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Face Recognition using Histogram

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Abstract: *Human face conveys more information about identification, expression, and emotions of a person. In today's world every individual in the society wants to be more secure from unauthorized authentication. In order to provide more security, "Facial Recognition" has come into the picture and lead a most challenging role of detecting the face with more accurate results without any false identities. To increase the efficiency of the face recognition, histogram based facial recognition is chosen, where a face region is fragmented into a number of regions and histogram values are extracted and they are linked together into a single vector. This vector is compared for the similarities between the facial images and provides a most efficient outcome. Technique used in face recognition system is histogram. The histogram of oriented gradients (HOG) is a feature descriptor used in computer vision and image processing for the purpose of object detection. The technique counts occurrences of gradient orientation in localized portions of an image. This method is similar to that of edge orientation histograms, scale-invariant feature transform descriptors, and shape contexts, but differs in that it is computed on a dense grid of uniformly spaced cells and uses overlapping local contrast normalization for improved accuracy.*

Index Terms: *Face Recognition, Histogram, Face Detection (key words)*

I. INTRODUCTION

Face recognition is a method of identifying or verifying the identity of an individual using their face. Face recognition systems can be used to identify people in photos, video, or in real-time. Law enforcement may also use mobile devices to identify people during police stops. But face recognition data can be prone to error, which can implicate people for crimes they haven't committed. Facial recognition software is particularly bad at recognizing African Americans and other ethnic minorities, women, and young people, often misidentifying or failing to identify them, disparately impacting certain groups.

Additionally, face recognition has been used to target people engaging in protected speech. In the near future, face recognition technology will likely become more ubiquitous. It may be used to track individuals' movements out in the world like automated license plate readers track vehicles by plate numbers. Real-time face recognition is already being used in other countries and even at sporting events in the United States.

While initially a form of computer application, it has seen wider uses in recent times on mobile platforms and in other forms of technology, such as robotics. It is typically used as access control in security systems and can be compared to other biometrics such as fingerprint or eye iris recognition systems. Although the accuracy of facial recognition system as a biometric technology is lower than iris recognition and fingerprint recognition, it is widely adopted due to its contactless and non-invasive process. Recently, it has also become popular as a commercial identification and marketing tool. Other applications include advanced human-computer interaction, video surveillance, automatic indexing of images, and video database, among others.

II. FACE RECOGNITIONAL TECHNOLOGY(3-DIMENSIONAL RECOGNITION)

Three-dimensional face recognition technique uses 3D sensors to capture information about the shape of a face. This information is then used to identify distinctive features on the surface of a face, such as the contour of the eye sockets, nose, and chin.

One advantage of 3D face recognition is that it is not affected by changes in lighting like other techniques. It can also identify a face from a range of viewing angles, including a profile view. Three-dimensional data points from a face vastly improve the precision of face recognition. 3D research is enhanced by the development of sophisticated sensors that do a better job of capturing 3D face imagery. The sensors work by projecting structured light onto the face. Up to a dozen or more of these image sensors can be placed on the same CMOS chip—each sensor captures a different part of the spectrum....

Even a perfect 3D matching technique could be sensitive to expressions. For that goal a group at the Technion applied tools from metric geometry to treat expressions as isometries.

A new method is to introduce a way to capture a 3D picture by using three tracking cameras that point at different angles; one camera will be pointing at the front of the subject, second one to the side, and third one at an angle. All these cameras will work together so it can track a subject's face in real time and be able to face detect and recognize.

III. PROPOSED WORK

The task of the proposed system is to capture the face of each person and store it in the database for displaying its Name. Students face should be captured in such a way that all the features are recognized. The working mainly is that the video captured data is converted into image to detect and recognize it further. Further the recognized image is provided with its name.

A. Facial Recognition

Face recognition systems use computer algorithms to pick out specific, distinctive details about a person's face. These details, such as distance between the eyes or shape of the chin, are then converted into a mathematical representation and compared to data on other faces collected in a face recognition database. The data about a particular face is often called a face template and is distinct from a photograph because it's designed to only include certain details that can be used to distinguish one face from another.

Some face recognition systems, instead of positively identifying an unknown person, are designed to calculate a probability match score between the unknown person and specific face templates stored in the database. These systems will offer up several potential matches, ranked in order of likelihood of correct identification, instead of just returning a single result. Face recognition systems vary in their ability to identify people under challenging conditions such as poor lighting, low quality image resolution, and suboptimal angle of view (such as in a photograph taken from above looking down on an unknown person).

B. How facial Identification Works

- 1) Image is captured.
- 2) Eye Locations are determined.
- 3) Image converted to grayscale and cropped.
- 4) Image is converted to a template used by the search engine for facial comparison results.
- 5) Image is searched and matched using algorithm to compare the template to other templates on file.
- 6) Duplicate licenses are investigated for fraud.

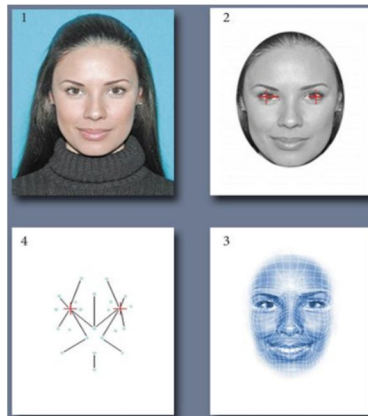
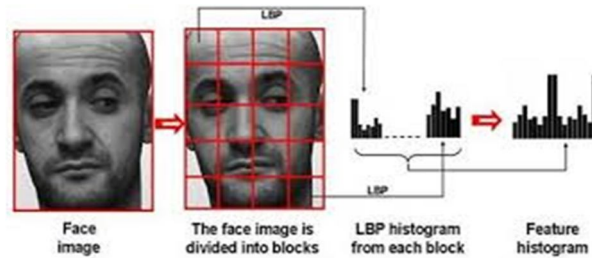


Fig 1: process of face identification work

IV. HISTOGRAM

The essential thought behind the histogram of oriented gradients descriptor is that local object appearance and shape within an image can be described by the distribution of intensity gradients or edge directions. The image is divided into small connected regions called cells, and for the pixels within each cell, a histogram of gradient directions is compiled. The descriptor is the concatenation of these histograms. For improved accuracy, the local histograms can be contrast-normalized by calculating a measure of the intensity across a larger region of the image, called a block, and then using this value to normalize all cells within the block. This normalization results in better invariance to changes in illumination and shadowing.

The HOG descriptor has a few key advantages over other descriptors. Since it operates on local cells, it is invariant to geometric and photometric transformations, except for object orientation. Such changes would only appear in larger spatial regions. Moreover, as Dalal and Triggs discovered, coarse spatial sampling, fine orientation sampling, and strong local photometric normalization permits the individual body movement of pedestrians to be ignored so long as they maintain a roughly upright position. The HOG descriptor is thus particularly suited for human detection in images.



A. Orientation Binning

The second step of calculation is creating the cell histograms. Each pixel within the cell casts a weighted vote for an orientation-based histogram channel based on the values found in the gradient computation. The cells themselves can either be rectangular or radial in shape, and the histogram channels are evenly spread over 0 to 180 degrees or 0 to 360 degrees, depending on whether the gradient is “unsigned” or “signed”. Dalal and Triggs found that unsigned gradients used in conjunction with 9 histogram channels performed best in their human detection experiments. As for the vote weight, pixel contribution can either be the gradient magnitude itself, or some function of the magnitude. In tests, the gradient magnitude itself generally produces the best results. Other options for the vote weight could include the square root or square of the gradient magnitude, or some clipped version of the magnitude.

B. Descriptor Blocks

To account for changes in illumination and contrast, the gradient strengths must be locally normalized, which requires grouping the cells together into larger, spatially connected blocks. The HOG descriptor is then the concatenated vector of the components of the normalized cell histograms from all of the block regions. These blocks typically overlap, meaning that each cell contributes more than once to the final descriptor. Two main block geometries exist: rectangular R-HOG blocks and circular C-HOG blocks. R-HOG blocks are generally square grids, represented by three parameters: the number of cells per block, the number of pixels per cell, and the number of channels per cell histogram. In the Dalal and Triggs human detection experiment, the optimal parameters were found to be four 8x8 pixels cells per block (16x16 pixels per block) with 9 histogram channels. Moreover, they found that some minor improvement in performance could be gained by applying a Gaussian spatial window within each block before tabulating histogram votes in order to weight pixels around the edge of the blocks less. The R-HOG blocks appear quite similar to the scale-invariant feature transform (SIFT) descriptors; however, despite their similar formation, R-HOG blocks are computed in dense grids at some single scale without orientation alignment, whereas SIFT descriptors are usually computed at sparse, scale-invariant key image points and are rotated to align orientation. In addition, the R-HOG blocks are used in conjunction to encode spatial form information, while SIFT descriptors are used singly. Circular HOG blocks (C-HOG) can be found in two variants: those with a single, central cell and those with an angularly divided central cell. In addition, these C-HOG blocks can be described with four parameters: the number of angular and radial bins, the radius of the center bin, and the expansion factor for the radius of additional radial bins. Dalal and Triggs found that the two main variants provided equal performance, and that two radial bins with four angular bins, a center radius of 4 pixels, and an expansion factor of 2 provided the best performance in their experimentation (to achieve a good performance, at last use this configure). Also, Gaussian weighting provided no benefit when used in conjunction with the C-HOG blocks. C-HOG blocks appear similar to shape context descriptors, but differ strongly in that C-HOG blocks contain cells with several orientation channels, while shape contexts only make use of a single edge presence count in their formulation.

C. Block Normalization

The Dalal and trigs explored four different methods for block normalization. Let v be the non-normalized vector containing all histograms in a given block, $\|v\|_k$ be its k-norm for $k=1,2$ and e be some small constant. Then the normalization factor can be one of the following:

$$\text{L2-norm: } f = \frac{v}{\sqrt{\|v\|_2^2 + e^2}}$$

L2-hys: L2-norm followed by clipping (limiting the maximum values of v to 0.2) and renormalizing

$$\text{L1-norm: } f = \frac{v}{(\|v\|_1 + e)}$$

$$\text{L1-sqrt: } f = \sqrt{\frac{v}{(\|v\|_1 + e)}}$$

D. Object Recognition

The HOG descriptors may be used for object recognition by providing them as features to a machine learning algorithm. Dalal and Triggs used HOG descriptors as features in a support vector machine (SVM) ; however, HOG descriptors are not tied to a specific machine learning algorithm.

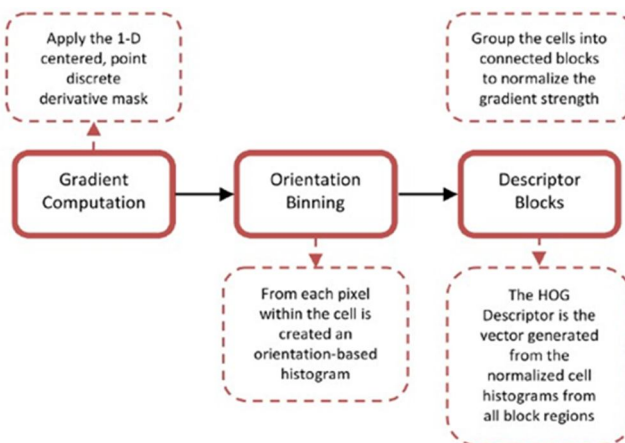
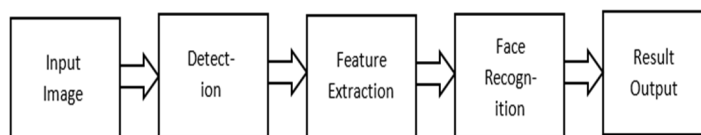


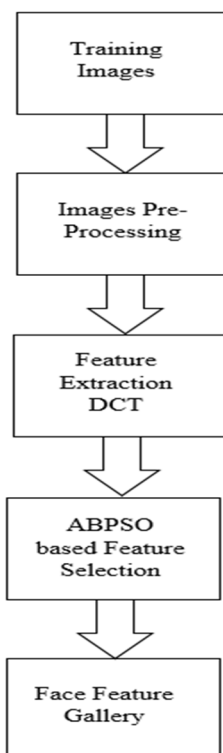
Fig.1. Block diagram of the overall process.

V. STEPS FOR FACE RECOGNITION

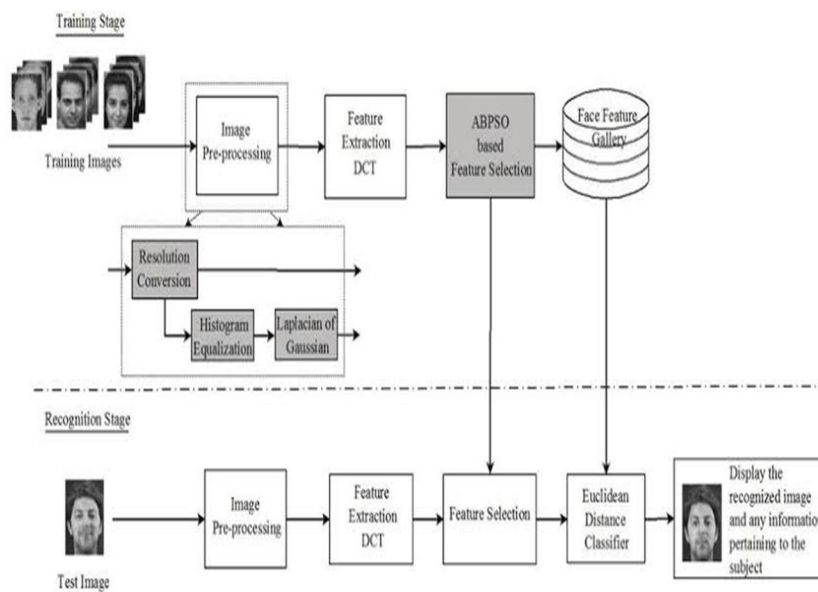
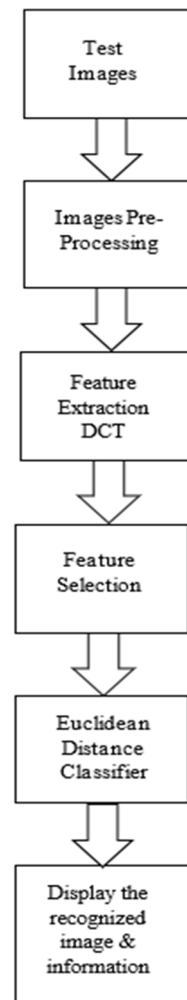


Flowchart of a Face Recognition

Training Stage:



Recognition Stage:



VI. CONCLUSION

This paper aims at capturing the video conversion into frames, check whether it is present in the database and displaying its Name. These techniques capture the different edge directional information, segmented geometric measurements and whole face information. Feature vector is generated by merging captured information. Data is discriminated using feature variance and normalization. Different expressions, variations in pose, orientation, accessories and makeup is handled by proposed work. After facial recognition name of the person is displayed. In future, facial measurements will be added to get more accurate results by considering orientation and illumination results. The proposed work is being compared with other techniques to improve the efficiency.

The HOG feature is widely used for pedestrian detection but has been rarely used for face recognition. A fast computational method was developed and different factors were evaluated. We explore the use of HOG features for face recognition. The contributions are threefold:

To provide robustness to facial feature detection, we propose uniform sampling of the HOG features.

To remove redundancy in the data, improve computational efficiency and avoid over fitting. We propose to use, dimensionality reduction in the HOG representation.

We show that a decision-level combination of results using HOG features extracted from different image patch sizes significantly improves in choosing a single best patch size.

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