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Secured Dynamic Hand Gestures Detection System.

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Abstract— Gesture means "a movement of part of the body, especially a hand or the head, to express an idea or meaning" here we are dealing with hand gesture with security issues.Secured Dynamic Hand Gestures Detection process gives us the knowledge of computer and human hand dynamic interaction with the help of 'Camera' especially webcam are used here. This nonverbal communication system is designed especially for the human and robotic-computer interface. Here 'MATLAB' is used for successful detection of different gestures. The execution of the programme start up with a security issue called 'Fingerprint Recognition', if the fingerprint is recognized, the system can access otherwise system access denied which make the system secured. Whenever system access the consecutive operation starts with 'Camera Interface'. A 'Skin Detection Process' is introduce to find out the hand from real time webcam. Inside 'Hand Segmentation' process Frame Extraction, Grayscale Subtraction, Median filtering, Graythresholding, Gray to Binary, Regionprops, Blob Detection and image cropping occurs. Then the most important part 'Hand Gesture Recognition' executes where Cropped Gesture is read in the Directory as input images. A gesture images of Database was created before in the directory. Detected input gesture has to perform a 'Template Matching' operation with database images. If template matched i.e. same posture detected by the system, an output will come which deals with the HCI related application.

Keywords— MATLAB, Fingerprint Recognition, Camera Interface, Skin Detection, Hand Segmentation, Blob Detection, Hand Cropping, Template Matching, Human Computer Interaction (HCI).

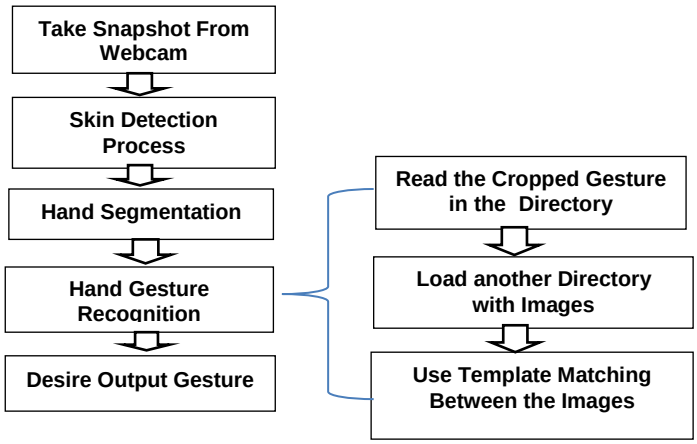
I. INTRODUCTION

In this civilization Human Computer Interaction 'HCI' is one of the most popular technique of science. People are trying to make the human life easier by putting their intelligence into machine. As a result almost in everyday we are getting new device which helping our regular life. Gesture was the first mode of communication for the primitive cave men. Human hand gestures provide the most important means for non-verbal interaction among people. They range from simple manipulative gestures that are used to point at and move objects around to more complex communicative ones that express our feelings and allow us to communicate with others. Later on human civilization has developed the verbal communication very well. Still nonverbal communication has not lost its weightage. Such non – verbal communication are being used not only for the physically challenged people, but also for different applications in diversified areas, such as aviation, surveying, music direction etc. It is the best method to interact with the computer without using other peripheral devices, such as keyboard, mouse. Hand gestures are an important modality for human computer interaction. Compared to many existing interfaces, hand gestures have the advantages of being easy to use, natural, and intuitive. Successful applications of hand gesture recognition include computer games control, human robot interaction, and sign language recognition. Vision-based recognition systems can give computers the capability of understanding and responding to hand gestures.

II. HISTORICAL BACKGROUND

The history of hand gesture recognition for computer control started with the invention of glove based control interfaces.[5] Researchers realized that gestures inspired by sign language can be used to offer simple commands for a computer interface. This gradually evolved with the development of much accurate accelerometers, infrared cameras and even optical goniometers. Numerous methods has been proposed for hand gesture recognition systems by many researchers. Generally, such systems are divided into two basis approaches namely glove based and vision based approaches. In glove-based analysis, the sensors on the hand eliminate detection of the hand, 3D model of the hand is easily subjected to the virtual world, and analysis comes next. Such systems are optimal for body motion capture purposes and widely used in industry. On the other hand, vision-based analysis are more natural and useful for real time applications. A healthy human can easily identify a hand gesture, however for a computer to recognize hand gesture first the hand should be detected in the acquired image and recognition of that hand should be done in a similar way as humans do. Yet this is a more challenging approach to implement because of the limitations of such a natural system. The vision-based approaches are carried out by using one or more cameras to capture and analyze 2D or 3D shapes of hands.

III. HAND GESTURE DETECTING STEPS



IV. Fingerprint Recognition System

The main security system of this program is built in on the basis of fingerprint recognition system. Algorithm developed by Edge detection and the number of point matching inside the Region Of Interest (ROI) area of the fingerprint images. Security issue maintain whenever the percentage of matching of the fingerprint image is to equal previously saved fingerprint image. Access to the system depends on the Percentage of matching, When Percentage of matching almost equal to in between the images the system access, on the other case the percentage of matching is not equal to in between images thus system denied to access.

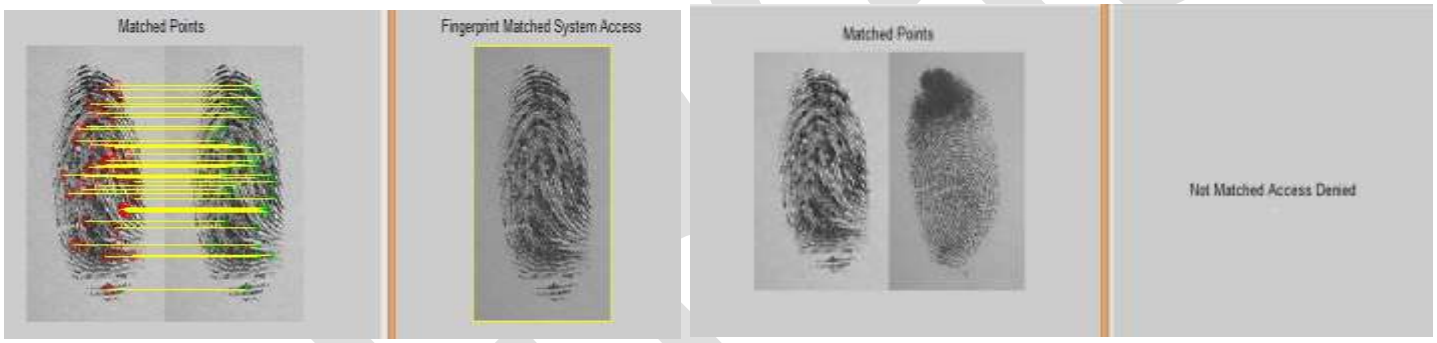


Fig: Fingerprint Recognition Test.

V. SKIN DETECTION PROCESS

Actual purpose of this process is to find out hand gesture from the live webcam video. First of all we subtract a constant value from the snapshot which is taken from camera on the basis of time interval snapshot and thus the background is eliminated as the value of the background is behave like still picture. Then we process the RGB data into gray scale. This two dimensional picture is passing through a 2D-Median Filter performs median filtering of the image matrix in two dimensions. Each output pixel contains the median value in the M-by-N neighborhood around the corresponding pixel in the input image and by this method images can remove its extra noise. Now here we adjust image intensity values or colormap and get the part of our body except background. Graythresholing computes a global threshold (LEVEL) that can be used to convert an intensity image to a binary image. Now we can covert the image into binary image. Here we need to fill binary image regions and holes. For labelling the connected components binary image we use image label command. Morphological operations on binary image so that we can get our desire binary image and removing some unexpected small objects for better detection process. Regionprops operation used to measure a set of properties for each connected component (object) in the binary image. Now binary 0 and 1 logical operation perform to find out the exact hand gesture from the image. Skin detection in color images and videos is a very efficient way to locate skin-colored pixels, which might indicate the existence of human faces and hands. However, many objects in the real world have skin-tone colors, such as some kinds of leather, sand, wood, fur, etc., which might be mistakenly detected by a skin detector. Therefore, skin detection can be very useful in finding human faces and hands in controlled environments where the background is guaranteed not to contain skin-tone colors. Since skin detection depends on locating skin-colored pixels, its use is limited to color images, i.e.it is not useful with gray-scale, infrared, or other types of image modalities that do not contain color information. There have been extensive research on finding human faces in images and videos using
other cues such as finding local facial features or finding holistic facial templates [5]. Skin detection can also be used as an efficient preprocessing filter to find potential skin regions in color images prior to applying more computationally expensive face or hand detectors.

Fig: Overall Skin detection process (Left to Right).

VI. HAND SEGMENTATION

The part of picture or any object is called Segmentation. Pattern recognition and image analysis are the early steps of image segmentation. In the computer hallucination domain and image analysis we can done important research topic in the segmentation of video with dynamic background. Image segmentation is most of adjudicating or analyzing function in image processing and analysis. Image segmentation denotes to partition of an image into different regions that are homogenous or similar and in homogenous in some characteristics. Image segmentation outcomes have an effect on image analysis and it following higher order tasks. Image analysis embraces object description and representation, feature quantity. For analyze and extract valuable information from the acquired image, one needs to find the desired data in the entire set of pixels. Here only the hand posture is to be segmented from the process imaged. This purpose a body-centered technique is adopted. From the live video snapshot we will find a processed skin detected image. During morphological operation object properties found from that properties we will manage to assume a centroid along with x and y coordinates. From the center to the edge of the detected skin is behave likes variable constant and a bounding box is created for the real time video gesture detection. Also color is very powerful descriptor for hand segmentation. [11] So for the segmentation purpose color information was used, which is invariant to rotation and geometric variation of the hand. As the hand has not a strict shape like face, hand gesture recognition has less spot then face detection. Most systems avoid handling hand systems because of this fact [12].Here the area of the bounding box is cropped which is actually denotes the final segmentation process. Meanwhile a color space 1D system introduce while bounding box is segmented.

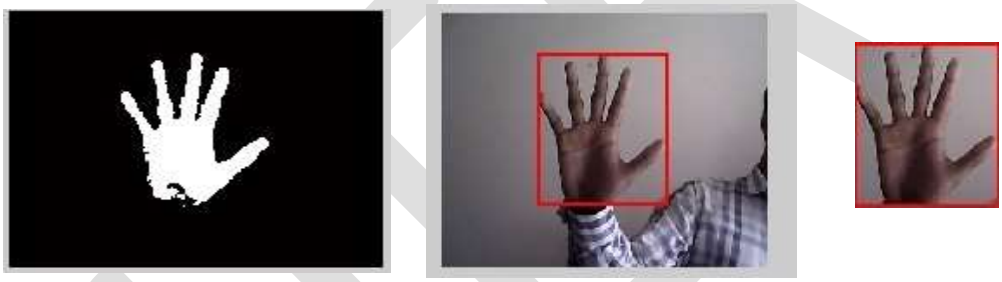


Fig: Hand Segmentation Process.

VII. HAND GESTURE RECOGNITION

Recognizing various hand configurations is a difficult and largely unsolved problem. Ong and Bowden [6] distinguished hand shapes with boosted classifier tree and obtained fairly good results. However, their method is time consuming and unpractical for interactive interfaces. Hanning Zhou and T. Huang made effort to recognize static hand gestures using local oriental histogram feature distribution model, but background in experiments are quite simple and sleeve color and texture are restricted [7]. Kolsch used fanned boosting detection for classification and got nearly real time results. In his method, all gestures' template should have identical resolutions and the hand areas must have identical aspect ratios [8]. Since Lindberg made seminal work on scale-space framework for image geometric structures detection [9], scale-space features detection have been widely applied in object recognition, image registering, etc. For planar hand shape, the scale-space feature detection can be used to detect blob and ridge structures, i.e. palm and finger structures. Blobs are detected as local maxima in scale space of the square of the normalized Laplacian operator [10]. Lars Bretzner in [10] using multi-scale color features to detect planar hand posture structures, i.e. fingers and palms. But our dynamic recognition system deals with a very easy detection and template matching process.

Fig: Gesture Recognition process.

VIII. TEMPLATE MATCHING

Template matching [1] is a technique in digital image processing for finding small parts of an image, which match a template image. It can be used in manufacturing as a part of quality control, [2] a way to navigate a mobile robot, [3] or as a way to detect edges in images. [4] A basic method of template matching uses a convolution mask (template), tailored to a specific feature of the search image, which we want to detect. This technique can be easily performed on grey images or edge images. This method is normally implemented by first picking out a part of the search image to use as a template: We will call the search image S(x, y), where (x, y) represent the coordinates of each pixel in the search image. We will call the template T(x t, y t), where (xt, yt) represent the coordinates of each pixel in the template. We then simply move the center (or the origin) of the template T(x t, y t) over each (x, y) point in the search image and calculate the sum of products between the coefficients in S(x, y) and T(xt, yt) over the whole area spanned by the template. As all possible positions of the template with respect to the search image are considered, the position with the highest score is the best position.

A pixel in the search image with coordinates (xs, ys) has intensity Is(xs, ys) and a pixel in the template with coordinates (xt, yt) has intensity It(xt, yt). Thus the absolute difference in the pixel intensities is defined as Diff(xs, ys, x t, y t) = | Is(xs, ys) – It(x t, y t) |.

$$SAD(x,y) = \sum_{i=0}^{T_{rows}} \sum_{j=0}^{T_{cols}} \text{Diff}(x+i, y+j, i, j)$$

The mathematical representation of the idea about looping through the pixels in the search image as we translate the origin of the template at every pixel and take the SAD measure is the following:

$$\sum_{x=0}^{S_{rows}} \sum_{y=0}^{S_{cols}} SAD(x,y)$$

S_{rows} and S_{cols} denote the rows and the columns of the search image and T_{rows} and T_{cols} denote the rows and the columns of the template image, respectively. In this method the lowest SAD score gives the estimate for the best position of template within the search image. The method is simple to implement and understand, but it is one of the slowest methods.

FUTURE WORK

The future scope lies in making this algorithm applicable for various orientations of hand gestures, also different classification scheme can be applied. Gesture recognition could be used in many settings in the future. The algorithm can be improved so that images with non-uniform background can also be used, this will enhance the human computer interaction. Visually impaired people can make use of hand gestures for human computer interaction like controlling television, in games and in gesture to speech conversion.

CONCLUSION

In this thesis study, a hand gesture recognition system, which works under all lightning conditions with different skin, colored users and with different camera parameters was aimed. It should not need any training or not make the user wear a special glove etc. In addition, the system was aimed to work in or nearly real time to be applicable in human computer applications. Finally, it should work in a typical PC with a cheap USB webcam with all security features. In the experiments, we could have a working system with the mentioned theory.

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