FACE RECOGNITION USING HOG FEATURE AND SVM

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ABSTRACT

There are many advancements in the technology solving very difficult problems of the society. One of the alleged controversial technologies in the times is Face Recognition systems. These systems are majorly used in the banking and security sectors. There are numerous algorithms developed in the past few decades to perform Face Recognition like LBPH (Local Binary Patterns Histograms), Fisherfaces, Eigenfaces, SURF (Speed Up Robust Features) and HOG (Histogram of Oriented Gradients). HOG is used in this paper for the purpose of feature extraction. The PCA an important feature method in Eigen faces method is today an important brainwave for almost all the face recognition algorithms unfolded into new and better programming methods [**?**].

***Index Terms*—** LBPH, Fisherfaces, Eigenfaces, SURF, HOG

1. INTRODUCTION

In this paper, an intelligent Face Recognition System is developed using MATLAB. The same solution can also be used for the purpose of object detection and object tracking systems. There are many individual developers and multi national companies are who are working to develop and improve the Face Recognition technology. This technology is being used in many security applications like banking, social indexing, Access control, Image Database Investigation, General identity verification, Surveillance, etc [**?**].

The first and foremost tasks performed in this project is to process the data beforehand. In this scenario, the image size is resized to be compatible with both HOG feature extractor and Deep Learning alexnet.

The dataset is split into training and testing set and the pictures are sent to the HOG feature extractor. Once the features are extracted, the data is sent through the SVM (Support Vector Machine) classifier to train the model to detect different persons.

2. HOG (HISTOGRAM OF ORIENTED GRADIENTS)

HOG (Histogram of Oriented Features) [**?**] is a feature descriptor mostly used in the field of Computer Vision for Object Detection, Object Tracking and Facial Recognition applications.

Robert K. McConnell of Wayland Research Inc. first described the concept behind HOG without using the term HOG in a patent application in 1986 [**?**].

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.

To make the HOG feature descriptor, we need to calculate the respective horizontal and vertical gradients to actually provide the histogram that can be used in the algorithm. This can be done by simply filtering the image through these kernels [**?**].

$$\begin{bmatrix} -1 & 0 & 1 \end{bmatrix} \tag{1}$$

$$\begin{bmatrix} -1 \\ 0 \\ 1 \end{bmatrix} \tag{2}$$

Kernels like these are often used in image classification mainly in convolutional neural networks in order to find the edges and important points in a particular image.

The magnitude and direction gradients from an image can be calculated using the below equations.

$$Gradient\ Magnitude = \sqrt{(Gradient_X)^2 + (Gradient_Y)^2} \tag{3}$$

$$Gradient\ Direction = \tan^{-1}(Gradient_X / Gradient_Y) \tag{4}$$

Feature descriptors will allow for a concise and succinct representation of particular patches of the images. A 8x8 cell can simply be explained using 128 numbers (8x8x2 where the last 2 are from the gradient magnitude and directional values). By further converting these numbers to calculate histograms, we allow for an image patch that is much more robust to noise and more compact.

A bin is selected depending on the direction chosen, and the value that is subsequently placed inside of the bin is dependent on the magnitude. If a pixel is halfway between two

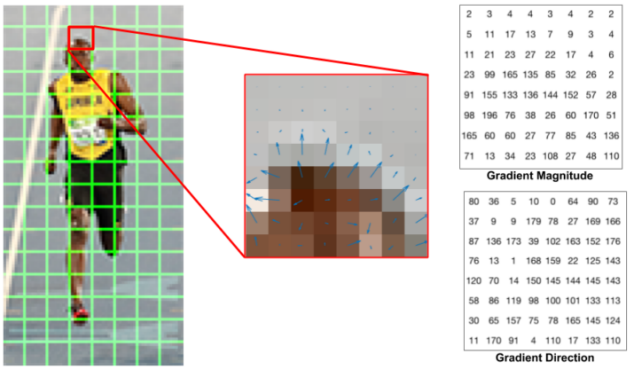

Fig. 1. Center : The RGB patch and gradients represented using arrows. Right : The gradients in the same patch represented as numbers[**?**]

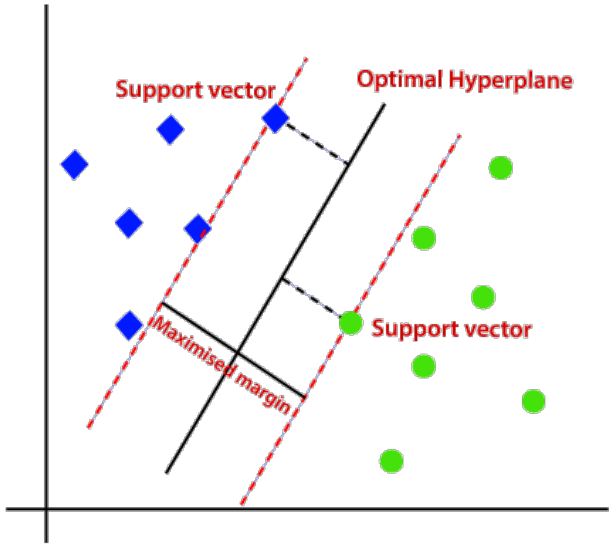

Fig. 2. Optimal Hyperplane using the SVM algorithm[**?**]

bins, then it splits up the magnitudes accordingly depending on their distance away from each respective bin. After performing this process, a histogram can be formed, and the bins that have the most weight can easily be seen.

3. SVM (SUPPORT VECTOR MACHINES)

SVM is a supervised Machine Learning algorithm i.e., used for both classification and regression problems. The SVM algorithm separates the classes using lines or hyperplanes. The SVM takes data or features as input and outputs a line or a plane which separates the different classes in the data.

SVM finds the closest data points separating the two classes, these points are called as support vectors and draws a line separating then such as the distance between the points are maximum.

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1. Pre-process the images
   (a) Define destination image size and image type
   (b) Load the complete raw data i.e., images
   (c) Load the image from the raw data
   (d) resize the image and save to the destination directory
   (e) Repeat the steps from (c) for all the remaining images
2. Load the complete raw data i.e., images from the processed directory
3. Split the data into train and test dataset's
4. Use Feature extractor to extract the features the loaded data
   (a) Extract HOG features from all the images
5. Use Machine Learning algorithm to classify the classes from the dataset
   (a) SVM (Support Vector Machines) is used to classify the classes from HOG features
6. Test the accuracy of the model on test dataset
7. Save the model
8. Infer the data using a different or real-time streaming data

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