame with accurate skin segmentation.
Step 4: Calculating the biggest countours.
Step 5: Dismissing the countours which do not represent the hand.
Step 6: Apply Hull Convex method and form the convex polygons using the fingertips.
Step 7: Calculate the length of each side of the polygon and the angles formed within the polygon.
Step 8: Identify the gesture based on the convexity defects and the angles calculated.

IV. Results and Implementation

The algorithm is used to perform segmentation of the palm which is the region of interest. Then we calculate the convex points in the countour and filter out irrelevant convexity defects. The cosine rule is applied to calculate the angles between different polygons of the fingers formed and these angles are utilized to identify the gestures. We have defined a library having 11 gestures using one hand.

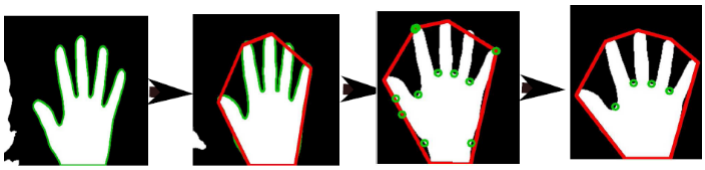

Figure 3: Filtering out the convexity defect that are not relevant

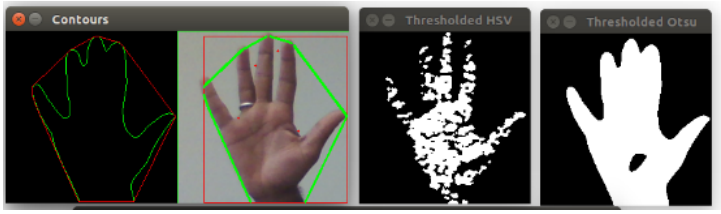

Figure 4: Contours and Thresholding

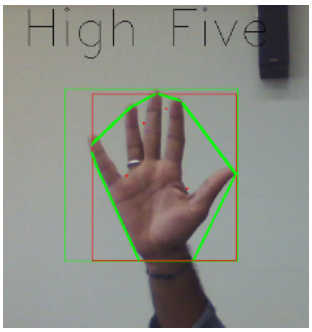

Figure 5: Gesture: High-Five

Table 1: Accuracy

	Ideal Conditions	Non-ideal Conditions
Accuracy	More than 85%	Between 30-50%

V. Conclusion

We have presented a method for detecting hand gestures based on computer-vision techniques, together with an implementation that works in real time on a ordinary webcam. The method combines skin-color filtering, edge detection, convex-hull computation, and a rule-based reasoning with the depths of the convexity defects. We had reported as well user experiments on the detection accuracy of the developed prototype, detecting correctly eleven hand gestures made on either hand, in a controlled environment. Additionally, Hull convexity removes convexity defects and helps to form different hand contours.Convexity defect is the deepest point of deviation on the contour. Cosine rule helps to find angle for all convexity defects and separate different gestures.

References

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