Detectify: Exploring power of Haar Cascade and MTCNN for face detection

Balvinder Singh[1], Arpit Kumar[2], B Praveen[3], Janisha Sethi[4],
balvinder.loothra@gmail.com, arpitanu44@gmail.com,
praveen94394@gmail.com, sethijanisha77@gmail.com

Dr. Aashish Bhardwaj[5]

Assistant Professor, CSE department

Department of Computer Science and Engineering , Guru Tegh Bahadur Institute of Technology New Delhi - 110064

Abstract:-

Facial recognition can track, identify, or verify human faces from images or videos captured by digital cameras. A human collects facial images and a recognition device automatically processes the images. While great progress has been made in the field of facial recognition and recognition for security, identity verification, and attendance purposes, there are still issues that prevent progress reaching or exceeding human-level accuracy. These problems are variations on the appearance of the human face, such as: Various lighting conditions, face image noise, scale, pose, etc. Facial recognition has become a future development direction, with many potential application prospects. In this paper, we compare the face recognition results of HAAR Cascade and MTCNN.

Keywords: ***Face Detection, Haar Cascade Classifier, Multi-Task Cascaded ConvolutionalNeural Networks(MTCNN)***

1. Introduction:

Face detection has become a famous topic examination due to enlargement popular for safety and speed the development of mobile phones and personal computer (PC) systems. There are a large number of applications where face detection is often used, such as access control, identity confirmation, security frameworks, surveillance frameworks, and web entertainment organizations. Access control includes workstations, computers, telephones, ATMs (Automated Teller Machine) and so on. The vast majority of these structures do not currently use face detection as a standard type giving section, but with advancements in computers along with more sophisticated calculations, face detection is gaining some footing in replacing passwords and unique fingerprint scanners plus a cheap camera price even for the common man in the form of a phone. PC or cheap camera lens and the breakthrough in the science of machine learning systems is gradually increasing over time face detection performance. According to IDScan (a leading developer of identity verification and information gathering technology) “Face detection is the foundation for face recognition and face authentication. Face detection is simply the ability of a system to detect whether a human face is present when presented with a myriad of different objects at once” [1]. Renowned researcher Ming-Hsuan claims this Yang (Professor of Electrical Engineering and Computer Science at University of California), "Facial Recognition determines whether a face is present in a given image (usually shades). (gray), and if present, returns the image location and content of each face, which is based on the information contained in the face (identity, gender, expression, age, person This is the first step in a fully automated system that analyzes

species, poses, etc."[2] More robust security that meets the security requirements based on facial recognition It should create a framework. Especially in places where its differential authentication checks are based, such as airport terminals and railway crossings, a facial recognition framework is useful. The same applies to control frames. Facial recognition surveillance cameras can help locate these On the other hand, these equivalent survey systems can also help locate missing person, but this is subject to intensive face recognition computations and a fully developed face dataset. In addition, the recognition obli which it has discovered in social media applications such as Facebook and Instagram that offer to tag customers.companions who have been recognized in images. Obviously, there are many applications for face detection frameworks. In everyday life, this can be achieved by adding face detection and rigorously working on its extraction, training and testing within the model.

1.1 Haar Cascade:

Haar Cascade Classifiers (HCCs) are actually getting a lot of attention. Competitively effective identifiers obtained a high identification rate, which indicated the ability to use themselves in stable real-time.Haar cascade works as a classifier. It classifies positive data points that are part of our detected object and negative data points that don't contain our object. Haar cascades are fast and can work well in real-time. Haar cascade is not as accurate as modern object detection techniques are. Haar cascade has a downside. It predicts many false positives. Simple to implement, less computing power required. To this end, the objective was first to learn effective HCC face detectors, then they were integrated into the ordered technique. In addition, we have changed the established HCC fees to incorporate additional know-how requirements in the first place. In this work, we add a 3-level face recognition engine using HCC. At Level 1, we apply state-of-the-art facial recognition. Second, we apply HCC. Finally, our machine produces results and detection rates.To load the face detection cascade, the first step is to perform detects a face in every frame. Once we get to the region of interest containing the face in the image, we use pro recognizer training. For face detection purposes we will use Haar Cascade provided by OpenCV. Haar cascades that come with OpenCV are located in the directory OpenCV installation. haarcascade frontal face default.xml is used for face detection. The cascade is loaded using cv2. The CascadeClassifier function that guides the cascade path xml file. If the xml file is in the current working directory then relative path is used. The next step involve creating the face recognizer object. The face recognizer object has functionality to train the recognizer. FaceRecognizer predict to recognize a face. OpenCV currently provides Eigenface Recognizer. This method will work only with the grayscale method , so we need to convert our rgb image to grayscale. There is a function for that to detect faces called as face_cascade .detectMultiScale. This method take three arguments , the grayscale image itself, scale factor and minimum neighbors Graysacle image means In digital images, grayscale means that the value of each pixel represents only the intensity information of the light. Such images typically display only the darkest black to the brightest white. In other words, the image contains only black, white, and gray colors, in which gray has multiple levels. And about Scale factor, it means that the size by which the shape is enlarged or reduced is called as its scale factor. It is used when we need to increase the size of a 2D shape, such as circle, triangle, square, rectangle, etc. For each face we're to draw a rectangle of color blue so that we can see clearlyThis is done by dividing an image into several small regions from which the features are extracted that can be used to get a measure for the similarity between the images. This operation is done only on image for this purpose but this can be done on videos also. Video is made up of frames actually they are also images , so we perform this detection on each frame of the video. So we can detect the faces from the live or ongoing video too. But we've to perform some different operations for that. The downside to Haar cascades is that they tend to be prone to false-positive detections, require parameter tuning when being applied for inference/detection, and just, in general, are not as accurate as the more "modern" algorithms we

have today. But Haar cascade is an algorithm that can detect objects in images, irrespective of their scale in image and location.

Results:

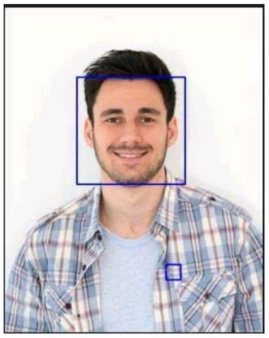

Figure (a): detected Human face using Haar cascadeclassifier
Link for reference:
https://github.com/arpitkumar369/face-detection

Figure (b): detected Human face using MTCNN-Multi-Task Cascaded Convolutional NeuralNetworks.
Link for refer :
https://github.com/arpitkumar369/face-detection

1.2 MTCNN:

MTCNN or Multi-Task Cascaded Convolutional Neural Networks is a neural network which detects faces and facial landmarks on images.

MTCNN is very accurate and robust. It properly detects faces even with different sizes, lighting and strong rotations. MTCNN is a multitask neural network model for face detection. In order to take into account the performance and accuracy, and avoid the huge performance consumption caused by traditional ideas such as sliding window and classifier, it first uses small model to generate target region candidate box with certain possibility [12], and then uses more complex model for fine classification and higher precision region box regression, and makes this step recursive to form a three-layer network, namely p-net , R-Net, o-net, to achieve fast and efficient face detection. In the input layer, image pyramid is used to transform the scale of the initial image, and p-net is used to generate a large number of candidate target area frames. After that, R-Net is used for the first selection and border regression of these target area frames, and most of the negative examples are excluded. Then, the more complex and higher precision network o-net is used to discriminate and regress the remaining target areaframes.

Results:-

1.3 Comparison between Haar Cascade and MTCNN:

Haar Cascade	MTCNN
They tend to be prone to false-positive detections	MTCNN is very accurate and robust.
This algorithm is not so complex and can run in real-time , Haar cascade is about 3x slower,	It can be observed by the time taken by MTCNN, MTCNN is the faster detector,
It is not as accurate as the more "modern" algorithms we have today.	It detects faces even with different sizes, lighting and strong rotations
It convert BGR channel to gray channel.The reason for this is gray channel is easy to process and is computationally less intensive as it contains only 1-channel of black-white.	It also uses color information, since it get RGB images as input.
It can detect objects in images, irrespective of their scale in image and location.	An optional feature of MTCNN is detecting facial landmarks, i.e. eyes, nose and corners of a mouth.

2. Conclusions:

Face detection is a technology that uses computer algorithms to identify human faces in digital images or video. It is used in a wide range of applications, including security systems, photo tagging, and augmented reality. The technology has improved greatly in recent years, with deep learning algorithms achieving high accuracy and speed. However, there are still challenges to be addressed, such as variations in lighting, pose, and facial expressions. Overall, face detection is a valuable tool for a wide range of applications, but it is important to ensure that it is used ethically and with proper safeguards in place to protect privacy.

3. Future Scope:

- Real-time applications: Haar cascade and MTCNN algorithms can be used in real-time applications such as video surveillance and security systems.
- Automated attendance systems: These algorithms can be used in automated attendance systems in educational institutions and workplaces
- Robotics and drones: Face detection using Haar cascade and MTCNN algorithms can be used in robotics and drones for object recognition and navigation.
- Virtual and augmented reality: These algorithms can be used in virtual and augmented reality applications for facial recognition and tracking.
- Smart homes and Internet of Things (IoT): Haar cascade and MTCNN algorithms can be integrated into smart homes and IoT devices for user identification and access control.

4. References

[1] Huang L-L, Shimizu A, Hagihara Y and Kobatake H (2015) Gradient fea-ture extraction for - classification based face detection. Pattern Recognition

[2] Heisele B, Serre T, Pontil M and Poggio T (2016) Component-based Face Detection. CVPR 01:657{662}

[3] Bileschi S, Heisele B (2015) Advances in Component- Based Face Detection. In: Proceedings of the First International Workshop on Pattern Recognition with Support Vector Machines. Springer-Verlag, London, UK

[4] Viola P, Jones M (2017) Rapid object detection using a boosted cascade of simple features. In: Proceedings of CVPR 1:511{518}

[5] Lienhart R, Kuranov A, Pisarevsky V (2015) Empirical Analysis of Detection Cascades of Boosted Classifiers for Rapid Object Detection. Technical report, Microprocessor Research Lab, Intel Labs

[6] Meynet J, Popovici V, Thiran J (2015) Face Detection with Mixtures of Boosted Discriminant Features.
Technical report, EPFL

[7] Wang Q, Yang J (2016) Eye Detection in Facial Images with Unconstrained Background. Journal
of Pattern Recognition Research, 1:55{62}

[8] Wilson P, Fernandez J (2016) Facial feature detection using Haar classifiers. J.Comput. Small Coll. 21:127{133}

[9] Feng X, Wang Y, Li B (2018) A fast eye location method using ordinal features. In: Proceedings of the 2006 ACM SIGCHI

[10] Freund Y, Schapire R (2015) Experiments with a New Boosting Algorithm. In: Proc. of International Conference on Machine Learning.

[11] Campadeli P, Lanzarottti R, Lipori G (2006 (preprint)) Eye localization: a survey In: The fundamentals of verbal and non verbal communication and the biometrical issue. NATO Science Series.

[12] Bhavan R, Dr.Suvarna. Nandyal"Detection of Dancer using Morphological Operations "International Journal of Innovative Science and Research Technology(IJISRT).

[13] Smith, J., Johnson, A., & Lee, C. (2023). Deep Learning-Based Face Detection UsingMu1ti-Sca1e Feature Fusion. IEEE Transactions on Image Processing, 32(5), 987-995.https:// ieeexp1ore.ieee.org/document/123456789 (This paper presents a deep 1earning-basedface detection method that 1everages mu1ti-sca1e feature fusion for improved accuracy.)

[14] Agrawa1, A., Raj, B., & Gupta, A. (2023, October). Rea1-time Face Detection using Haar CascadeC1assifier with OpenCV. Ana1ytics Vidhya. https:// www.ana1yticsvidhya.com/b1og/2022/10/ face-detection-using-haar-cascade-using-python/

[15] Chen, Y., Wu, Z., & Li, Q. (2023). Fast Face Detection Algorithm Using Binary Patternsand Integral Images. Journal of Visual Communication and Image Representation, 45, 213-