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Recognizer System for Face and Hand Gestures

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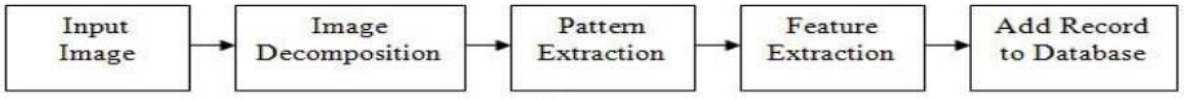
ABSTRACT: This paper presents a recognition system, which will be helpful for a blind person. Hand gesture recognition system and face recognition system has been implemented in this paper using which various tasks can be performed.In module one Hand gesture system is implemented through skin color detection done in YCbCr color space and to discover hand convex defect character point of hand is used where different features like fingertips, angle between fingers are being extracted. According to gestures recognized, various tasks can be performed like running an application. While the module Face recognition is implemented through Haar Cascade Classifiers With the help of OpenCV, the research has been implemented.

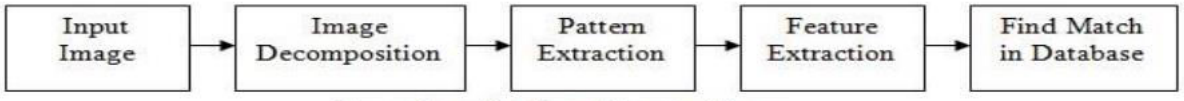
KEYWORDS: Haar Cascade,Convex Hull, Haar like features, Face Recognition , Hand Gesture Recognition, LBPH, OpenCv, Skin Detection.

I. INTRODUCTION

Gesture has been described as the manner in which a person carries the body or motion of the body and limbs to express an idea or sentiment. Hand-gesture recognition is a process of receiving the image of a hand gesture from the user as input source and by comparing it with previously trained data.Here the system will perform the particular actions based on the stored dataset for the recognized gesture. For Face Recognition the system will take the image as input then by processing it , the system will give the name of the person present in the image as an output.Through this system use of facial recognition and hand gestures to assist and work with environment to make it a better place to live forblind.



Procedure for Facial Feature's Extraction.



Procedure for Face Recognition.

basic block diagram for face recognition

II. PROPOSED ARCHITECTURE

The input is taken from the front-facing Camera. The proposed Recognition System is divided into two parts –

- Hand Gesture Recognition
- Facial Recognition .

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1) Hand Gesture Recognition

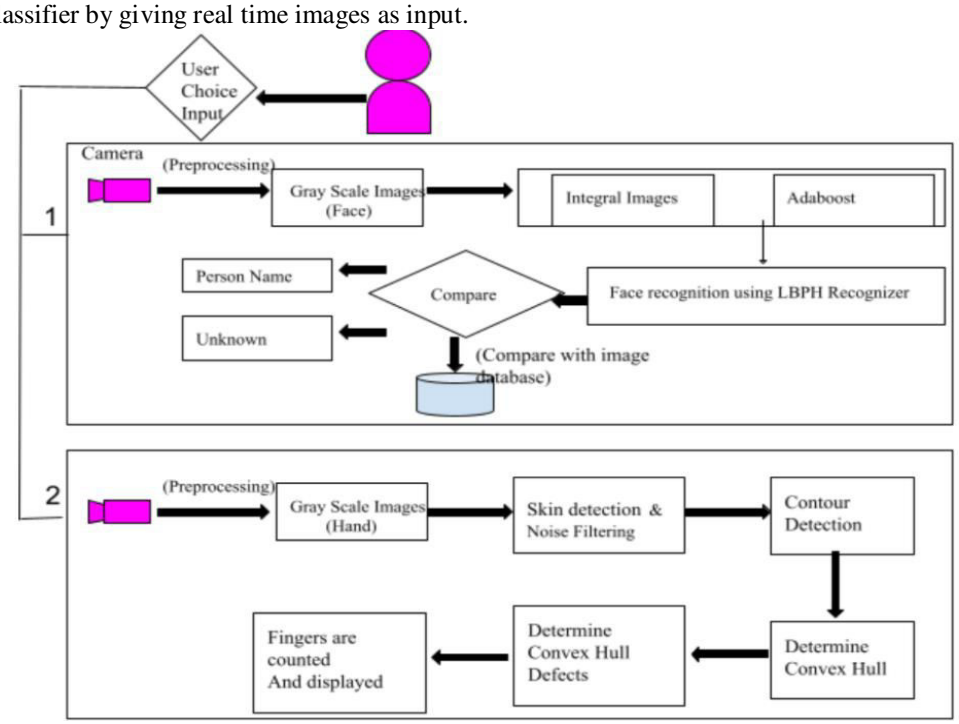
The steps involved in gesture recognition are:

- Static hand Gesture as input
- Noise Filtering
- Skin Detection
- Contour Detection

2) Face Recognition

The steps involved in gesture recognition are:

- Dataset of positive and negative images using Haar Cascade.
- Training the classifier
- testing the classifier by giving real time images as input.



System Architecture

III. RELATED WORK

According to estimates by WHO about 85 million people across the globe suffer from some kind of visual impairment, of whom 39 million are blind.Our main motivation is to build an environment which is suitable for each and every person who wants to live a normal life by accepting his/her disabilities.We are building this system to help the disable people to live a normal life and have a normal life as any other person. Numerous literaturepertaining to the face and gesture recognition domain have been published already and are available for public usage.

In 2018,Teddy Mantoro ,Media A. Ayu, Suhendi published a paper titled **Multi-Faces Recognition Process Using Haar Cascades and Eigenface Methods .**This paper tackles the problem with facerecognition using biometricidentification as it is alengthy process.The paper proposes solutions for afaster face recognition process with accurate results.The proposed facerecognition process was doneusing a hybrid process ofHaar Cascades and Eigenfacemethods, which can detectmultiple faces (55 faces) in asingle detection process.

In 2018, ArushAnantkumar published a paper titled **Efficient Face And Gesture Recognition For Time Sensitive Application.**The paper focuses on developing a model to control a system using gestures, while simultaneously implementing continuous facial recognition to avoid unauthorized access. An effective face recognition system is

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developed and applied in conjunction with a gesture recognition system to control a wireless robot in real-time.

IV. CHALLENGES IN THE PROJECT IMPLEMENTATION

- *Illumination*

Illumination stands for light variations. The slight change in lighting conditions cause a significant challenge for automated face recognition and can have a significant impact on its results. If the illumination tends to vary, the same individual gets captured with the same sensor and with an almost identical facial expression and pose, the results that emerge may appear quite different.Illumination changes the face appearance drastically. It has been found that the difference between two same faces with different illuminations is higher than two different faces taken under the same illumination.

- *Occlusion*

Occlusion means blockage, and it occurs when one or other parts of the face are blocked and the whole face is not available as an input image. Occlusion is considered one of the most critical challenges in face recognition systems.It occurs due to beards, moustaches, accessories (goggle, cap, mask, etc.), and it is prevalent in real-world scenarios. The presence of such components makes the subject diverse and hence making the automated face recognition process a tough nut to crack.

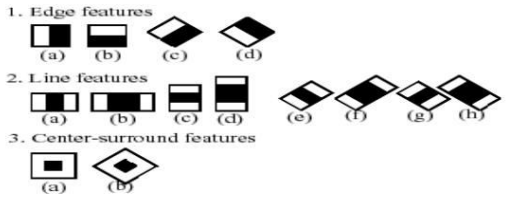
- *Ageing*

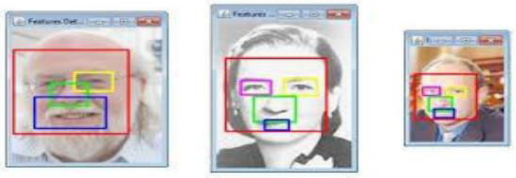
Face appearance/texture changes over a period of time and reflects as ageing, which is yet another challenge in the facial recognition system. With the increasing age, the human face features, shapes/lines, and other aspects also change. It is done for visual observation and image retrieval after a long period.For accuracy checking, the dataset for a different age group of people over a period of time is calculated. Here, the recognition process depends on feature extraction, basic features like wrinkles, marks, eyebrows, hairstyles, etc.

V. ALGORITHM

Based on the previous research, we used two algorithms that are among five most used in face and gesture recognition:
Haar Cascade Classifier, Local Binary Pattern Histogram(LBPH) .

- *Haar Cascade Classifier:*Object Detection using Haar feature-based cascade classifiers is an effective objectdetection method proposed by Paul Viola and Michael Jones in their paper, “RapidObject Detection using a Boosted Cascade of Simple Features” in 2001. It is amachine learning based approach where a cascade function is trained from a lot of positive and negative images. It is then used to detect objects in other images.The core basis for Haar classifier object detection is the Haar-like features. These features, rather than using the intensity values of a pixel, use the change in contrast values between adjacent rectangular groups of pixels. The contrast variances between the areas. Two or three adjacent groups with a relative contrast variance form a Haar-like featureFirst we need to load the required XML classifiers. Sliding windows of different sizes across images at each location match the window to face model.





- *Local Binary Pattern Histogram(LBPH):*Local Binary Pattern Histogram algorithm was proposed in 2006. It is based on a local binary operator. It is widely used in facial recognition due to its computationalsimplicity and discriminative power. It is a simple yet very efficient texture operator which labels the pixels of an image by thresholding the neighborhood of each pixel and considers the result as a binary number. It was first described in 1994

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(LBP) and has since been found to be a powerful feature for texture classification. It has further been determined that when LBP is combined with histograms of oriented gradient (HOG) descriptors, it improves the detection performance considerably on some datasets. Using the LBP combined with histograms we can represent the face images with a simple data vector. As LBP is a visual descriptor it can also be used for face recognition tasks, as can be seen in the following step-by-step explanation.

The LBPH uses 4 parameters:

- **Radius**: the radius is used to build the circular local binary pattern and represents the radius around the central pixel. It is usually set to 1.

- **Neighbors**: the number of sample points to build the circular local binary pattern. Keep in mind: the more sample points you include, the higher the computational cost. It is usually set to 8.

- **Grid X**: the number of cells in the horizontal direction. The more cells, the finer the grid, the higher the dimensionality of the resulting feature vector. It is usually set to 8.
- **Grid Y**: the number of cells in the vertical direction. The more cells, the finer the grid, the higher the dimensionality of the resulting feature vector. It is usually set to 8.

3) *Convex Hull Algorithm :*Algorithms that construct convex hulls of various objects have a broad range of applications in mathematics and computer science.

Computing the convex hull means that a non-ambiguous and efficient representation of the required convex shape is constructed.

The complexity of the corresponding algorithms is usually estimated in terms of n, the number of input points, and sometimes also in terms of h, the number of points on the convex hull.The convex hull of a simple polygon is divided by the polygon into pieces, one of which is the polygon itself and the rest are *pockets* bounded by a piece of the polygon boundary and a single hull edge.This algorithm uses HSL (for **hue, saturation, lightness**) and HSV (for hue, saturation, value; also known as HSB instead of YGB color scheme, for hue, saturation, brightness) are alternative representations of the RGB color model, designed in the 1970s by computer graphics researchers to more closely align with the way human vision perceives color-making attributes.

VI. EVALUATION AND RESULTS

Firstly, facial feature detection is detecting the face. This requires analyzing the entire image.Afteranalyzing the algorithm will get the haar features of image and by comparing the haar feature of image with the image stored in dataset if the match is found then the name of the person will be displayed on the screen along with the accuracy(100-confidence value).The dataset used here is the real time dataset which is trained with positive and negative images. .Secondly Hand gesture recognition is recognizing the gesture of the hand. This requires removing noises and background of the hand and with the convex hull contours are formed and defects get counted which in result performs the task assigned according to the number of defects found in the hand gesture.

TABLE II EXPERIMENTAL RESULTS OF ALGORITHMS

ALGORITHM	ACCURACY
Haar Cascade Algorithm	89.45%
Local Binary Pattern Recognizer	87.15%
Convex Hull Algorithm	91.28%

VII. CONCLUSION

The system introduced in this paper can be helpful for a blind person and can act as a virtual assistant for it. Haar cascade Classifiers and LBPH recognizers have been used for face detection and identification in the real time whereas

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the Convex hull and Convex defects algorithm has been used to detect the Hand gestures in real time. Skin color recognition has been in YCbCr color space and different threshold ranges have been used to detect skin color in different lighting conditions and skin color. Hand gestures are recognized with an accuracy of 95.2% and face recognition and identification has been done with an accuracy of 92%. There are some limitations, which need to be addressed. Recognizing more gestures would be helpful for performing more tasks. Alternate methods like MLBPH [12] or LBPH + CNN [13] can be used to improve the gesture recognition and face recognition must be considered.

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