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Facial Features Extraction and Recognition for Criminal Identification

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Abstract - *This paper represents a real time recognition and identification using an automatic surveillance camera and respective hardware. The proposed system involves 4 steps, including (1) training of real time data and pictures (2) face detection using Haar -Cascade classifier (3) comparison and matching of trained images with live images from camera (4) identification based on the comparison. A core application of interest is automated surveillance, where the aim is to acknowledge people from watch list. The purpose of this paper is to match an image with several already trained. This system represents a technique for face detection precisely in real time environment. Haar cascade is one of the prominent open source platforms for face detection. Here system uses Haar classifiers to trace faces in image using OpenCV platform. The accuracy of the face recognition is significantly high. The system can proficiently recognize one unique face, useful for quick search of suspected persons because the computation time is remarkably low. In India, we have a typical system for unique citizen recognition called Aadhaar. If system makes use of this as a citizenship database, it can differentiate between individuals and keep a record of the criminals in a specific region and add their identities to the criminal system watchlist.*

Key Words: **IOT, Raspberry Pi, Python, Open CV, Surveillance Camera, Haar Cascade, Face Recognition, Image Masking.**

1. INTRODUCTION

Face recognition is a combination of machine learning algorithms and therefore holds the qualities of not only extreme precision but also reliability. For automatic detection of the face from the databases this technique is extremely helpful. In recent years Open CV (Open Source Computer Vision Library) has been widely utilized in different sectors of applications like surveillance camera, robotics, image pre-processing, identification etc. This technology is employed for capture, pre-process, authenticate, validate, authorize, and identify. In developed countries, the government creates a dataset of citizens which is then used to compare suspected faces with trained data stored in database.

Face identification is defined in three steps - face detection, feature extraction and face recognition after comparing the features. Camera configuration is extremely important to trace moving persons and recognize them precisely. Facial feature points encode crucial information about face shape. Precise location of features and facial points tracing are important. Each feature point is typically detected and traced by performing an area look for the higher matching position. There are very few researches on face recognition using edge-based facial features detection. The sides aren't only carrying valuable data about face but also are simple to process and hence computation power and the time required is drastically reduced. The Viola Jones method provides a classifier by selecting a couple of significant features using AdaBoost. Viola jones method successfully combines more composite classifiers in Haar cascade structure which exponentially increases speed of detector in the favourable features of the face. Software out there that resemble similar services related to the face recognition system do exist, however, this system also has its own merits and excellences which can contribute to the society.

Due to its intricacy, the recognition of the automated facial identification tool might be burdensome. Moreover, there's also possibility for making the interface as user friendly which wants the minimal amount of interaction among the users and system. With this system, which automatically processes the image, users are only required to provide input a real time image & the system will do the rest. Furthermore, new functions are often added by experienced developers as per requirements because this is often an open source and modular system. This is often a simple model which always makes the system easier to utilize. Overall, there are some advantages and merits which require to be recognized as below:

It is a healthier substitute or alternative to identifying using the thumb print. Criminal photo captured through a video source are getting to be fed to identification system. This system has the capacity for automatically doing the further process like recognize, extract, and detect the features of the photographs and identifies the actions.

2. METHODOLOGY

This paper goes to develop extraction and recognition system that's capable of processing images promptly while acquiring surprisingly high true positive face identification rates. Beholding frameworks are tried crosswise over different standard face databases, with and without noise and other

practical effects. The results of visual perception frameworks uncover that well utilized face recognition even from inferior pictures and shows astounding execution productivity, monitor possible threats, and prevent/examine criminal activities addition to face and motion detection is typically an important requirement.

Facial Feature Extraction and Recognition for Criminal Identification is particularly about maintaining a secure environment. OpenCV (open source computer vision) is the pivotal software that's getting used during this technique. For face detection, system uses Haar Cascade and Linear SVM. The foremost proposed method during this work is, if an individual comes in viewpoint of the camera, first it'll look for potential matches that we've already stored in the trained database. If the module finds a match then it fires an alarm in the form of buzzer/LCD display and email alert is sent to administrator at headquarters.

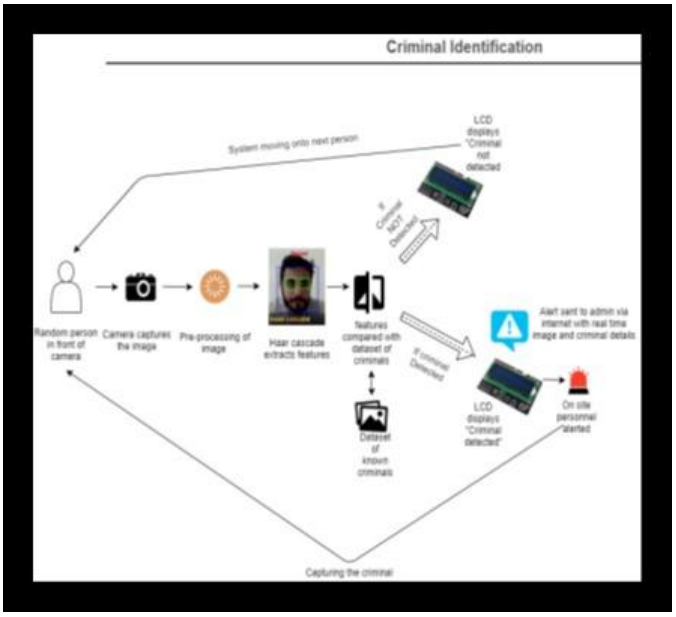

Fig -1: Architecture of System

3. System Implementation

Training the system: To identify the criminals, it is necessary to train the system with their images so the system will have dataset of facial features of each criminal for comparison. The process is as shown below. Each criminal will have his own id assigned.

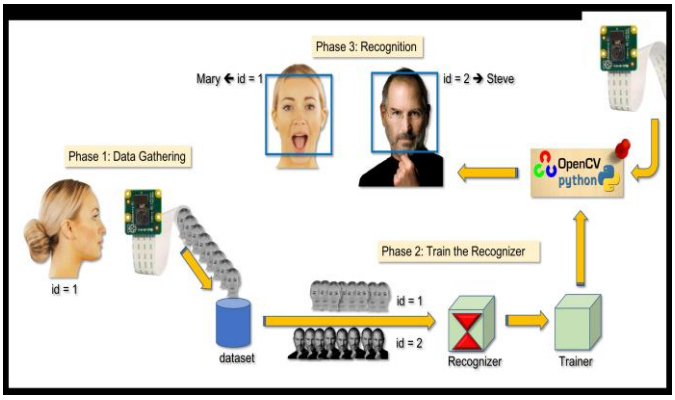

Fig -2: Training of Algorithm

Setup: The system will be integrated to a raspberry pi and will require a stable power supply to operate. It will also need internet connection possible via LAN or Wi-Fi ports to be able to send notification to the administrator. In the developed system, a 42MP camera with good density of pixels will be setup at a location where people will enter through a gate or a small entrance for example, the entry door of a VIP's house from where criminals might enter. This camera will be connected via HDMI cable to the Raspberry Pi system. An IR sensor will be used on the Raspberry Pi which will detect motion. Only if motion is detected, it will turn on the camera, hence saving a lot of power, then the camera will capture an image only if a person's face is detected in the frame and will hence save data size and reduce unnecessary processing. This identification of whether a person's face is present or absent in the frame of camera will be done using OpenCV framework.

OpenCV: OpenCV identifies human faces using facial features like eyes and face features present in the captured image basically. It provides a platform and access to libraries that provide pre-trained algorithms to identify human faces. This saves a lot of time that is needed for training and testing to help the algorithm to differentiate between human faces and other shapes present in images. This is done with the help of face cascade classifier and eye cascade classifier.

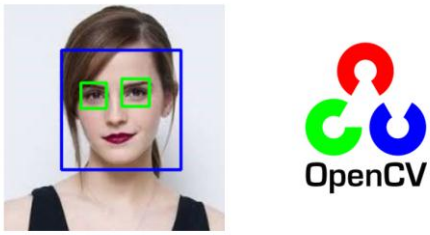

Fig -3: Human Face in OpenCV

Pre-processing: When the system is setup, whenever a person's face is captured, it is pre-processed. This involves converting the RGB image to grey scale. This is done because Haar cascade algorithm only works with black and white pixels and has the added benefit of reducing image size and further processing power required. Then the image is cropped to include only the face of the person. This also

saves on image size. Then the image is sent for Haar cascade detection.

Application of Algorithm: The features of the image captured in real time will be extracted using Haar Cascade image masking techniques. The processed real time image is then compared with the processed images stored in dataset. After comparison of features, the decision will be taken by the algorithm whether it is a match or not. Haar cascade algorithm uses Haar features as shown to identify faces. These features are applied on top of the pre-processed image which is in grey scale. Thus, the system is able to identify human faces using these features. Now each human face is unique and after applying millions of these Haar features on top of the face, each and every human face will generate a unique combination of features. These features are stored in the matrix form as below. The white pixels are represented by '-1' and black by another number or as in this case'5'.

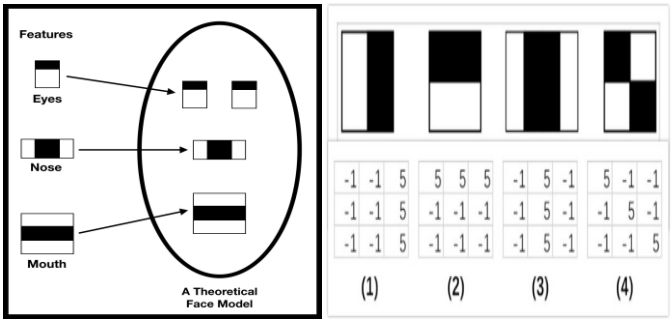

Fig -4: Haar Cascade Features and Matrix Storage

There are 2 types of pixels in the image, i.e., black or white. The face is full of these combinations of pixels. For example, the eyebrows are generally represented by black pixels and hence will create such a matrix. The borders of the face will be defined by the edge features surrounding the face and as each face shape is unique, it will create another unique combination of pixels in matrix form. Similarly, millions of unique combinations of matrix will be created using nose, ears, eyes, cheeks, lips etc based on their shape and size. Thus, these stored features can now be compared with trained dataset images of criminals. And due to high possible combinations of features for each person, misidentifying is rare and accuracy is high. This is because multiple stages of feature extraction are implemented, where in the initial stages a broader image is considered and as depth is increased, the complexity increases and so do the pixel combinations.

Detection and Alert: If the image captured in real time is matched with a known criminal then an alert will be sent from by the system to the administrator via internet. The admin also gets the real time captured image along with criminal details so appropriate action can be taken. Also, the LCD will display a message that the person is criminal and hence on-site police will be alerted. In case the face is not a match, the LCD displays such a message and the system moves onto the next image. Only the administrator can add or remove new criminals to the system. This can be done by accessing the system, training it with the new criminal's images and then storing them on storage of Raspberry Pi.

4. Results:

The system is capable of providing immediate output and provided there is stable internet connection and power supply, the complete criminal identification process takes place within 1 second with a 96% accuracy. This can be further increased by providing a higher number of training data set images to the system and a tradeoff between the processing time and accuracy takes place. So, the admin can according to his needs, decide the relation between accuracy and time delay.

Fig -5: Registering a Criminal

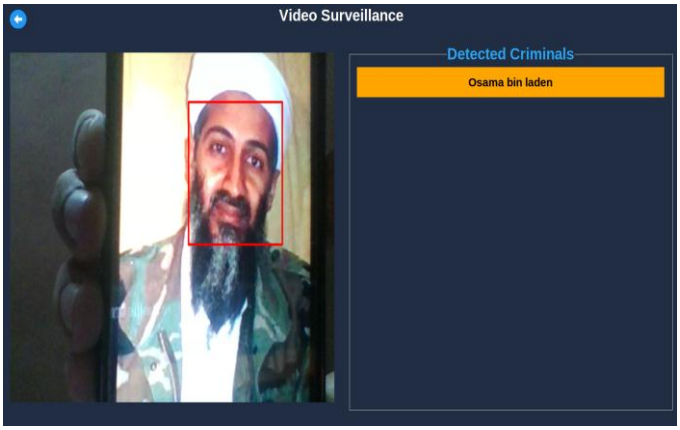

Fig -6: Detecting a Criminal

5. CONCLUSION

This paper has introduced the face recognition supported Raspberry Pi IOT system and Machine Learning algorithms embedded in Open CV and Python Language. Albeit the stored bunch of images of the person within the database differ from the input image, the system may be a useful method of identifying the individual faces and so hunt down the difference between real time image and stored images

the system takes and calculates main features from the important time image.

Thus, some minor changes within the image to be recognized are often allowed. Great recognition accuracy and better discriminatory power, lower computational cost because smaller images with only main features require least processing to teach the Algorithm. The key advantage is that system uses citizenship database which already exists. Thus, it is a feasible and efficient method of identification of criminals in a secure location.

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