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Face Recognition for Automated Attendance using HOG & Machine Learning

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Abstract— **Machine Learning attracted huge attention due to its exemplary unique performance and solving a number of complex problems. This technology gained massive attention due to its training techniques which. This paper discusses the successful implementation of face recognition using HOG and machine learning. It will analyze the attendance of students using machine learning to ease the daily routine for teachers and staff. Secondly, Histogram of Oriented Gradients (HOG) is used to extract the features from the face using our dataset to classify the students. Lastly, the detected face will be matched with the face in dataset and recognize him accordingly.**

Keywords— **Machine Learning, Histogram Oriented Gradients (HOG), Face Recognition, Attendance, Python, Face detection and Haarcascade.**

I. INTRODUCTION

The introduction of facial recognition in the field of pattern recognition has impact the range of applicability particularly for cyber investigations. This has been possible due to advanced training techniques and progression made in analysis. Due to increased demand of security day by day verifying identities, internet connections, online communications led the researchers to find ways for these problems. Along with this facial recognition systems are main part in finding solutions to these problems. Identity of any person is incomplete without facial recognition. Just like any other form of biometric identification, face recognition requires samples to be collected, identified, extracted with necessary (features) information, and stored for recognition. The entire face recognition solution is divided into following major modules:

1. Face Capture
2. Face Train
3. Face Recognition

Face Detection is the fundamental step in any of the operations carried out in the face recognition process. The Haar Feature-based Cascade Classifier is a widely used mechanism for detecting faces. In order to train a classifier to detect faces, two large sets of images are formed, with one set containing images with faces, and the other set without. These images are then used to generate classifier models. The classifier is generated by extracting Haar features from the images.

II. TECHNOLOGIES USED

A. *Histogram of Oriented Gradients*

HOG is one of the feature extractor used in computer vision and image processing. It is describe as the distribution of edge directions in an image. The image is then divided into small cells. Several pixels are present in every cell in which accordingly a histogram of gradients id formed histogram of the gradient is made. For better accuracy the HOG is contrast-normalized, this is done by calculating intensity over a larger area several cell known as block, then this value is used to normalize all cells within that block. The normalized result gives better performance on variation in illumination and intensity. HOG descriptors have some advantages over other descriptors such as it is invariant to geometric and photometric transformations except object orientation. It is particularly suited for human detection in images. Histograms of oriented gradients (HOG) applications are found in object and pattern recognition domain as it is capable of extracting crucial information even from the images that are obtained under garbled environments. It is therefore well suited for tackling the facial recognition problem. The feature extraction process of HOG is based on extracting information about the edges in local regions of a target image. Simply HOG feature extraction is primarily the characterization of the orientation and magnitude values of the pixels in an image. That is, it defines an image in terms of groups of local histograms that point to local regions of an image. The features of HOG can be seen on a grid of rose plots spaced uniformly. The grid dimensions depend upon the size of the cell and image. Thus, every rose plot depicts the gradient orientations distributed in a HOG cell.

B. Haar Cascade

Haar Cascade classifier is based on the Haar Wavelet technique to analyse pixels in the image into squares by function. This uses "integral image" concepts to compute the "features" detected. Haar Cascades uses the **Ada-boost** learning algorithm which selects a small number of important features from a large set to give an efficient result of classifiers then use cascading techniques to detect the face in an image. Haar cascade classifier is based on the Viola-Jones detection algorithm which is trained in given some input faces and non-faces and training a classifier that identifies a face. Haar features are similar to these convolution kernels which are used to detect the presence of that feature in the given image. A Haar-Feature is just like a kernel in CNN, except that in a CNN, the values of the kernel are determined by training, while a Haar-Feature is manually determined.

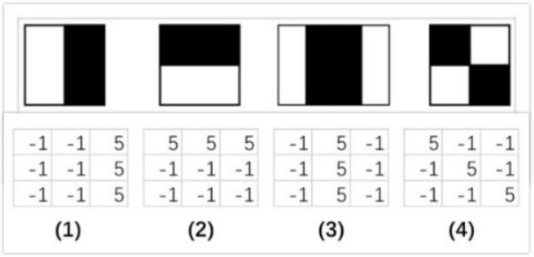

Fig. 2. Haar Features

Here are some Haar-Features. The first two are "edge features", used to detect edges. The third is a "line feature", while the fourth is a "four rectangle feature", most likely used to detect a slanted line. Each feature results in a single value which is calculated by subtracting the sum of pixels under a white rectangle from the sum of pixels under the black rectangle.

C. Machine Leaning for Face Recognition

Face recognition is the problem of identifying and verifying people in a photograph by their face. It is a task that is trivially performed by humans, even under varying light and when faces are changed by age or obstructed with accessories and facial hair. Nevertheless, it is remained a challenging computer vision problem for decades until recently. Deep learning methods are able to leverage very large datasets of faces and learn rich and compact representations of faces, allowing modern models to first perform as-well and later to outperform the face recognition capabilities of humans. Face recognition is specific to these tasks according to the requirements:

- **Face Matching**: Find the best match for a given face.
- **Face Similarity**: Find faces that are most similar to a given face.
- **Face Transformation**: Generate new faces that are similar to a given face.

III. METHODOLOGY

The proposed automated attendance system is based on face recognition. Using the camera we will take a picture of the student followed by detecting face in the image, recognizing the students and then updating their attendance in database.
An efficient face detection algorithm enhances the performance of face recognition systems. Some of the algorithms proposed for face detection are Face geometry based methods and Machine learning based methods. Face region is extracted and pre-processed for further processing. This pre-processing step involves with histogram equalization of the extracted face image and is resized. Histogram Equalization is the most common Histogram Normalization technique. This improves the contrast of the image by making it clearer as it stretches the range of the intensities in an image. As we chose face recognition based system enrolment of every individual is required i.e. we have to take the images of individuals in different angles, dif f e r e n t expressions and create a training dataset which is used by classifier to recognize individuals.

A. Detection and Extraction

Face detection is important as the image taken through the camera given to the system, face detection algorithm applies to identify the human faces in that image, the number of image processing algorithms are introduce to detect faces in an images and also the location of that detected faces. We have used HOG method to detect human faces in given image.

B. Face Positioning

There are 68 specific points in a human face. In other words we can say 68 face landmarks. The main function of this step is to detect landmarks of faces and to position the image. A python script is used to automatically detect the face landmarks and to position the face as much as possible without distorting the image.

C. Face Encoding

Once the faces are detected in the given image, the next step is to extract the unique identifying facial feature for each image. Basically whenever we get localization of face, the facial point are extracted for each image given input which are highly accurate and these are stored in data file for face recognition.

D. Face matching

This is last step of face recognition process. We have used the one of the best learning technique that is deep learning which is highly accurate and capable of outputting real value feature vector. Our system ratifies the faces, constructing the embedding (ratification) for each. Internally face_enc.py function is used to compute face in image and all faces in the dataset. If the current image is matched with the 60%

threshold with the existing dataset, it will move to attendance marking.

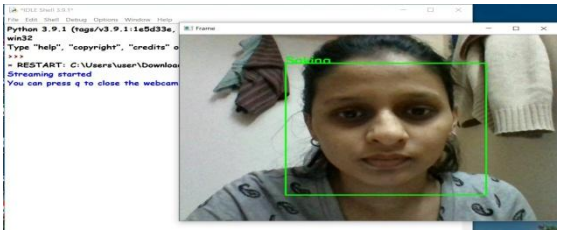

Fig.3. Recognized Face from Dataset

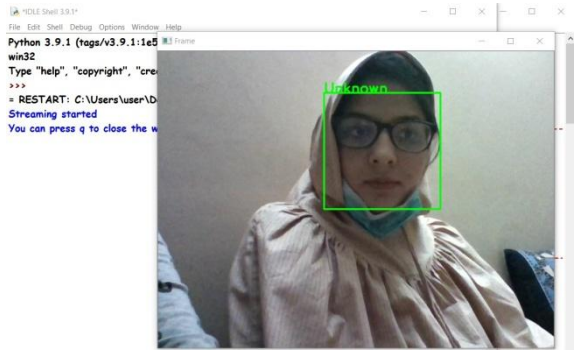

Fig.3.1. Unrecognized Face from Dataset

E. Model Designing

i. Python language is being used for this automated system.
ii. Software : Python IDLE 3.9.1
iii. AI model: Histogram of Oriented Gradients
iv. Files: Following files were made for execution of program face_enc.py, live_webcam.py and gui.py

F. Dataset

The dataset is saved simply in the directories in which. First, the Images folder is created which contains multiple other folders. These folders are named after each person present for the dataset. In each of the "person-name" folders, there are multiple images of the same person. The path which can be followed is Images/Person-Name/Person-Pictures. For Example Images/Sakina/1.jpg and Images/Sehrish/1.jpg. Libraries which are being used are imutils, face_recognition, Pickle, opencv, dlib, logging and tkinter.

G. Block Diagram

In Fig.3.2. the proposed technique deploys two progresses of images such as the input images and the image captured through live streaming. Both these process undergoes four common procedures namely, face acquisition, pre-processing, face detection using Haar-cascade classifier. These values are stored in the database only in case of processing an input image. Finally, comparison of the values in the database with the values computed via live streaming takes place which recognizes the human face as known or unknown based on the matching.

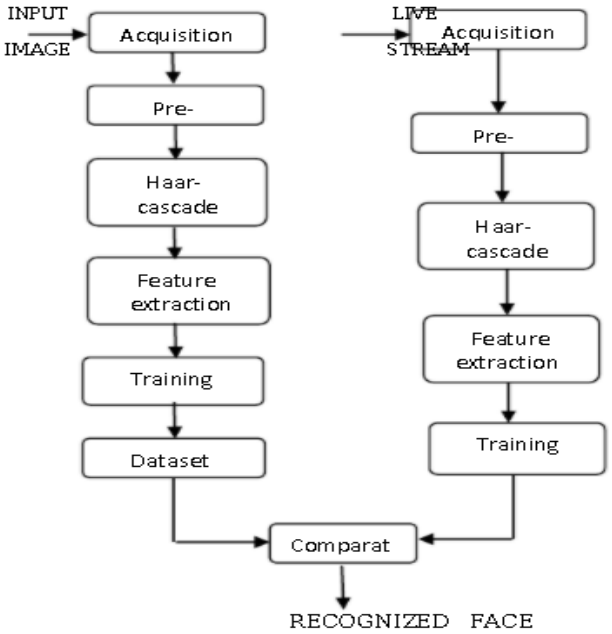

Fig.3.2. Proposed Block Diagramt

IV. ABBREVIATIONS USED

- **HOG:** Histogram of Oriented Gradients.
- **ML:** Machine Learning
- **DL:** Deep Learning

V. RESULTS

The expected output is that when the gui.py is executed, a webcam should open. Then whichever face (known in the dataset) appears in front of it, it detects the face with the name and displays it on the webcam.

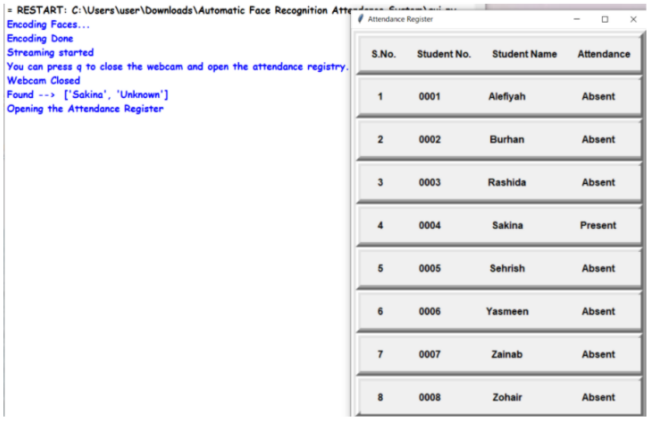

Fig.5.1. OUTPUT

Then, after the webcam is closed, the list of names is displayed on the python shell and also an attendance registry opens up to show all the names and marks present in front of all those that were found in the live streaming.

VI. SUGGESTED IMPROVEMENTS

There are multiple things which can impact the overall performance of the automated attendance system such as distance of face being recognized from the camera and excessive images in different angles of the same person which might result in hanging of the system. An equal number of images taken from every student will definitely improve the overall performance. 100 % accuracy of this setup is not guaranteed as it might result in failure sometimes due to environmental, noise, internet and live web camera issues.

It might not work with people such as twins, or siblings studying in the same class with similarity in features. Our computers does not contain GPU/CUDA cores in our system that is why we preferred HOG algorithms for better accuracy and results of our system.

VII. CONCLUSION

An automated face recognition system is made which gives accurate results. Human face recognition plays a very important role as part of modern surveillance and security applications. By applying the methods described in this paper, accurate algorithms and quality face recognition results can be obtained. Moreover, with the help of HOG models, one can achieve high-performance levels in recognizing human faces and analysing facial features, even in scenes containing complex backgrounds.

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