An Aid for Operative Criminal Detection

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Abstract - Over the last few decades, there were tremendous changes in the police force due to the increase in the crime rate whether it can be in specialized preventive or specialized investigation departments. They strive hard to protect the lives, possessions of citizens, and to prevent crime and disorder in society. Thus, improving the police procedures with the advancements of technology is our aim objective. This project helps the citizens to register their complaints online while checking their status time-to-time. Police officials would enquire the complaint details and use an automated facial recognition system for criminal database using deep metric learning HOG (Histogram of Oriented Gradients) feature descriptor with an accuracy of 98%. The proposed framework is to provide an online platform that allows reporting and managing crimes which is accessible to both public and police officials to trace the criminals within the stipulated time.

Keywords - Image processing, criminal identification, real-time, OpenCV, deep metric learning.

I. INTRODUCTION

A few years ago, India is a place where the victim has to visit the police station in order to register a complaint. General public is usually afraid to register complaints in police stations. It might be because of their unfounded fear, ignorance or dearth of time. Science and Technology revolutionize our lives, and this advancement should be made, so it can be fitting into our lives in such a way that we dont even notice it. Using the Internet and filling in the complaint will resolve these assumptions and help the police to take immediate action within the golden hour.

Face is an identity for any human being which helps in distinguishing one person from the other uniquely. Face recognition is an easy task for a human being but when it comes to a computer its completely a strenuous task. Recognition techniques can be used in wide variety of fields such as airport or private surveillance, security in public places to ensure safety of the common man. If the witness or victim can identify the face of the criminal using CCTV image or a sketch drawn by the artists, we can then upload this image into the central database (where all the previous criminal records are available with detailed information). But these images may appear in a different scale, pose within the plane rotations. Before processing this image, one has to digitize an image extract the information based on radiometric or geometric corrections, sharpen the image features at boundaries, contrast manipulation, filtering, noise reduction, interpolation and magnification and so on. After processing the image, in order to detect, feature extract and recognize the faces we need to calculate the gradient images, check unsigned gradients, normalize then calculate the feature vector of HOG descriptor. Thus, we can check whether this criminal has a record in our database or he is someone new. If one has a previous record, we can get his details from the database which can save us time and effort. Our intention is that the proposed system with its automated and state-wide online accessibility would make these criminal cases more open and can remove the poor image of police functioning.

With the advancement of technology, now we can use an email id verification or use an OTP through mobile, register themselves and then can file a complaint online without visiting the police station. Through these verification's one can easily avoid some of the fake complaints. After the complaint is registered, police officers would study the case, investigate its authenticity and hence set an FIR (First Information Report) number for the complaint. Earlier all this has been done using papers-based records and they can be easily exploited or lost. Time-to-time the details about the case can be accordingly updated into the system by the officials. Since the details are updated regularly, public may file a complaint or request for verification if the case doesnt show any progress, according to the time it was last accessed. This helps the police to maintain transparency with the complaints.

The rest of the paper is organized as follows: Section II illustrates various other methods of recognition in the past. Section III describes the System Design. Section IV demonstrates our proposed hog descriptor and the procedures involved in verifying the recognition and Section V concludes the paper.

II. LITERATURE REVIEW

In [1] authors proposed, identification of criminal in Malaysia is done through thumbprint identification. However, this type of identification is constrained as most of criminal nowadays getting cleverer not to leave their thumbprint on the scene. With the advent of security technology, cameras especially CCTV have been installed in many public and private areas to provide surveillance activities, we can be using this footage to identify suspects on scene. In this paper, an automated facial recognition system for criminal database was proposed using known Principal Component Analysis approach. In case of no thumbprint found on the scene, this would help the police to identify the criminal. This system will be able to detect face and recognize face automatically without any manual

intervention. This project outputs results with 80% accuracy.

In [2] authors proposed, an automated facial recognition system for criminal database was proposed using known Haar feature-based cascade classifier. This system will be able to detect face and recognize face automatically in real time. An accurate location of the face is still a challenging task. Viola- Jones framework has been widely used by researchers in order to detect the location of faces and objects in a given image. Through our paper, we studied and implemented a simple but very effective face detection algorithm which takes human skin color into account. Authors aim, which we believe we have reached, was to develop a system that can be used by police or investigation department to recognize criminal from their faces. The method of face recognition used is fast, robust, reasonably simple and accurate with a relatively simple and easy to understand algorithms and technique.

In [3] authors proposed, Face acknowledgment has turned into a well-known region of research in PC vision, it is normally utilized in system security frameworks and access control frameworks however it is additionally helpful in other sight and sound data handling territories. One of its application is criminal face recognizable proof. Criminal record by and large contains individual data about specific individual alongside the photo. To recognize any criminal, we need some distinguishing proof with respect to specific individual, which are given by unfortunate casualties. In light of the subtleties given by the onlookers, the further examination would be completed. As a rule the quality and goals of the recorded picture sections is poor and difficult to recognize a face. In this paper, we have arranged picture preparing activities into three classes; low, medium and abnormal state to process and dissect a given face. This paper exhibits preferred outcomes over traditional techniques being used identifying with the face acknowledgment process that are utilized in criminal recognizable proof.

In [4] authors proposed, Multiple techniques are used for recognition and to increase the accuracy we used face acknowledgment dependent on inclination heading histogram (HOG) highlights extraction and quick foremost segment examination (PCA) calculation is proposed to take care of the issue of low exactness of face acknowledgment under non-prohibitive conditions. In this strategy, the Haar include classifier is utilized to concentrate and concentrate the first information, and after that the HOG highlights are separated from the picture information and the PCA measurement de- crease is handled, and the Support Vector Machines (SVM) calculation is utilized to perceive the face. It is confirming the viability of the strategy with the test results.

III. SYSTEM DESIGN

The proposed systems has two phases namely,

A. Processing Phase

B. Application Phase

A. Processing Phase -

1) Stream of data is captured from a webcam and is analyzed in order to store it in the database.
2) After analyzing, the data one can be stored to recognize the image.
3) The recognize images are stored in database for further detection module.

B. Application Phase -

1) Log-in credentials are verified.
2) When the video/image is captured from a camera and then it is served as an input data.
3) This video/image is validated and forwarded to analysis module.
4) The video/image is pre-processed, noise is removed and objects are detected then it will be sent to detection module.
5) The Detection Engine is capable of detecting objects from the historical data.
6) The results are sent to the users from the Detection Engine.

IV. PROPOSED METHOD

A. Calculating the Histogram of Oriented Gradients - Hog is a feature descriptor. A feature descriptor represents an image or image patch that usually simplifies an image by extracting useful information such as objects (faces) and avoid unnecessary information that delays our effort and time. In Hog feature descriptor, the distribution of directions of gradients are used as features. The execution of these descriptors can be accomplished by separating each image into little yet associated areas called cells, and for every cell we should sort out a histogram of gradient directions or edge orientations for each and every pixel in the cell. In this manner, the mix of these histograms at that point can indicate a descriptor.

An 8x8 picture fix contains 8x8x3 - 192-pixel values. The inclination of this fix contains 2 esteems (magnitude and direction) per pixel. By the end, we can see those 128 numbers are depicted utilizing a 9-bin histogram which can be stored as an array of 9 numbers. Not only this representation is more compact, but the calculation of histogram over an image patch makes this more sturdy to noise. Individual gradients may have noise, but a histogram over 8x8 patch makes the representation much less sensitive to noise.

It shows the patch of the image overlaid with arrows showing the gradient the arrow shows the direction of gradient and its length shows the magnitude. The direction of arrows points to the direction of change in intensity and magnitude gives a huge difference. To the right, one can see the raw numbers representing the gradients in the 8x8 cells but the angles are between them are 0 and 180 instead of 0 to 360 degrees. These are called unsigned gradients because a gradient and its negative are represented by the same numbers.

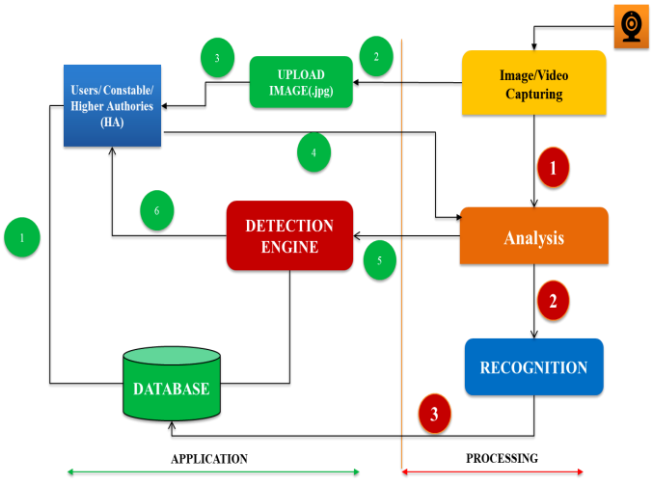


Figure 1: Frame work of Face Detection

The gradient components of each pixel (x, y) in horizontal and vertical directions are calculated by the following formulae (1,2). While the gradient magnitude and gradient direction of each pixel point is calculated using formulae (3,4).

$$G_x(x,y) = I(x+1,y) - I(x-1,y) \quad (1)$$

$$G_y(x,y) = I(x,y+1) - I(x,y-1) \quad (2)$$

$$m(x,y) = \sqrt{(G_x(x,y))^2 + (G_y(x,y))^2} \quad (3)$$

$$\theta(x,y) = \arctan\frac{G_y(x,y)}{G_x(x,y)} \quad (4)$$

The HOG descriptor of an image patch is usually visualized by plotting the 9x1 normalized histograms in the 8x8 cells. In the image placed above, one can notice that the direction of the histogram captures the shape of the person, particularly around his torso and legs.

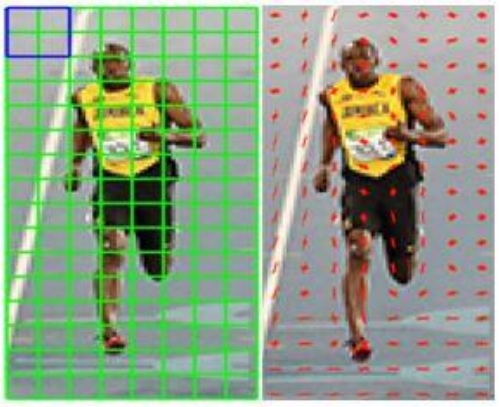


Figure 2: Image patch visualized by normalizing histograms

B. Proposed System Procedure for face recognition - It is a one-to-many coordinating procedure that looks at an inquiry face picture against all the format pictures in a face database to decide the identity of the questioned face. The entire face recognition solution is divided into the following modules.

Face Capture - First and foremost, we need to collect the face samples. We can either collect the image from a surveillance video or a pc camera and then upload this image into the training dataset. Images may contain object data and non-object data.

Face Train - We first need to quantify the face in our training set and so are trained to create 128-d embeddings. We can always train a network from scratch or even fine-tune weights of an existing model but it is more likely to overkill for many projects. Instead it would be much easier to use a pre-trained network and use it to construct 128-d embeddings for each of the image present in our dataset. From there, well extract the name and id of the person from the imagePath and then load the image while OpenCV orders color channels in BGR to RGB since dilib and face recognition prefers rgb image.

For each iteration of the loop, were going to detect a face or possibly multiple faces and assume that it is the same person in multiple locations of the image. This assumption may or may not hold true always. Then we model the training set using hog which is considered to be much more faster but less accurate when compared to cnn.

Face Recognition - Now that we have created our 128-d embeddings for each image in our dataset we are now ready to recognize faces using OpenCV, Python and deep learning. Now all we need to do is to run these faces through the trained model to get the 128 measurements for each face. Then we need to train the pickle file to take these measurements from the new image and tell whose face is the closest match. If the image is present in the database then it would give the output with their name and id else it shows the output as unknown.

C. Web Modules - Login page gives us the access to user, police and admin. Thus, these three become the main modules:

User Module - This is where the user registers himself with the police force and then after verification would file a complaint with detailed information. He will be able to check the status of his complaint when the police updates the criminal case detail.

Police Module - This is where police login with their id. He will able access all the complaints. If there is a new complaint, he would then study the case, verify the authenticity and then provide an FIR number for the criminal case and then later while investigation process is being done he would update the details when required and so the user might view the updates.

Admin Module - Admin logs in with his id and would be able to register new police stations and can update crime types, provide id to both users and police when required. He would be able to store the criminal data into the database.

V. RESULTS AND DISCUSSIONS

There are two ways in which we can extract features from a given image.

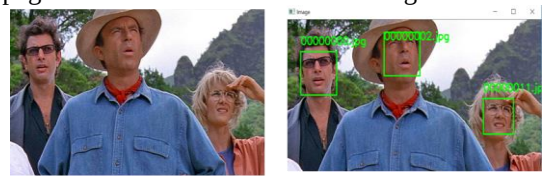
A. LiveCapture - LiveCapture through pc camera and then analyze the image to extract the hog features. This image thus gets the 128 embeddings of weights in a pickle file which will be further used for recognition.

B. Uploading Image - Image, which are being captured from the surveillance cameras or sketch document can be uploaded into the dataset to extract the hog features from the image and then create a pickle file with respective weights that is further used in recognition.

C. Detection and Recognition - First, the dataset is trained with all the images present in the database. When an image is uploaded and if the trainer recognizes the faces it gives the following output:

When the pickle couldn't match the weights of the given image, it gives the following output:

All this would be done by the admin module created in the web pages. It would look like the following:



a b

Figure 3(a) Sample image from Jurassic world; (b)Id of the uploaded image for the respective people when recognized by the hog descriptor.

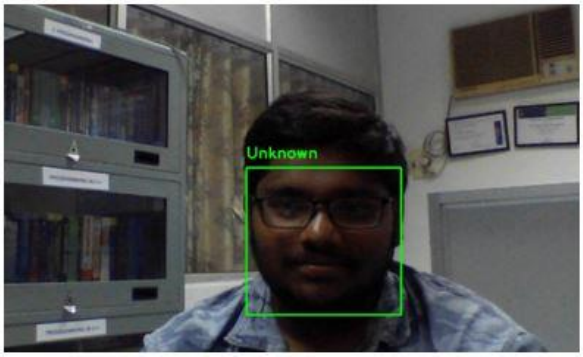


Figure 4. Unknown is given as output when hog couldn't recognize the person

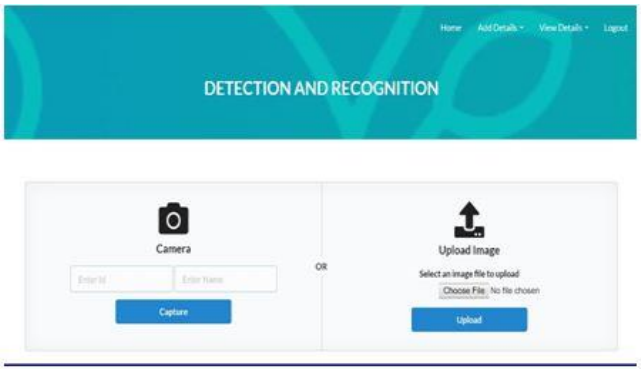


Figure 5. Live Capture and Image Upload

Thus, after finding either of the image id or name one can find the records of the criminal which would help them in further investigation.

VI. CONCLUSION

The methodology displayed in this work utilizes the window division process in which input picture is checked at pretty much every pixel area and scale, while boosting the performance with the upgraded precision. In this work we have taken both live captured images and some pre-captured images and performed face detection and recognition on them.

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