| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | Impact Factor: 7.488 |

||Volume 8, Issue 5, May 2020||

Security Alert in Surveillance System using Face Detection Algorithm

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ABSTRACT: Now-a-days, identifying a specific person such as criminals, terrorists, missing person through police and security personnel has been a difficult task for over many years. So Security is one of the important requirements of residential and business places which require biometric authentication. Face recognition is one of the easiest ways to identify an individual person which is widely used for personal identification, verification and security applications. It involves capturing face image from a video or from a surveillance camera. The face of the person can be uploaded in the database from an image surveillance camera. The face of the person in the surveillance is compared with the faces in the stored database. The stored database consists of persons whose images can be compared with the image from surveillance camera. Face biometrics involves training known images, classify them with known classes and then they are stored in the database. When a test image is given to the system it is classified and compared with stored database. Face biometrics is a challenging field of research with various limitations imposed for machine face recognition like variations in head poses, change in illumination, facial expression, aging, occlusion due to accessories. The proposed system eliminates the above stated limitations with the MATLAB software.

KEYWORDS: Histogram of oriented gradients; Speeded up robust feature; MATLAB; OpenCV

I.INTRODUCTION

In todays world, the use of closed-circuit television (CCTV) has increased to secure the premises with the decrease in installation and video storage cost. The excess of terror and crime makes the selective access to place a major concern for many organizations. Conventional methods e.g., password and smart card are unauthentic and fallible. Comparably, face recognition is a reliable and an intelligent biometric identification method. Automatic face recognition has been a challenging task for the research community. It has been extensively adopted by the applications including biometrics, surveillance, security, identification, and authentication. Face recognition usually exploit high-dimensional information which makes it computationally intensive. In addition, wrong detected features can make the recognition process even slower [1]. Thus, the interest in robust face recognition techniques to determine whether two facial images belong to same person is increasing rapidly. Security being popular domain of face recognition, allows us to mount a CCTV camera on fixed position and have a controlled flow of people, thus restricting pose and illumination. Although this reduces the complexity of face recognition, there is still a concern regarding the real-time protection of sensitive portions. It should be noted that this problem is somewhat a hard task and can be solved by automatically shooting the unauthorized person attempting to trespass the sensitive area. In this paper, we proposed a smart security system for access-controlled areas by exploiting face recognition. Firstly, we detect the human motion from CCTV surveillance camera and after that we extract the human face from the CCTV image. Afterwards, we recognize the extracted face with the help of the available training database.Tracking the intruder through a second CCTV camera provides us with the coordinates which were passed to the control system.

II.EXISTING SYSTEM

Many face recognition software have been implemented during the past decade. Each software uses different methods and different algorithm than other software. Some facial recognition software extracts the face features from the input image to identify the face. Other algorithms normalize a set of face images and then compress the face data, the saves the data in one image that can be used for facial recognition. The input image is compared with the face data. New method for face recognition is being used which is the three-dimensional facial recognition. In this method, a 3-D sensor is used to capture information about the shape of the face so that only distinctive features of the face, such as the contour of eye sockets, nose and chin, are used for face recognition. This new method offers some advantages over other algorithms in that recognition it is not affected by the change of light, and the face can be identified from a variety of angles, including profile view. Another new technique in facial recognition is called skin texture analysis. This technique uses the visual details of the skin, as captured in standard digital or scanned images and then turns the unique lines, patterns, and spots apparent in a person's skin into a mathematical space. Below is an introduction for some of the existing facial recognition programs that were used for security reasons.

A. *Face First:*

Face First is a software that provides a fully automated, user friendly, turnkey mobile and live-video surveillance facial recognition system. This software generates an alert whenever a face is recognized; and this occurs when the match of the input face with a face in the database is above a user defined probability. The advantage of Face First system is the availability to work in low resolution environments enabling real-world performance.

B. *MorphoTrak:*

MorphoTrak provides biometric and identity management solutions to a broad array of markets including law enforcement, border control, driver licenses, civil identification, and facility/IT security. MorphoTrak is part of the world's largest biometric company and leading innovator in large fingerprint identification systems, facial and iris recognition, as well as secure credentials.

C. *Cross Match Technologies:*

Cross Match Technologies is a leading global provider of biometric identity management systems, applications and enabling technologies to governments, law enforcement agencies and businesses around the world. Offerings include biometric technologies capable of wireless, mobile or stationary use that encompass facial recognition systems and other systems.

III.PROPOSED SYSTEM

The proposed design contains surveillance camera to capture image of the person want to find. The testing photos are inserted into the database for matching with the captured image. By the testing photos, the person's eye retina, forehead and other unique features are recorded and stored for comparing purpose. When the camera recognizes the face of the person, the matching of image is identified. When a match is found it will be notified with message.*Feature selection Algorithm:*Feature extraction describes the relevant shape information contained in a pattern so that the task of classifying the pattern is made easy by a formal procedure. In pattern recognition and in image processing, feature extraction is a special form of dimensionality reduction. The main goal of feature extraction is to obtain the most relevant information from the original data and represent that information in a lower dimensionality space. When the input data to an algorithm is too large to be processed and it is suspected to be redundant (much data, but not much information) then the input data will be transformed into a reduced representation set of features (also named features vector). Transforming the input data into the set of features is called feature extraction. If the features extracted are carefully chosen it is expected that the features set will extract the relevant information from the input data in order to perform the desired task using this reduced representation instead of the full-size input Pattern recognition is an emerging field of research in the area of image processing. Finally, it demonstrates that the proposed feature selection algorithm outperforms the other two methods as

- Histogram of oriented gradients (HOG)
- Speeded-up robust features (SURF)
-

A. *Histogram of oriented gradients:*

Histogram of oriented gradients (HOG) Histogram of oriented gradients (HOG) is a feature descriptor used to detect objects in computer vision and image processing. The HOG descriptor technique counts occurrences of gradient orientation in localized portions of an image - detection window, or region of interest (ROI). This method is similar to the previous method, except that here we have a bin size of 20. So, the number of buckets we would get here is 9. Again, for each pixel, we will check the orientation, and store the frequency of the orientation values in the form of a 9 x 1 matrix.

Implementation of the HOG descriptor algorithm is as follows:

1. Divide the image into small connected regions called cells, and for each cell compute a histogram of gradient directions or edge orientations for the pixels within the cell.
2. Discretize each cell into angular bins according to the gradient orientation.
3. Each cell's pixel contributes weighted gradient to its corresponding angular bin.
4. Groups of adjacent cells are considered as spatial regions called blocks. The grouping of cells into a block is the basis for grouping and normalization of histograms.
5. Normalized group of histograms represents the block histogram. The set of these block histograms represents the descriptor.

Computation of the HOG descriptor requires the following basic configuration parameters:

- Masks to compute derivatives and gradients
- Geometry of splitting an image into cells and grouping cells into a block
- Block overlapping
- Normalization parameters

Step 1: Pre-processing:

As mentioned earlier HOG feature descriptor used for pedestrian detection is calculated on a 64×128 patch of an image. Of course, an image may be of any size. Typically patches at multiple scales are analysed at many image locations. The only constraint is that the patches being analysed have a fixed aspect ratio. In our case, the patches need to have an aspect ratio of 1:2. For example, they can be 100×200, 128×256, or 1000×2000 but not 101×205. HOG Pre-processing The paper by Dalal and Triggs also mentions gamma correction as a preprocessing step, but the performance gains are minor and so we are skipping the step.

Step 2: Calculate the Gradient Images:

To calculate a HOG descriptor, we need to first calculate the horizontal and vertical gradients; after all, we want to calculate the histogram of gradients. The magnitude of gradient fires where ever there is a sharp change in intensity. None of them fire when the region is smooth. I have deliberately left out the image showing the direction of gradient because direction shown as an image does not convey much. The gradient image removed a lot of non-essential information (e.g. constant coloured background), but highlighted outlines. In other words, you can look at the gradient image and still easily say there is a person in the picture. At every pixel, the gradient has a magnitude and a direction. For colour images, the gradients of the three channels are evaluated (as shown in the figure above). The magnitude of gradient at a pixel is the maximum of the magnitude of gradients of the three channels, and the angle is the angle corresponding to the maximum gradient.

Step 3: Calculate Histogram of Gradients in 8×8 cells:

8x8 cells of HOG

8×8 cells of HOG.Image is scaled by 4x for display.

In this step, the image is divided into 8×8 cells and a histogram of gradients is calculated for each 8×8 cells.

Step 4: 16×16 Block Normalization HOG:

16x16 Block Normalization:

In the previous step, we created a histogram based on the gradient of the image. Gradients of an image are sensitive to overall lighting. If you make the image darker by dividing all pixel values by 2, the gradient magnitude will change by half, and therefore the histogram values will change by half. Ideally, we want our descriptor to be independent of lighting variations. In other words, we would like to “normalize” the histogram so they are not affected by lighting variations.

Step 5: Calculate the HOG feature vector:

To calculate the final feature vector for the entire image patch, the 36×1 vectors are concatenated into one giant vector. The task of finding point correspondences between two images of the same scene or object is part of many computer vision applications. Image registration, camera calibration, object recognition, and image retrieval are just a few.

B. *Speeded up robust features (SURF):*

The search for discrete image point correspondences can be divided into three main steps. First, 'interest points' are selected at distinctive locations in the image, such as corners, blobs, and T-junctions. The most valuable property of an interest point detector is its repeatability. The repeatability expresses the reliability of a detector for finding the same physical interest points under different viewing conditions. Next, the neighbourhood of every interest point is represented by a feature vector. This descriptor has to be distinctive and at the same time robust to noise, detection displacements and geometric and photometric deformations. Finally, the descriptor vectors are matched between different images. The matching is based on a distance between the vectors, e.g. the Mahalanobis or Euclidean distance. The dimension of the descriptor has a direct impact on the time this takes, and less dimensions are desirable for fast interest point matching. However, lower dimensional feature vectors are in general less distinctive than their high-dimensional counterparts.Ithas been our goal to develop both a detector and descriptor that, in comparison to the state-of-the-art, are fast to compute while not sacrificing performance. In order to succeed, one has to strike a balance between the above requirements like simplifying the detection scheme while keeping it accurate, and reducing the descriptor's size while keeping it sufficiently distinctive.

Box Filter approximation of Laplacian:

For orientation assignment, SURF uses wavelet responses in horizontal and vertical direction for a neighborhood of size 6s. Adequate gaussian weights are also applied to it. Then they are plotted in a space as given in below image. The dominant orientation is estimated by calculating the sum of all responses within a sliding orientation window of angle 60 degrees. Interesting thing is that, wavelet response can be found out using integral images very easily at any scale. For many applications, rotation invariance is not required, so no need of finding this orientation, which speeds up the process. SURF provides such a functionality called Upright-SURF or U-SURF. It improves speed and is robust up to \pm 15^{\circ}. OpenCV supports both, depending upon the flag, upright. If it is 0, orientation is calculated. If it is 1, orientation is not calculated and it is more faster.

Orientation Assignment in SURF :

For feature description, SURF uses Wavelet responses in horizontal and vertical direction (again, use of integral images makes things easier). A neighborhood of size 20sX20s is taken around the key point where s is the size. It is divided into 4x4 subregions. For each subregion, horizontal and vertical wavelet responses are taken and a vector is formed like this, v = (sum{d_x}, \sum{d_y}, \sum{|d_x|}, \sum{|d_y|}). This when represented as a vector gives SURF feature descriptor with total 64 dimensions. Lower the dimension, higher the speed of computation and matching, but provide better distinctiveness of features.For more distinctiveness, SURF feature descriptor has an extended 128 dimension version. The sums of d_x and |d_x| are computed separately for d_y < 0 and d_y \geq 0. Similarly, the sums of d_y and |d_y| are split up according to the sign of d_x , thereby doubling the number of features. It doesn't add much computation complexity.

IV.BLOCK DIAGRAM

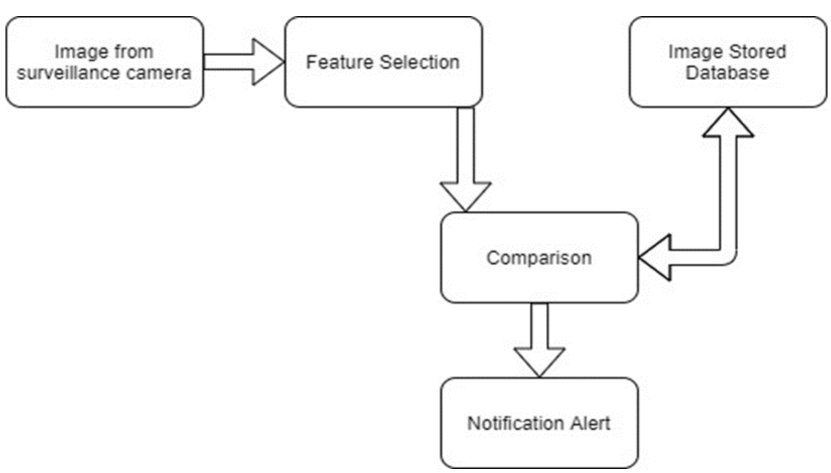

Figure 1: Workflow of proposed system

V.WORKING

The project consists of four modules such as

- Capturing Live Images
- Inserting Images
- Matlab Coding
- Sending Alert/Notification

The Module descriptions is as follow:

A. *Capturing Live Images:*

Automatic face detection and recognition under CCTV condition is a challenging task because of the large differences between face images of the same scene person due to variation in illumination variation, pose and expression. It mostly depends on the position of the CCTV camera [6]. Most importantly, illumination variation due to light source at absolute position and intensity sometime give rise to large variability. To cope up with this situation, the image is normalized by employing the lighting compensation technique which uses white as a reference to normalize the color appearance. We detected the face from the lighted-compensated frame by skin color (local feature) analysis.

B. *Inserting Images:*

The image of specific person such as criminals, terrorists, missing person can be collected and inserted into the database for comparison purpose. Face recognition is the most important module of the security system. It decides whether the person is authorized to enter the sensitive area or not. After face localization, preprocessing is done to extract the region of interest. Here we crop face part from the image to start the recognition process. The test images of all the authorized persons are stored in training database, while the cropped image after face detection is used to place in test database.

C. *Matlab Coding:*

In this module, after the images are inserted into the database, coding can be done to perform necessary actions. The system starts working when a person is detected by the camera. By receiving the image from the image recognition and detection section where we use Matlab programming environment starts acquisition. From the video captured face of the person is detected using Matlab programming techniques. We will take snapshots using get snapshot function in Matlab. Comparison is done between the captured image and the reference image we created during the training.

D. *Sending Alert/Notification:*

In the case of matching the time of access and date of access is sent as SMS using a GSM modem. In the case of unrecognized image an alert is given through the buzzer and an SMS is sent using GSM modem regarding the time and date of access. Based on the area of application this notification and alert module get varied. Depending on the area of application we can send or provide notifications like alarm sound, alert message to the authorized personnel and providing a voice message for blind, etc.

VI.RESULTS AND CONCLUSION

In this paper, an improved and novel strategy combining HOG Feature selection and SVM classification algorithm is proposed to select a compact feature subset performing well in image classification and verifying it with the database for providing security alerts. In this method, the HOG Feature selection method is employed to obtain the effective facial features of the suspect by eliminating the unwanted noises in the image captured from live CCTV and then it is filtered by using the SVM classification algorithm to get the best image, which is used for comparison with the trained dataset. This experimental result demonstrates that with the above proposed system a better security surveillance system can be achieved. However, some future work is needed to further improve the performance of the selection algorithm. For example, much more image descriptors can be extracted for images before processing or even a more efficient and less computational time-consuming evaluation criterion can be devised. It is well recognized that the issue of effectively feature selection and accurately image classification still remains to be open.

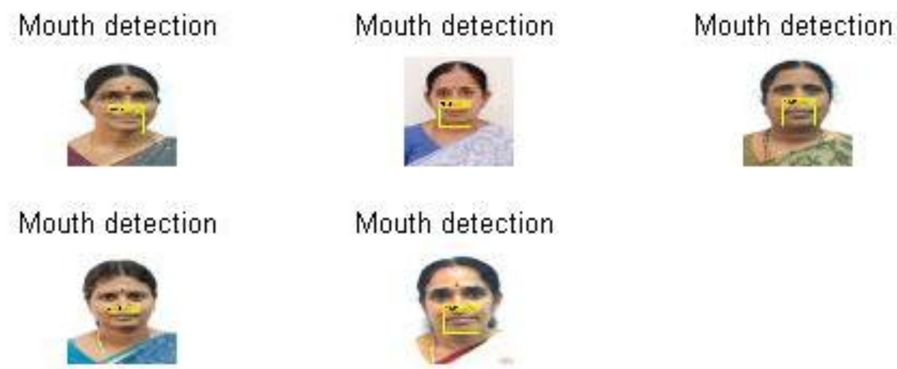

Figure 2: Individual Feature Detection in Dataset

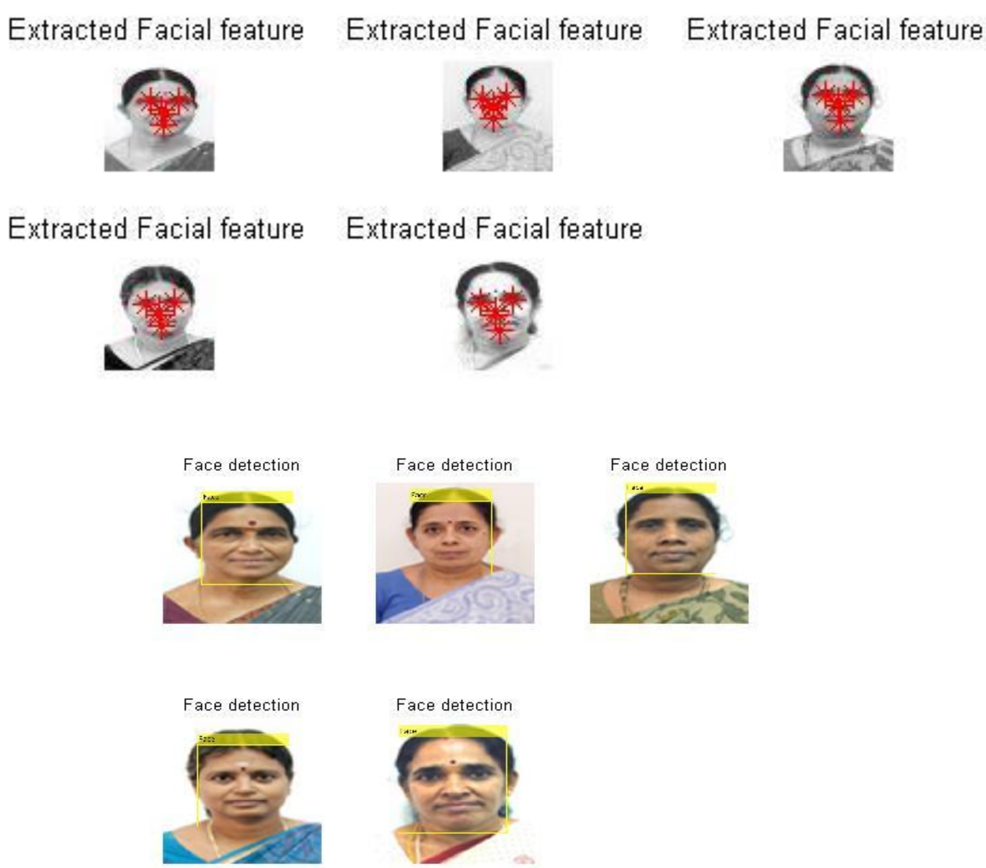

Figure 3: Extraction of Entire Facial Feature

Figure 4: Identification of Expected Facial Feature

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