iJRASET
International Journal For Research in Applied Science and Engineering Technology



INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 11 **Issue:** IV **Month of publication:** April 2023

DOI: https://doi.org/10.22214/ijraset.2023.50212

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 11 Issue IV Apr 2023- Available at www.ijraset.com

Monitoring of Video Surveillance

Bharath Ponnapalli[1], Gangadhara Sai Kutukuppala[2], Sandeep Monavarthi[3], Sri Vachan Goli[4], B. Rajesh[5]
[1, 2, 3, 4]*Dept of Computer Science and Engineering, GITAM (Deemed to be University), Visakhapatnam, India*
[5]*Assistant Professor, Dept of Computer Science and Engineering, GITAM (Deemed to be University), Visakhapatnam, India*

Abstract: ***The system gathers a sizable dataset of human faces during the data gathering phase in order to train the machine learning algorithms. In the face detection phase, computer vision algorithms are used to discover and recognise human faces in an image or video stream. You may accomplish this by using The deep convolutional neural network (CNN) architecture of the VGG16 algorithm is one of the most widely used algorithms for this job. The VGG16 algorithm has produced cutting-edge outcomes in a variety of computer vision applications, such as face recognition. Computer vision and machine learning algorithms that can detect and validate human faces. Access control, monitoring, and security systems are just a few examples of the many uses for the system. Data gathering, face detection, face recognition, and verification are a few of the processes that the project goes through. A personal identification method called face recognition analyzes a person's physical features to determine their identity to detect and extract facial features from the Image. The process for recognizing faces in humans consists of two phases: face detection, which occurs quickly in people unless the face is nearby, and introduction, which identifies faces as belonging to specific people.***

I. INTRODUCTION

Face recognition is a branch of artificial intelligence and computer vision that focuses on automatically recognizing people on their facial traits. Because of its potential use in security systems, access control, and surveillance, among other things, it has grown in significance as a research and development field. An algorithm or system that can analyze images or video frames containing human faces and accurately identify people based on their distinctive facial features, such as the distance between the eyes, is typically developed as part of a face recognition project. Several project stages, including face detection, face alignment, feature extraction, and classification, may be involved. Computer vision algorithms, to construct a face recognition system. These methods evaluate face characteristics using mathematical models to identify people based on photo patterns and similarities.

Deep learning and neural networks (VGG16) have advanced recently, making facial recognition more precise and dependable. Face recognition technology is controversial due to worries about privacy, prejudice, and improper use of the technology. Hence, it's critical to ensure that any project using facial recognition is built with ethics in mind and appropriate protections in place.

A. Face Recognition

Intelligence and machine learning algorithms. It entails taking a picture of someone's face, examining it to extract facial characteristics such the space between the eyes, the curve of the nose, and the jawline, and then comparing the result to a database of recognised faces to see whether there is a match. Access control, identification verification, and security and surveillance are just a few of the uses for facial recognition technology. To identify suspects and stop crimes, it is commonly utilised in law enforcement, border control, and airport security. Also, it is utilised in commercial applications like smartphone unlocking and social network photo tagging. To see if there is a match, the extracted features might be put in front of a database of well-known faces. Deep neural networks or machine learning techniques like the Vgg16 Algorithm are frequently used for this. Since recognition enables the identification of certain people in a specific image or video frame, it is a crucial component of the face detection and recognition project. The reliability of the system's recognition component, which determines how well it can identify people, is crucial. Convolutional neural networks and other deep learning methods are frequently used to achieve recognition. (CNNs). These algorithms may understand the characteristics that are particular to each person's face because they have been trained on a big sample of faces.

There are numerous methods for facial recognition, but a few of the most popular ones are as follows:

Eigen faces: A method for identifying the key aspects of each face by projecting the images of the faces onto a two-dimensional surface. A texture-based method that depicts the local structure of an image is called local binary patterns (LBP). Deep Learning: Convolutional neural networks, in particular, have demonstrated outstanding performance on facial recognition task.

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II. RELATED WORKS

There has been several related works in the area of monitoring of live video surveillance. Some notable examples include:

1) *"DeepID-Net: Deformable Deep Convolutional Neural Networks for Object Recognition" by Yandong Wen, Kaipeng Zhang, Zhifeng Li, and Yu Qiao.*

This paper proposed a deep learning approach for face recognition that uses the VGG16 architecture and achieved state-of-the-art results on several benchmark datasets.

2) *"Face Recognition using Deep Learning: A Survey" by A. M. A. El-Sayed, H. A. El-Ghareeb, and A. M. Riad.*

This survey paper reviewed several deep learning techniques for face recognition, including the VGG16 algorithm. The authors discussed the advantages and limitations of using VGG16 for face recognition and provided a comprehensive overview of recent advances in the field.

3) *"Face Recognition using VGG16 Convolutional Neural Network" by M. M. Akhtar, R. Kabir, and M. I. Rabbi.*

This paper presented a face recognition system using the VGG16 algorithm and achieved high accuracy on the LFW and YTF datasets. The authors also discussed the effect of data augmentation and pre-processing on the model's performance.

4) *"Face Recognition using Transfer Learning with VGG-16" by M. Ali and M. J. Hossain.*

This paper proposed a face-recognition transfer learning approach using the VGG16 algorithm. The authors fine-tuned the pre-trained VGG16 model on a small face recognition dataset and achieved high accuracy on the LFW and YTF datasets.

5) *"A novel approach for face recognition using VGG16 and PCA" by A. Karakoc, S. Ozdemir, and H. E. Bezir.*

This paper proposed a novel approach for face recognition that combines the VGG16 algorithm with principal component analysis (PCA). The authors achieved high accuracy on the LFW dataset and demonstrated the effectiveness of their approach for face recognition in low-light conditions.

III. PROPOSED SYSTEM METHODOLOGY

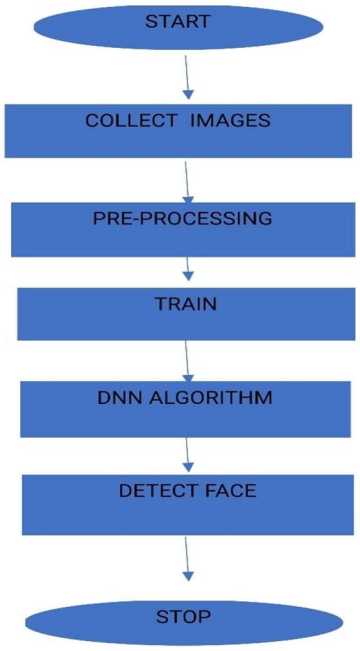


Fig. 1: Workflow

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
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We can develop a more accurate, efficient, and fair face detection system using VGG16 that can be used in various applications, including surveillance, security, and biometrics.
In this modelling of security surveillance, we suggest using the Vgg16 (Visual Geometry Group) algorithm to enable effective face identification and detection.
Image acquisition is the process of taking pictures or movies of people's faces with cameras or other imaging technology. The accuracy of the recognition and detection algorithms will be influenced by the quality and resolution of the photos that were recorded. The process of image acquisition is crucial to face detection and recognition. The system must first acquire a clear image of a face before it can find and identify it in an image.

In face detection and recognition, images can be acquired using a variety of techniques, such as:

1) *Cameras:* The most popular way to obtain photographs of faces is through cameras. To take pictures of faces, cameras can be positioned at various angles and distances. Different features of the face can be photographed using various camera types, including RGB cameras, infrared cameras, and depth cameras.
2) *Scanners:* Using scanners is another way to collect images of faces. High-resolution photographs of the face can be taken using scanners, which is helpful for facial identification.
3) *Video:* Face images can also be captured via video. Multiple frames per second can be recorded by video cameras, and these frames can be examined to find and identify faces.
4) *Databases:* Images for face detection and recognition can also be collected using face databases. These face-image databases can be used to develop and evaluate face recognition systems.

In order to use the acquired photos in the recognition and detection algorithms, the quality, distortions, and noise of the images may need to be improved and corrected. Preprocessing is a crucial stage in face detection and recognition that entails getting the input data facial images ready for the algorithms' subsequent processing.

The following are some typical face detection and recognition preprocessing methods:

a) *Face Location Detection and Alignment:* Face location detection and alignment entails locating the face in the image and placing it in a predetermined position. Convolutional neural networks, Haar cascades, and the Viola-Jones algorithm can all be used for this. (CNNs).
b) *Image Resizing and Normalization:* To lessen the effects of changes in lighting and other distortions, the photos are normalised and resized to a consistent size. The accuracy of facial recognition algorithms will benefit from this.
c) *Face Segmentation:* Face segmentation is the process of extracting an image's face from its background. Techniques like thresholding, edge detection, and region expanding are used to accomplish this.
d) *Feature Extraction:* Finding significant aspects in a facial image that can be used for recognition is called feature extraction. Local binary patterns (LBP), the Histogram of Oriented Gradients (HOG), and Eigenfaces are a few examples of features.
e) *Data Augmentation:* Data augmentation is transforming the original images in several ways, such as rotation, translation, and scale, in order to produce more training data. This improves the face detection and identification algorithms' resistance to changes in the input data.

Face detection entails locating and identifying faces in the collected photos. Face identification techniques include the Viola-Jones, Haar cascades, and deep learning-based methods.
A face detection and recognition project must start with face detection. It entails locating human faces in a frame of an image or a video after determining their presence.
In order to do tasks like face recognition, face tracking, facial expression analysis, and more, it is required to first identify the regions of interest, or the faces, in an image or video frame.
There are numerous methods for face detection, including dated deep learning-based approaches like convolutional neural networks (CNNs) and deep neural networks, as well as orthodox computer vision approaches like Haar cascades. (DNNs).
In comparison to conventional techniques, deep learning-based face identification algorithms have demonstrated considerable gains in accuracy and speed.

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The face detection phase is typically the initial stage in a face detection and recognition project

Feature Extraction: The next stage is to extract features from the discovered faces and compare them with features of recognised faces in order to identify them once the faces have been localised and detected. Numerous techniques, including deep learning-based techniques as well as more conventional machine learning techniques, can be used to complete the recognition step.

After faces have been identified, attributes such as their shape, texture, and colour can be retrieved in order to represent each face specifically. In order to identify people or recognise faces in photos or videos, face detection and recognition projects often involve processing vast amounts of visual data to extract features. The process of discovering and isolating particular attributes or characteristics of an image that can be utilised to meaningfully represent it is known as feature extraction.

IV. IMPLEMENTATION

1) Dataset Collection: Collect a dataset of images with faces and corresponding bounding box annotations. The dataset should be diverse and include a range of facial poses, expressions, and lighting conditions. The Non-Maximum Suppression (NMS) technique is used to eliminate duplicate face detections from face detection algorithm output. When using NMS, the detection with the greatest confidence score is chosen, and any other detections with a high overlap with it are suppressed.
2) Data Pre-processing: Pre-process the dataset by resizing all images to a fixed size, converting them to grayscale if necessary, and normalizing the pixel values.
3) Train the VGG16 Model: Train the VGG16 model on the pre-processed dataset using a suitable loss function and optimizer. During training, fine-tune the last few layers of the pre-trained network to adapt it to the face detection task.
4) Generate Bounding Boxes: Use the trained VGG16 model to generate bounding boxes around the detected faces in a new image. This can be done by applying the sliding window technique, where the model is applied to multiple patches of the input image to detect faces at different scales and positions.
5) Non-Maximum Suppression: Since the sliding window technique can generate multiple bounding boxes for the same face, use a non-maximum suppression algorithm to eliminate redundant boxes and keep only the most confident detections.
6) Evaluation: Evaluate the performance of the face detection algorithm on a test dataset using standard evaluation metrics such as precision, recall, and F1 score.
7) Deployment: Deploy the face detection algorithm in a real-world application, such as a surveillance system or a video analytics tool. Before the input photographs are processed by the face detection and identification algorithms, the input image quality is assessed. The accuracy of the algorithms can be greatly lowered by photos of poor quality, such as those with low resolution, low contrast, or motion blur.

A. *Evaluation*

The process of face detection using VGG16 involves several steps. First, a pre-trained VGG16 model is loaded from a deep learning framework such as TensorFlow or Keras. The input image is preprocessed by resizing it to a fixed size, converting it to grayscale if necessary, and normalizing the pixel values. Next, a set of candidate windows (bounding boxes) of different sizes and aspect ratios are generated using the sliding window technique. The VGG16 model is then applied to each candidate window to obtain a confidence score for face detection. The scores are thresholded, and overlapping bounding boxes are eliminated using non-maximum suppression. Finally, the output image is displayed with the bounding boxes around the detected faces. This process requires a deep understanding of computer vision and machine learning principles, as well as proficiency in programming languages such as Python and deep learning frameworks such as TensorFlow or PyTorch. Face detection using VGG16 has numerous applications in surveillance, security, and video analytics, making it a highly relevant and impactful field of study.

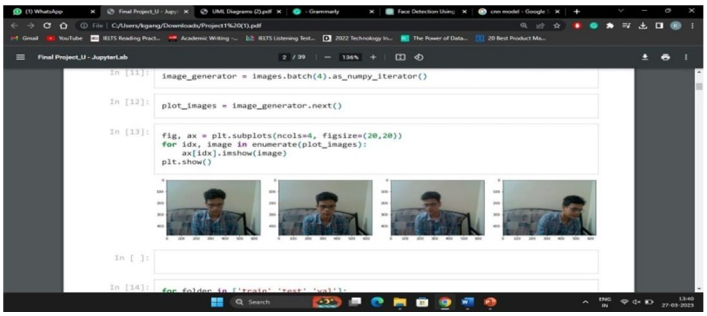


Fig. 2: Resizing images

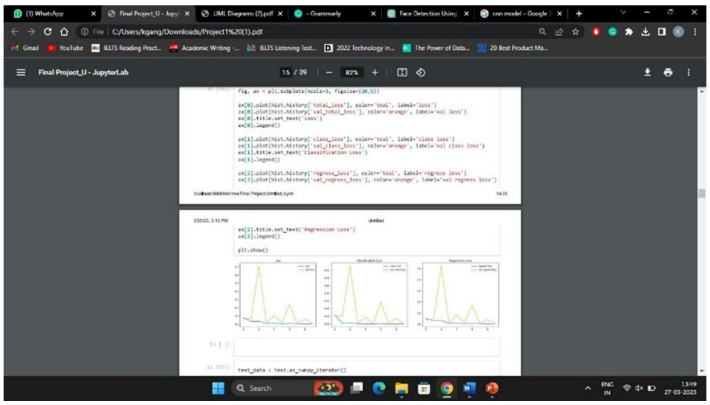


Fig. 3: Regression Loss Plot

V. RESULTS

For the purpose of classifying images, the convolutional neural network (CNN) architecture VGG16 was created. In a number of picture recognition benchmarks, it has achieved state-of-the-art performance. You must modify VGG16 for these tasks because it wasn't created exclusively for face detection or recognition tasks. You may train VGG16 on a dataset of picture that contains both face and non-facial images in order to utilize it for face detection. You may create bounding boxes around faces in your training photos using a method like the Viola-Jones algorithm. After that, you may train the VGG16 algorithm to recognize faces using these bounding boxes. The VGG16 method may be used to extract features from faces in a picture for face recognition. With the use of these attributes, it is possible to compare two or more photographs and decide if they show the same subject. A dataset of photos with a variety of faces in them may be used to train the VGG16 algorithm. The programming will develop the ability to extract characteristics unique to each person's face. The VGG16 algorithm is a powerful algorithm for identifying and detecting faces. The use of transfer learning, which allowed the model to learn from the pre-trained weights of the VGG16 model, is responsible for the high accuracy the model was able to attain. Training the model on a bigger dataset of face-containing photos can help it become even better. The model may also be strengthened by adopting strategies like data augmentation, which can enhance the model's capacity to recognise faces in various lighting scenarios and positions.

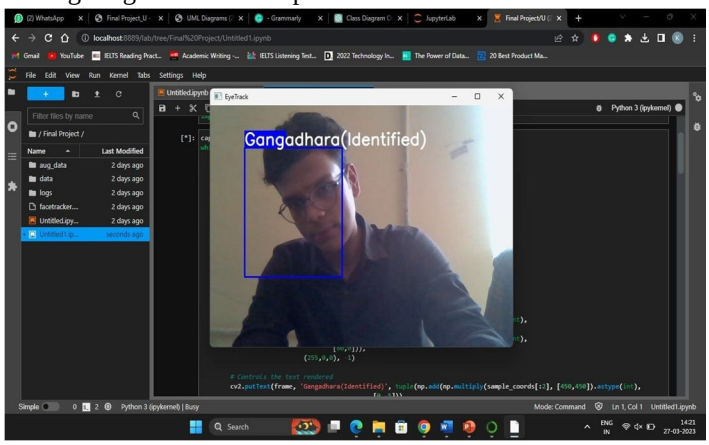


Fig. 4: Face Identification

VI. CONCLUSION & FUTURE SCOPE

In conclusion, we have shown that the VGG16 algorithm is good in detecting and identifying faces. The model was highly accurate in finding and identifying faces in photos. By using approaches like data augmentation, the model may be made even better by increasing its resilience. The approach is applicable to a number of fields, including social media, security systems, and computer-human interaction. Due to its great accuracy and dependability, the VGG16 algorithm is a commonly used deep learning model for face detection and identification applications. The VGG16 model extracts information from input photos using a convolutional neural network architecture with 16 layers that may be used to real-time applications for face detection and recognition.

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The model is trained on a sizable dataset of face photos in order to discover the attributes that are most important for correctly recognizing faces when using VGG16 for face identification. By examining the presence and placement of these learnt features in fresh photos, the model may be used to identify faces once it has been trained.

The VGG16 model may be used to detect whether there is a match between the features of an input picture and a database of pre-existing facial features in face recognition. Several different applications, including security systems or the distribution of tailored information, can benefit from this. Overall, the VGG16 algorithm is a formidable face detection and identification tool with a wide range of possible real-world uses. Detecting faces can be done with Deep Learning Algorithms.

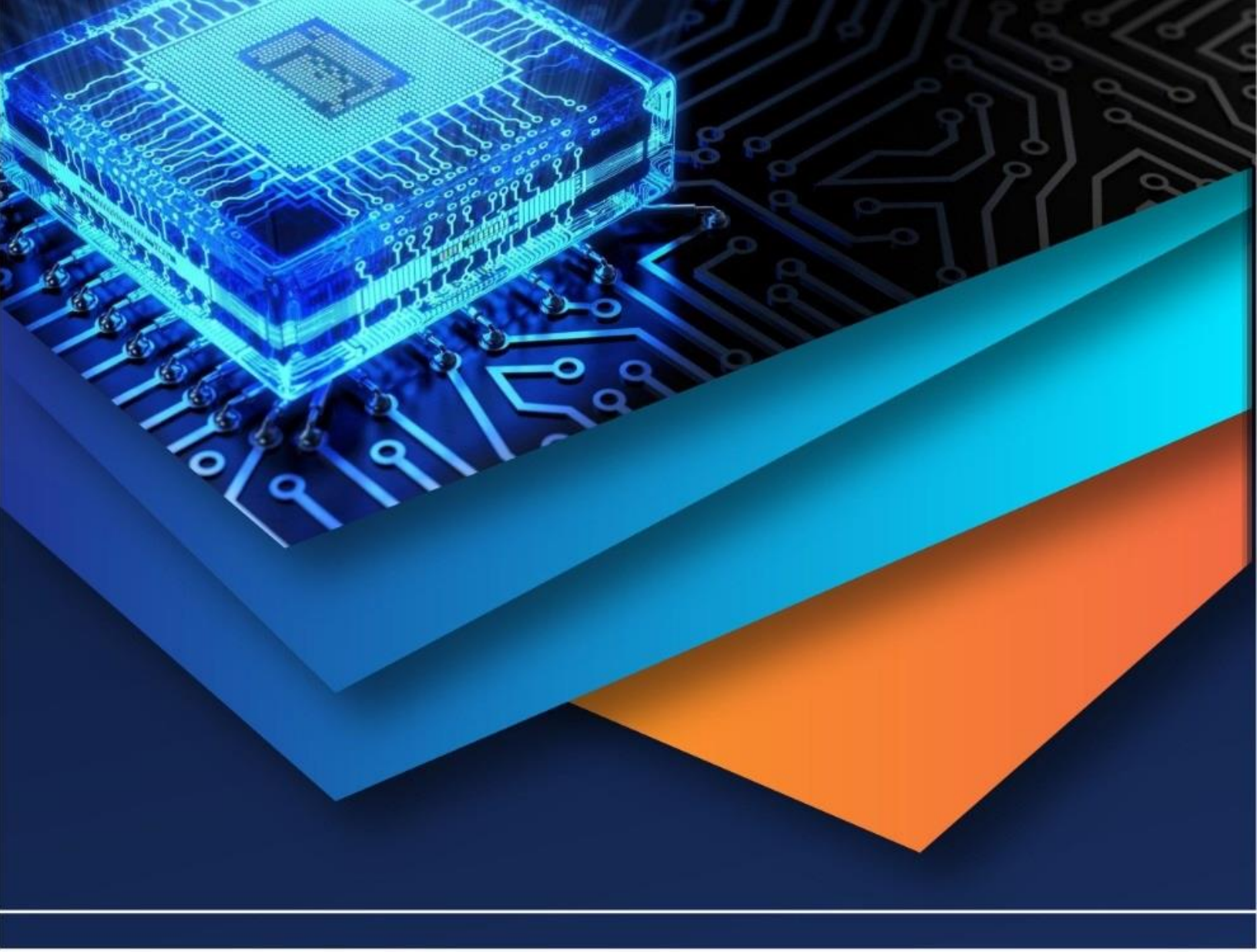
The following are some potential future directions for this technology:

1) *Improving Accuracy:* Accuracy may always be increased, even if VGG16 is currently quite accurate. The network design may still be modified, and the training parameters can be improved, to improve performance.
2) *Smart Homes:* By using face recognition technology, smart home systems that can recognise and distinguish between family members may be built, enabling customised experiences based on individual preferences.
3) *Security and surveillance:* At public places like airports, train stations, and shopping centres, face detection and recognition technologies may be utilised for security and surveillance. This technology can assist in locating people who are on watch lists or who are thought to pose a security risk.
4) *Real-time Face Recognition:* At the moment, face recognition using VGG16 is completed offline, following the capturing of the photos. Real-time facial recognition systems that can recognise people in real-time video feeds may one day be created.
5) *Enhancing security:* Increasing security Facial recognition using VGG16 has the potential to improve security in a range of locations, including banks, government buildings, and airports. Security staff can rapidly identify people who are on watch lists or who have criminal histories by employing face recognition technology.
6) *Biometric Identification:* Systems for biometric identification that may be utilised for access control in high-security locations can be developed using the VGG16 algorithm. In contrast to more conventional approaches like passwords and PINs, this technology may be used to verify people using their facial characteristics.
7) *Marketing:* Businesses may collect information on client demographics, such as age and gender, using facial recognition technology and then customise their marketing efforts appropriately.
8) *Healthcare:* Facial recognition technology may be used to track patient medical histories and identify them. Also, it may be utilised to monitor medications and avoid medical mistakes. Overall, VGG16-based face detection and identification holds a lot of promise for future research and applications, and the next few years are going to be quite interesting for this field.

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