

Sign Language Recognition Using Image Based Hand Gesture Recognition Techniques

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Abstract—Hand gesture is one of the method used in sign language for non-verbal communication. It is most commonly used by deaf & dumb people who have hearing or speech problems to communicate among themselves or with normal people. Various sign language systems has been developed by many makers around the world but they are neither flexible nor cost-effective for the end users. Hence in this paper introduced software which presents a system prototype that is able to automatically recognize sign language to help deaf and dumb people to communicate more effectively with each other or normal people. Pattern recognition and Gesture recognition are the developing fields of research. Being a significant part in non-verbal communication hand gestures are playing key role in our daily life. Hand Gesture recognition system provides us an innovative, natural, user friendly way of communication with the computer which is more familiar to the human beings. By considering in mind the similarities of human hand shape with four fingers and one thumb, the software aims to present a real time system for recognition of hand gesture on basis of detection of some shape based features like orientation, Centre of mass centroid , fingers status, thumb in positions of raised or folded fingers of hand

Index Terms—Centroid, Gesture, Orientation, Recognition, sign language.

I. INTRODUCTION

The sign language is a very important way of communication for deaf-dumb people. In sign language each gesture has a specific meaning. So therefore complex meanings can be explained by the help of combination of various basic elements. Sign language is a gesture based language for communication of deaf and dumb people. It is basically a non-verbal language which is usually used to deaf and dumb people to communicate more effectively with each other or normal people. Sign language contains special rules and grammar's for expressing effectively. Basically there are two main sign language recognition approaches image-based and sensor-based. But lots of research is going on image based approaches only because of advantage of not need to wear complex devices like Hand Gloves, Helmet etc. like in sensor based approach[24]. Gesture recognition is gaining importance in many applications areas such as human interface, communication, multimedia and security. Typically Sign recognition is related as image understanding. It contains two phases: sign detection and sign recognition. Sign detection is an extracting feature of certain object with respect

to certain parameters. Sign recognition is recognizing a certain shape that differentiates the object from the remaining shapes. Language, especially in the cases when no alternative communication is available. The technical point of view characteristic features of sign language communication are: its social direction and meaning; technical and technological convenience and easy to use. The system will use a webcam for the capturing images and pre-processing of the signs will be done by using Microsoft Visual Studio as an IDE and OpenCv library. On having the input sequence of images captured through web-cam here uses some image pre-processing steps for removal of background noise and employs slope distance based algorithm i.e. Fingertip Detection by convexity hull algorithm which generates a ratio with a help of which a template of the captured image is generated.

II. LITERATURE SURVEY

Basically there are two approaches for sign recognition vision based and sensor based gesture recognition[4]. Lots of study has been done on sensor based approaches like gloves, wires, helmets etc[20][21][22]. but due to disadvantage of wear it continuously is not possible, therefore further work is concentrated on Image based approaches [1].

Some earlier work has done on image based approaches for hand gesture and sign recognition in last few years[3].there has been various approaches for gesture recognition like HMM(Hidden markov model)[16],ANN(Artificial neural network)[17].Eigen value based[18], perceptual color based[1][19]. In [14] authors suggested gesture recognition algorithm using GMM and HMM. Methods like Support Vector Machines (SVM) proposed for classification and particle filtering [15]. There are various methods for image segmentation. The HSV, color space defines color with intuitive values. The Perception of the color space components and Discrimination between luminance and chrominance components works effectively for skin color segmentation [6]. Therefore HSV color model selected for hand Segmentation. The various methods used in Feature Extraction [10] Describes those methods: Contour shape techniques which extract boundary information of signs [2]. One of the most prominent achievements that were achieved in the field of sign to voice conversion and voice to sign which can remove communication barrier[9].

III. IMAGE BASED GESTURE RECOGNITION

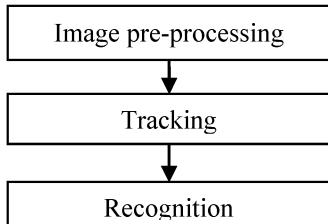


Fig.1 Gesture Recognition System

As shown in Fig.1, Image based gesture recognition system is divided into three steps. In Image-preprocessing color to binary conversion & Noise filtering is done for captured image., Tracking is mainly used for tracking a hand gesture from capture image using Convexity hull algorithm[12]. Finally recognition is done with the help of features like convex hull and convex defects taken from tracking. Image based gesture recognition can be used in many applications one of them is sign language recognition which is as explained below.

IV. PROPOSED METHODOLOGY

A. Acquisition of Data (Camera Interfacing)

This is a primary and essential step in sign recognition whole process. Camera interfacing is necessary task to capture images with the help of Webcam. Now a days lots of Laptops are coming with inbuilt camera system so that's helps lot for capturing images to process it further. Gestures can be captured by inbuilt camera to detect hand movements and position. Capturing 30fps will be sufficient to process images; more input images may leads to higher computational time and will make system slow and vulnerable.

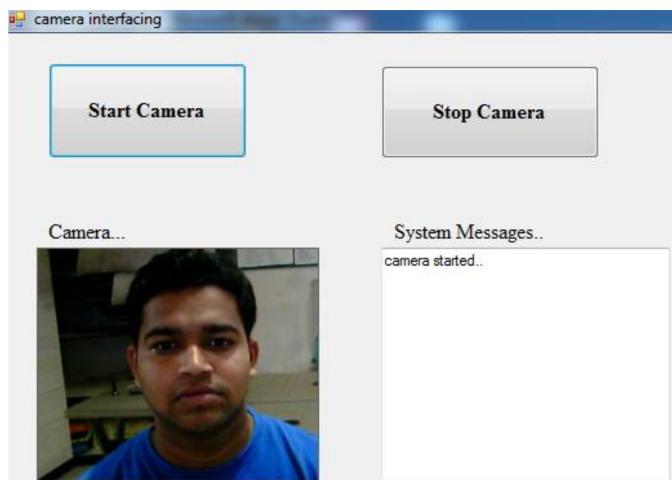


Fig.2 Camera interfacing

B. Image Preprocessing

Image pre-processing contains removing unwanted noise, adjusting brightness and contrast of the image, cropping the image as per requirement [11]. In this process contains image enhancement, segmentation and color filtering process.

I. Image Enhancement and segmentation

As images captured by webcam is RGB images, but RGB images are very much sensitive for various light conditions therefore RGB information convert into YCbCr. Where Y is luma component which denotes luminance information of image, and Cb, Cr are chromo components which give color information of images red difference and blue difference. Luminance component may create problems so only chrominance components get process further. After that YCbCr image converted to binary image.

II. Color filtering and skin segmentation

As real time image capture by web camera contains collection of frames. There is need to convert RGB image frames into HSV images, because it is related to human color perception. Basically the color spaces differentiate into three components: hue (H), saturation(S), value (V). Image segmentation is typically performed to locate the hand object and boundaries of images, for this HSV features helps user to specify boundary of skin color in terms of hue and saturation value. V value gives brightness information so therefore it is easy to classify skin color and non-skin color information in images[23]. In this approach adjusting value of HSV within range 0 to 255 to extract and get accurate boundary of object.

C. Noise Removal: Erosion and Dilation

The set of operations which performs on the image based on shapes are known as Morphological operations. There are two most basic morphological operations: Erosion and Dilation, it uses for Removing noise, Separation of individual elements and joining misaligned elements in an image, even Finding of intensity bumps or holes in an image. Erosion shrinks boundaries of an image and enlarges holes; Erosion can be used to remove noises from an image. And Dilation is used to add pixels at region of boundaries or to fill in holes which generate during erosion process. Dilation can also be used to connect disjoint pixels and add pixels at edges.

D. Thresholding

Thresholding is the simplest method of image segmentation. From a grayscale image, thresholding process can be used to generate binary images. In thresholding each pixel in image replace into black pixel, if image intensity is less than some constant and a white pixel if intensity is greater than constant value. A primary property which pixels in image can share is its intensity. Hence in thresholding images separate into regions depending on Light and dark regions.

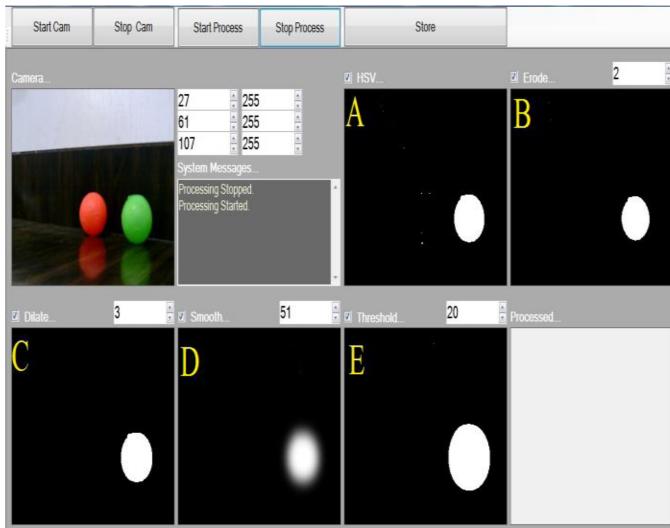


Fig.3 Image preprocessing: Color filtering. A)HSV image B)Erosion C)Dilation D)Smoothing E)Thresholding

E. Image Analysis: Blob Detection

In the field of computer based vision, blob detection refers to detection of points/regions in the image which either brighter or darker than surrounding region. Basically blob is defined as a collection of pixels organized into a structure. It is a detection of points/regions in the images which differs in features like brightness and color.

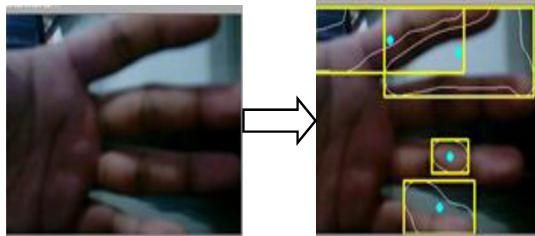


Fig.4 Blob detection

F. Contour detection

In contour detection convexity hull algorithm uses for drawing contour around the palm and finger points detection. In convexity hull algorithm adaptive boosting algorithm use for hand detection and can use haar classifier algorithm to train classifier. Initial step in convexity hull algorithm is to segment image in which hand is located. For this some feature must be assume. Here assumed shape of hand but that may change according to movement of hand. Therefore skin color of hand is considered, because it is invariant to scale and movement of hand. The next phase of a tracking system contains separating hand pixels from non-hand pixels. Before segmentation occurs, filter all captured images with a Gaussian filter [8] and then scales this filtered image by the non-changing background scene. And after segmentation contour is extracted [5].



Fig.5 Contour extraction[9]

In convexity hull algorithm initially computes maximum and minimum x & y coordinate points. and by joining those points form bounding rectangle in which contains hull. Like hulls there are other points also present i.e. convex defects of hand, which are present in between valley of two fingers[13] as shown in Fig.6 then by taking average of all such defects points surely get a center of palm.so radius of palm consider as a depth of palm only.then ratio of palm radius and distance of hull point from the center point of palm should be more or less to determine finger opening and closing position.

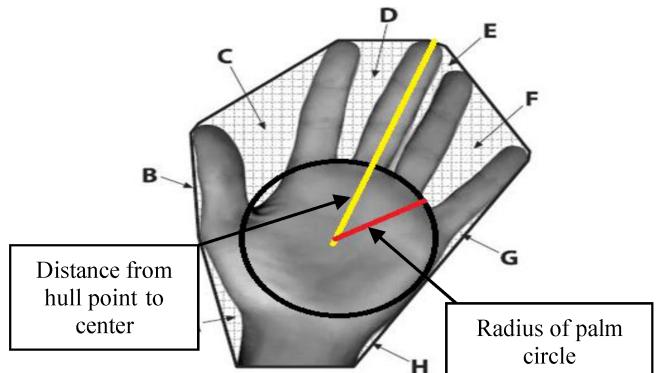
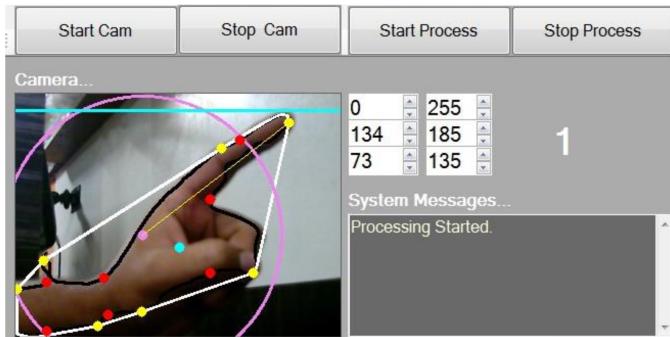


Fig.6 Convex Hulls and Defects[7]

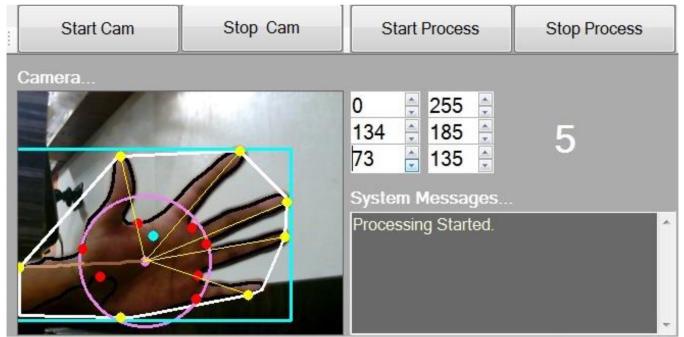
The points which join the boundary of hand are called as convex Hulls and letters A,B,C,D,E,F,G,H denotes gaps between fingers are called as convex defects. Hence for recognitions of fingers position, distance (D) of convex hulls from center point should be greater than radius(R) of inner defects circle depending on value of D and R finger opening and closing can be determine therefore Convexity hull algorithm is very convenient and appropriate method for finger point detection and number recognition.

V. IMPLEMENTED RESULTS

Firstly capture the live stream images with the help of webcam. After that applying image preprocessing steps to remove unwanted noise and adjust the brightness of images. Then perform image analysis and apply convexity algorithm to extract contour of hand position. Using a 2.40 GHz Intel® core™ processor windows based Opens image processing software and IDE used to analyze 640*480 capture image size at frame rate 30 frames per second. Below fig.7 shows finger gesture detection by proposed algorithm and identified gestures for recognition of numbers.

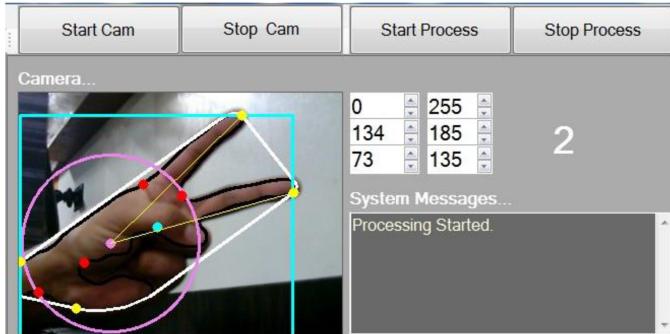


(a) Number 1 recognition



(e) Number 5 recognition

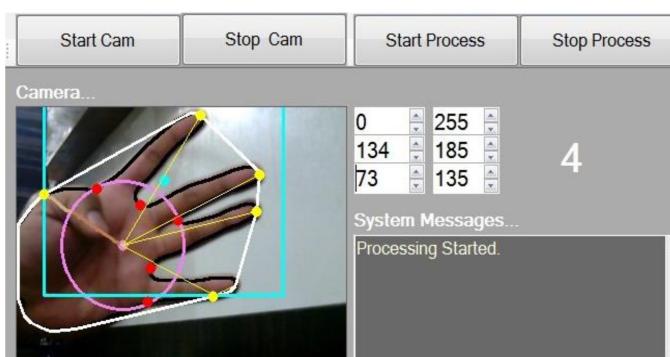
Fig.7 Number's recognition using convexity hull algorithm



(b) Number 2 recognition



(c) Number 3 recognition



(d) Number 4 recognition

VI. CONCLUSION & FUTURE WORK

As seen convexity hull algorithm can implement just for finger point detection and number recognition. A similar study can be done on English alphabets as well as Marathi alphabets by using contour analysis process. Because it contains methods for preliminary handling of the images, contours extraction, their filtrations and a Recognition. Also, it contains tools for automatic generation of templates for recognition of printing symbols. Recognition can be done by matching templates of hand by considering Contour curve shapes. In contour analysis by considering vectors value it is ease to recognize hand gestures irrespective of scaling and shape. Even by building an application which converts sign language to voice output can eliminate a barrier of communication between speech impaired people.

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