Smart Surveillance Using OpenCV, Motion Analysis And Facial Landmark

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Abstract

This paper proposes the implementation of a smart surveillance monitoring system with the use of IP webcam and face recognition. The previous system on face recognition had many security flaws. Our system is better with the use of efficient yet effective Local Binary Patterns Histogram (LPBH) algorithm, Facial landmark and motion detection algorithms. The system can recognize a face with more accuracy and confirm whether it is a real person or not with minimal error rates. The Experimental results after getting implementations and testing is of accuracy 85%-95%.

Keywords — *Face Recognition, OpenCV, IP Webcam.*

I. INTRODUCTION

Face detection is a computer technology being used in a variety of applications that identifies human faces in digital images. Face detection methods have been developed from the start of this century i.e. around from the year 2001.The next big leap in technology was facial recognition from the face detected.

Face recognition is a technology capable of identifying or verifying a person from a digital image or a video frame from a video source. Thus, we have merged the surveillance system with face detection technology to create a smart surveillance system.

The word "Surveillance" is a combination of two words- sur that means 'from above' and veiller that means 'to watch'. Video surveillance was initiated using analogue CCTV systems to monitor people, for increasing safety of events and various activities while leaving the task of threat detection exclusively on human operators. But monitoring the events or intruders using human operators is a very labour-intensive task as in real-time; smart surveillance detects situations in the video automatically and triggers the alarm. Smart cameras are rapidly finding their way into intelligent surveillance systems. Whether it's a smart refrigerator, a smart watch or SMART SURVEILLANCE system, smart systems are already transfiguring the field of technology.

A smart surveillance security camera system can have many benefits for the industrial site , hospitals, banks, museums, jail that include (Reduced theft, protect employees, building security, remote monitoring of facility from Smartphone or tablet, deter trespassers from attempting to gain access to the facility).

The problem of surveillance system or CCTV camera is that it is expensive because of the use of many components like computer, camera and cables. Also we need a hard disk with higher capacity to save the video. It requires more space for continuous recording and manpower to detect the unauthorized activity. But compared with Raspberry Pi, our system will be much cheaper with high resolution and low power consumption feature. It can have the capability to solve many of the issues regarding cost that may discourage consumers from investing in remote surveillance technology.

II. LITERATURE SURVEY

At present there are many different methods for Facial Recognition, but most of these methods have some shortcomings.

Sarika Raga [3] presented a method using the Euclidean distance algorithm to increase the accuracy of face detection. The Euclidean algorithm enables the model to detect the face at varying distance. But the shortcoming of this model is that it can be spoofed with images of the face and dataset used are insufficient to improve the accuracy of the detection.

Spoofing with only images can be handled using motion detection , in the paper [1] presented by Chinmaya uses infrared PIR(Passive Infrared Sensor) sensor to sense motion of the person hence able to detect if it is a real person or an image. But using an extra sensor adds to the cost and with OpenCV 3 has libraries with algorithm to detect motion in video, hence no need for an extra sensor.

Another research paper [6] uses the motion detection and LPBH algorithm to recognize face and mark the attendance of that person. But a person with another person's face mask can mark his attendance. Since this model cannot recognize face features, it's not completely spoof proof.

The paper implements LPBH algorithm to work on low resolution images [4]. It uses pixel manipulation technique to use low resolution images but this model till does not provide spoof proof qualities needed to be used for security surveillance.

All the above mentioned papers are able to implement face detection, but have backdrop that they can be spoofed with 2d images or face mask. Our

system improves upon this problem using Facial landmark methods.

III. PROPOSED METHODOLOGY

The question arises why to use LPBH method while there are many methods available, here LPBH method requires less computation power and it's very easy to train, it can deal with 100 images of data set to train int within a minute it which give a quick result in train and adding new labels (User).

At the beginning itself, valid faces/ familiar faces are stored in the database. System also uses motion analysis to detect motion and verify whether a real person is present or a 2D image is present in front of a camera.

When the camera detects the motion, it simply searches for a face. After detecting a face it compares it with the pictures or faces stored in the database. If the face matches with the one in the database, the face is authenticated and no action needs to be taken.

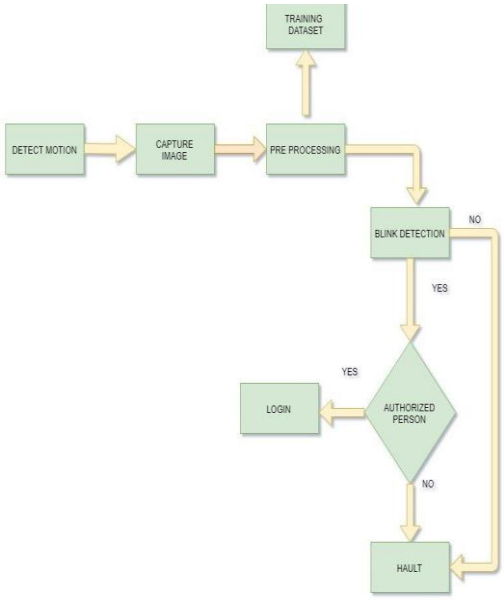

Fig 1: Flow Diagram

We use python and dataset generator script to generate and save the recognizer after we are done training the model, then we create a function which takes the training dataset and also get their ids.in the above function we will detect face capture the needed dataset save them according to their ids and return it.

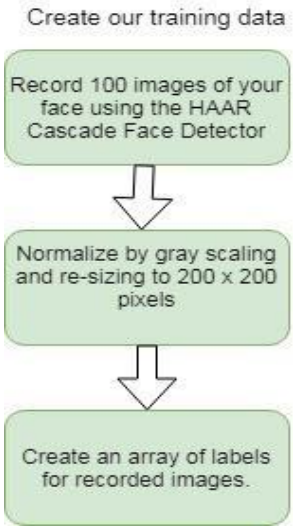

Fig 2: Collecting Dataset

After getting the dataset now we trained it with LPBH method, the LPBH feature vector, in its simplest form, is created by dividing the examined window into cells (e.g. 16x16 pixels for each cell). For each pixel in a cell, compare the pixel to each of its 8 neighbors (on its left-top, left-middle, left-bottom, right-top, etc.). Follow the pixels along a circle, i.e. clockwise or counter-clockwise. Where the center pixel's value is greater than the neighbor's value, write "0". Otherwise, write "1". This gives an 8-digit binary number (which is usually converted to decimal for convenience). Compute the histogram, over the cell, of the frequency of each "number" occurring (i.e., each combination of which pixels are smaller and which are greater than the center). This histogram can be seen as a 256-dimensional feature vector. Optionally normalize the histogram.

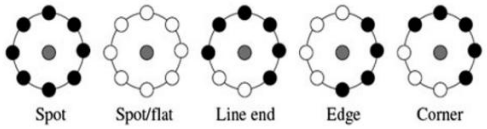

Fig 3: Some Visualization common pattern

A. Motion Analysis

The background of our video stream is largely static and unchanging over consecutive frames of a video. Therefore, if we can model the background, we monitor it for substantial changes. If there is a substantial change, we can detect it — this change normally corresponds to motion.

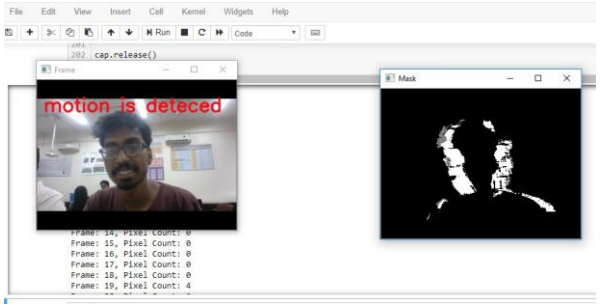

Fig 4:

B. Dlib's Facial Landmarks k Detector For Blink Detection

The pre-trained facial landmark detector inside the dlib library is used to estimate the location of 68 (x, y)-coordinates that map to facial structures on the face.

The indexes of the 68 coordinates can be visualized on the image below:

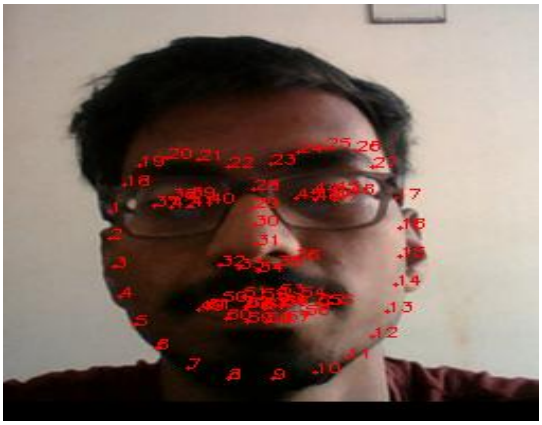

Fig 5 :

Here we will be using 6 coordinates for each eye so as to detect blink detection, We are using Euclidean difference in order to detect blink.

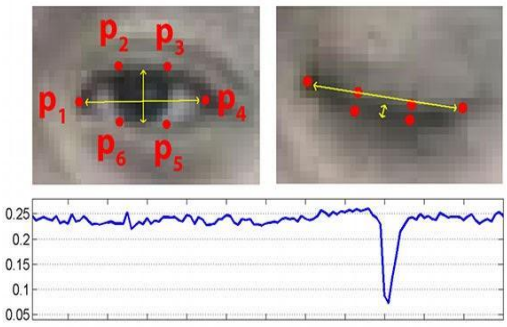

Fig 6 : Change in Euclidean difference in a blink of an eye

For blinking of eye, the eye lids when close the Euclidean difference become less , i.e it becomes less then 0.25 on the basis on experimental analysis threshold of 0.22 gives better result for blink detection[5].

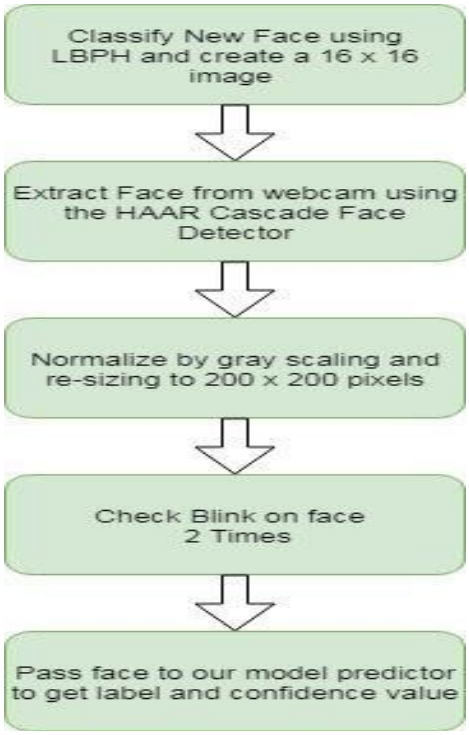

Fig 7: Testing

IV. FUTURE OUTLOOK

We can improve this system by adding some countermeasure in face recognition process. The most widely face recognition mocking assaults are photo and video assaults because of their convenience and minimal effort. Based on the observations in 2D, there are face recognition (FR) systems which are vulnerable to these attacks. There are different methods against photo and video attacks which are mainly based on liveliness detection, motion analysis, and texture analysis.

There are several countermeasures based on motion analysis. These countermeasures rely on the fact that the movement of a 2D plane is different compared to the movement of a 3D object. Under the assumption that a test region is a 2D plane, it should obtain a reference field from the actual optical flow field data. Then the degree of differences between the two fields is used to distinguish between a 3D face and a 2D photograph. A set of facial points are located automatically and their geometric invariants are used to detect attacks.

V. CONCLUSION

The proposed smart surveillance system taking into consideration that it will be able to fulfill the needs of the user/customer in circumstances where

the area to be monitored is fixed/limited for now significantly contributes to situation awareness in real time and also has been aimed to design in such a way that it can be used in many surveillance areas. On studying/researching all the requirements and possible outcomes we have designed a Smart Surveillance System which is perfectly capable of capturing, recording, detecting and identifying the faces, and even notifies/alarm if some unknown person arrives in the area. For instance, in one scenario it can be used by a person working in the industry to be aware of the activity happening at their own workplaces and can also be used for spy purposes at bank lockers, storage houses, military areas, smart homes, banks, offices, industries etc.

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