IJIRCCE

e-ISSN: 2320-9801 | p-ISSN: 2320-9798

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN COMPUTER & COMMUNICATION ENGINEERING

Volume 9, Issue 6, June 2021

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

Impact Factor: 7.542

9940 572 462 | 6381 907 438 | ijircce@gmail.com | www.ijircce.com

International Journal of Innovative Research in Computer and Communication Engineering

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 7.542 |

|| Volume 9, Issue 6, June 2021 ||

| DOI: 10.15680/IJIRCCE.2021.0906126 |

Implementation of Criminal Face Detection Using Tensorflow and OpenCV

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ABSTRACT: Face recognition is definitely one of the fast-growing future technologies in computer vision. It has applications ranging from security to entertainment websites. Face recognition systems are beneficial for criminal face identification, banks, companies, and other institutions for screening people. Many individuals do not approve of surveillance operating systems that take multiple photographs of people who have not authorized this action. The goal of this paper is to evaluate facial detection and recognition techniques to offer a new solution for image-based face detection and recognition with higher accuracy, better response rate.

KEYWORDS: Computer Vision, Facial detection, Face recognition, Criminal face identification

I.INTRODUCTION

A criminal record contains personal information about a particular person along with captured photographs. To identify anyone who commits a crime or theft we need identification regarding that person, which is given by the eyewitness. Identification can be done by eyes, fingerprint, DNA, etc. One of the major applications is face identification. Primary focus of attention is our face because it plays a major role in conveying identity and emotion. Although it is not easy to infer intelligence or character from facial appearance, the human capacity to recognize faces is remarkable. Face recognition system uses a data collection of images and differentiates other images against those to find a match if one exists. For every facial image, identification can be implemented using the RGB values for the eye color, the width, and the height of the face. The goal of this system is to identify the criminals in any investigation department. In this system, we collect and store the images of criminals in our database along with his or her details, and then these images are structured into four slices- forehead, eyes, nose, and lips. These images are again saved in another database record so that the identification process is easier. Thus, this system provides a very user-friendly environment for both the operator and the eyewitness to easily identify the criminal if the criminal's record exists in the database.

II.OVERVIEW

Face Recognition for Criminal Identification is a face acknowledgment framework in which the security master will include a picture of the individual being referred to inside the framework and the framework will first preprocess the picture which will cause undesirable components like commotion to be taken out from the picture. From that point forward, the framework will at that point characterize the picture, for instance the distance between the eyes, the length of the nose, and so forth at that point, the framework will run a hunt through the information base to track down its ideal match and show the yield. This work is zeroing in on executing the framework for criminal recognizable proof. Current act of thumbprint distinguishing proof which is straightforward and simple to be executed can be challenged by the utilization of idle thumbprint and now and then can't be procured from the crime location. The hoodlums have become cleverer and typically be cautious in leaving any thumbprint on the scene. This framework included a face data set and a picture preparing calculations to coordinate with the face feed with faces put away in the information base.

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II.ADVANTAGES

- Crime rate can be reduced.
- Find missing criminals, children and other cases
- Identify and find exploited children.
- Recognize and track criminals.
- Protects businesses against theft.
- Support and speed up investigations.
- Facial recognition helps officers to identify an individual faster and more accurately than the human eye

III. FACE RECOGNITION ISSUES

Face recognition is very much useful in virtual reality, human computer interaction, database recovery, multimedia, computer entertainment, information security but slight changes in the results may vary depending on certain conditions. Recognizing and detecting faces are challenging due to wide variability in poses, shapes, sizes, and textures. The problems in face identification and recognition are listed as follows:

1. **Face Posture:** Depending upon the camera angle the face posture may vary at the time the image was captured.

2.**Structural components:** Structural components on the face includes moustache, beard, hairstyle, or spectacles. These components may have different styles, shapes, textures, and colors.

3.**Facial emotions:** Facial features tend to change based on emotions.

4.**Obstruction:** A face may be somewhat blocked by someone else when the image is captured among the crowd.

5.**Image condition:** The condition of an image depends on the lighting and camera components that comprise image quality.

IV.RESEARCH ANALYSIS ON FACE RECOGNITION

Computer vision researchers aim to bring the automated face recognition systems which are equivalent, and eventually exceed, human act. The problem in face recognition has been in discussion more than two decades.The proposed literature review approaches are categorized as : model based and appearance based . The modelbased approach tries to drag measurable criteria from the facial segments.Whereas, the appearance based approach uses the Quality or intensity-derived factors such as eigen faces, eigenvectors to identify facesAs human face may change significantly due to expression variation, motion, lighting effects etc, There are approaches which recognize faces under dynamic motion. Active Appearance Model is one which blemishes a generic face model to fit into the input image.

V.FACIAL BIOMETRIC AUTHENTICATION

Physical human interaction plays a vital role in everyday tasks but over the years the necessity of human interaction has decreased. Speaking Of the automated society we are living in, we interact more frequently with mechanical technicians, anonymous users, and the electronic information sources of Google than with our human companions. In the 21st century, Identity has become an important issue. It is true that in an age where fraudsters are causing the public several losses every year and even the most powerful nations are powerless. This is why biometric authentication has already begun a rapid growth in a wide range of market sectors and unquestionablygoes on until biometric scans are as common as credit card swiping or writing a signature.

VI.VARIOUS CATEGORIES OF FACIAL RECOGNITION ALGORITHMS

- Neural networks·
- Information theory
- Graph matching
- Feature analysis

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Face recognition has numerous benefits than biometrics, it is unobtrusive. Whereas many biometrics require the subject's co-operation and awareness in order to perform identification or verification, such as looking into an eye scanner or positioning the hand on face recognition, a fingerprint reader could be performed which is described by the NSTC.

VII.FACE RECOGNITION TECHNOLOGY

Facial recognition technology allows users to engage in "multifactor biometrics" to verify a user's identity, such as voice and facial recognition. Acquiring face images is a method that depends upon the fundamental application. For instance, surveillance face recognition devices may be best performed by taking face images by capturing a video file while investigating image databases may need static intensity images taken by a standard camera. Applications like Top security domains, may require to disavow unobtrusively as making the user stand in front of an infra-red sensor or 3D scanner is necessary.

FACE RECOGNITION PRACTICES

Based on deep learning of images, face recognition practices or methods are distinguished into categories. Face recognition are generally classified as feature based and holistic approaches.

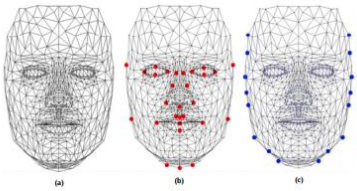
BASED ON FEATURE APPROACH

Feature-based approaches include processing input image is the first step for identifying and extracting the distinguishing facial parts like mouth, nose, eyes, hairstyle etc., and then measure the relationship in the facial points for detection, which minimizes the input facial image to a vector of computed features. Employing standard facial recognition techniques for matching faces from the measurements is done.

BASED ON HOLISTIC APPROACH

Holistic face recognition utilizes collection of information from faces from different places to perform face recognition. The first stage is to input a set of images into a database. The second stage is to form the eigenfaces. Eigenfaces can now be extracted from the image data by using a mathematical tool called Principal Component Analysis (PCA). When the eigenfaces have been created, each image will be represented as a vector of weights. The system is now ready to accept entering queries. A holistic approach is the simplest version, in which the image is represented as an intensity value of the 2D array, and a Comparison between the input face and all the other faces in the database is done by correlation

BASED ON STATISTICAL APPROACH



Human face recognition is now a very required aid, dealing with statistical and mathematical models, together with computer implementation.Also, this approach may work under limited conditions (i.e., scale, pose, equal illumination, etc.), it is numerically high-cost and suffers from the usual shortcomings of straightforward correlation-based approaches, such as sensitivity to size, background clutter, noise, variable lighting conditions, and face orientation

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BASED ON PREDOMINANT APPROACHES

Predominant approaches to the face recognition problem are of two types: photometric and geometric. As face recognition research continued deeper, New algorithms were born, three of which have been detailly documented in face recognition literature: Linear Discriminant Analysis (LDA), Principal Components Analysis (PCA), and Elastic Bunch Graph Matching (EBGM).

PCA

The PCA technique was formulated by Kirby and Sirovich. The PCA technique is then executed to minimize the length of the raw data by compressing data and revealing the most effective low dimensional structure of different facial patterns. Every single face image may be represented as a weighted sum (feature vector) of the eigen faces, which are stored in a 1D array. The PCA approach collectively requires the complete front face to be visualized each time, otherwise the image results in poor performance. The minification in dimensions excludes information that is not needed and precisely decomposes the face structure into orthogonal components known as eigen faces.
The main benefit of the PCA technique is 1/1000th of the data presented is compressed based on the needed data from the individual identification.

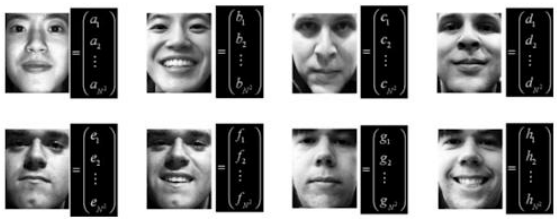

Fig1. Faces With Their Eigenvectors

LDA

LDA in simple terms is a statistical procedure for interpreting samples of unidentified classes referring to training samples with known classes. This initial goal of this technique is to maximize between-class variance and minimize within-class variance. When organizing high dimensional face data, this technique may detect the small sample size problem that arises when there are a least number of available training samples compared to the dimensionality of the sample space.

Fig2. Examples of Six Classes Using LDA

EBGM

EBGM relies on the fact that original face images have a lot of nonlinear characteristics that are not addressed by the linear analysis methods. Visual objects in EGM are presented as graphs, where the nodes denote local textures and the edges denote distances between the node locations on an image. Collection of local textures represented by image's object. Elastic Bunch Graph Matching is basically an algorithm used in computer vision for recognition of objects based on a graph representation extracted from other images. The Gabor jet is a node denoted by circles on the picture below, which

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defines the behavior around a given pixel. A Gabor wavelet transform forms a dynamic link formation that presents the face onto an elastic grid.

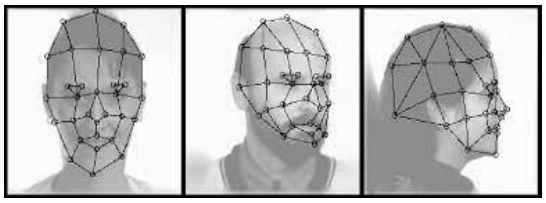

Fig 3.Elastic Bunch Graph Matching

THE SCALE INVARIANT DETECTOR

Converting the input image into an integral image is the first step in the Viola-Jones algorithm. The total sum of all pixels above and to the left of the discrete pixel is equal to each pixel. Thus, Calculation for any given rectangle uses only four values. The pixel values coincide with the integral image in the corner of the rectangles. The sum of the white rectangle is subtracted from the sum of the black rectangle to compute the single value as a face detector examines a given sub-window of two or more rectangles. Viones Jones found that 24*24 pixels give better results while allowing all possible sizes and postures of approximately 160.000 distinct features. It is found that the number of possible outcomes enormously numbered the 576 pixels in the detector at base resolution. The images given below are the screenshots from our system with their corresponding face for face recognition.

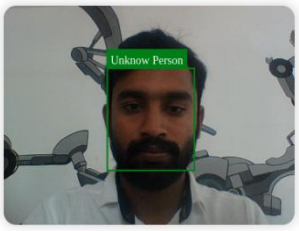

Fig4. Face Recognition from Live video

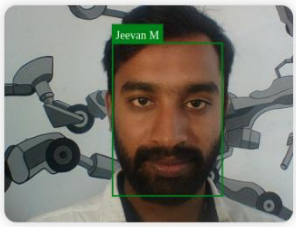

Fig5. Face Recognition with Image

NEURAL NETWORKS

Neural Networks are a group of neurons which are connected by weights. This algorithm is trained with a dataset by optimizing the loss function. The loss function is computed from the true values and the predicted values. This process of calculating loss and adjusting weights is called back propagation. It uses many layers of neurons to learn more complex functions.

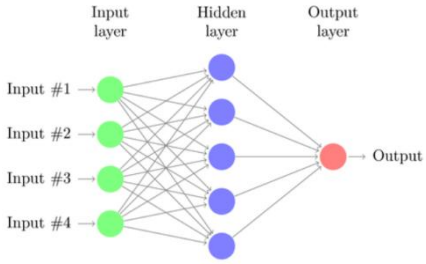

Fig6: Neural Networks 3

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 7.542 |

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The performance of a neural network depends on the dataset. The behavior of a neural network is a black box. The performance of the neural network is proportional to the size and variety of the dataset. Also, increasing the layers increases the complexity of the model. This can also lead to overfitting the dataset thus, it is very important to select the appropriate number of layers for a model.

CONVOLUTIONAL NEURAL NETWORKS

Convolutional neural network is also a type of neural network which contains learnable filters. The filters are in the form of a kernel which convolves with the input layer by computing dot product. The results of the dot product contain deep information about the input.

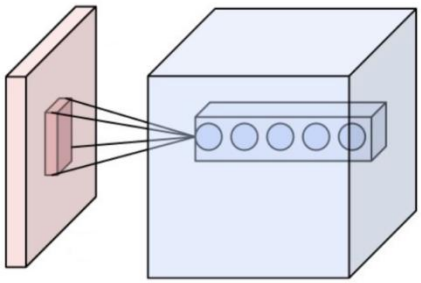

Fig7: Convolutional Neural Networks

This is flattened and given as input to the neural network. From this idea exploring the depth of input leads to better feature extraction methods. The advantage of this algorithm is that the filters are trained without any supervision and it leads to better feature extraction.

VIII.STEPS INVOLVED IN FACIAL RECOGNITION

You might recognize faces easily or you might be good at it. You probably find it simple to spot the face of a family member, friend, or dear ones. You're used to their facial features — their eyes, nose, and how they come together. That's how a facial recognition system works, but based on an algorithmic scale. When you see a facial character, face recognition technology sees data. That data can be stored, retrieved and accessed.

Step 1: The image of the face is captured in a crowd or alone from video or photo.

Step 2: Facial recognition system reads the geometry of your face. For face detection, this project implements a**SSD (Single Shot Multi box Detector)** based on **MobileNetV1**. The neural net will compute the locations of each face in an image and will return the bounding boxes together with it's probability for each face. This face detector is aiming towards obtaining high accuracy in detecting face bounding boxes instead of low inference time.

Step 3: Database of familiar faces is compared with your signature of the face. For face recognition, a ResNet-34 like architecture is implemented to compute a face descriptor (a feature vector with 128 values) from any given face image, which is used to describe the characteristics of a person's face.

Step 4: Determination is made by finding a match. You can determine the similarity of two arbitrary faces by comparing their face descriptors, for example by computing the Euclidean distance or using any other classifier of your choice. The model achieves a prediction accuracy of 99.38% on the LFW (Labeled Faces in the Wild) benchmark for face recognition.

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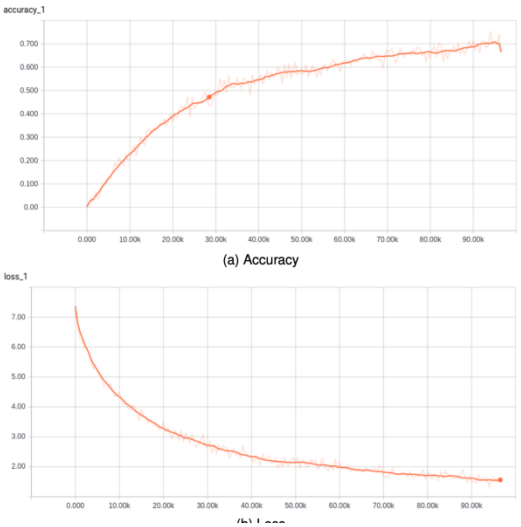

Fig8: Training Loss and Accuracy after 100,000 iterations.

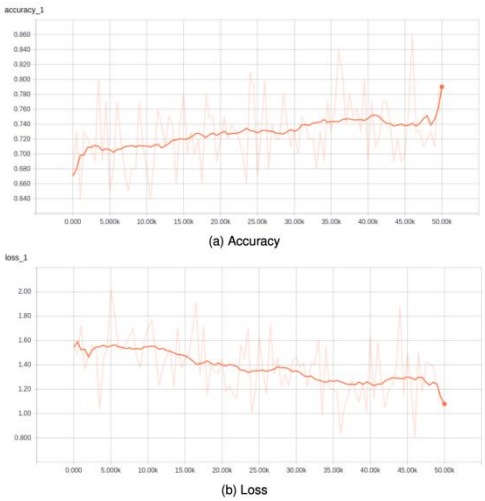

Fig9: Training Loss and Accuracy after 150,000 iterations.

IX.FACTORS IN FACIAL IDENTIFICATION

Facial recognizable identification by scientific analysts is a center segment of criminal examinations. These recognizable records of proof are regularly done in testing conditions that expect specialists to coordinate with personality across pictures and recordings taken at a different distance, under various brightening conditions, and across a wide scope of stances. Up to this point, research facility investigations of human face distinguishing proof have concentrated. DNA and Fingerprints won't change during a human's life, but for facial recognition following factors are taken into considerations:

- Age of the victim
- Cosmetics
- Subject's posture
- Smoking or drug abuse effects
- The victim has undergone any plastic surgery
- Illumination effects
- Medical history

X.CONCLUSION AND FUTURE WORK

Facial recognition works on an algorithm to match physical characteristics against photos and videos of people's faces, which have been collected from several sources to give accurate results. This face recognition system uses features of a face including colors, features and distances. Using its two degrees of freedom, our system allows two modes of operation, one that results in very few false positives and another which results in few false negatives. While crime-solving can become easier with the invention of facial recognition technology, there are some aspects to consider into account. As the consequences of utilizing facial recognition technology can have few impacts on suspects, the model used needs to maintain accuracy and adequate transparency and security.

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| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 7.542 |

|| Volume 9, Issue 6, June 2021 ||

| DOI: 10.15680/IJIRCCE.2021.0906126 |

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INNO SPACE
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Impact Factor: 7.542

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ISSN INTERNATIONAL STANDARD SERIAL NUMBER INDIA

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