



Solve the Mystery: DCGAN-Based Sketch to Real Face Conversion

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Abstract

This paper explores the advanced application of Artificial Intelligence (AI) in criminal identification through facial recognition, specifically by transforming forensic sketches into realistic photos using Deep Convolutional Generative Adversarial Networks (DCGAN). When a witness provides a description of a criminal, an expert creates a forensic sketch based on this description. By using DCGAN, this sketch is fed into a neural network, which, after training, generates accurate, realistic facial images of the suspect. This technique significantly aids crime investigations by quickly producing detailed, high-resolution images from basic sketches, even those that are incomplete or depict various poses. The method is valuable in forensics, law enforcement, facial recognition, and security systems, enhancing the efficiency and accuracy of criminal identification

Keywords: Deep Convolutional Generative Adversarial Network (DCGAN), Sketch-to-image, Crime Investigation, Facial Recognition.

1. Introduction

Traditional image processing [1] method called computer vision (CV) which cannot process digital images efficiently due to complexity of visual perception in vibrant and extremely varying physical world. But with the advent of machine learning concept the task of traditional image processing practises are further upgraded by coalescing machine learning algorithms [2] with traditional image processing algorithms to make the job of image processing easy and automated by eliminating the efforts of human intervention and also time required to enhance the resolution of an image. It uses one of the advanced concept of AI called Deep learning, which is used especially for image processing proficiently using convolutional neural network (CNN) to process N dimensional images without any difficulties with N number of neural network layers which our traditional computer vision cannot tackle to solve it. To enhance image processing further with the aid of certain efficient and advanced image

processing algorithms which are capable of making complex task in to a simple one. Hence it is time consuming for processing vast amount of images and yielding noble results with less effort. AI based Facial recognition [3]. It is a cutting-edge technology to coup up with technically growing digital world and also a fastest means of identifying a face. It plays a vital role in crime investigation to assist in finding out a criminal by making the neural network to recognize the face of a person by giving its corresponding hand drawn pictures. Based on this, a real photo is generated from the sketch by remembering the face and matching the generated real photo image with the existing database having details like aadhar, PAN or passport to pin point wrong doers. Deep learning based Facial Recognition [4] particularly in this pandemic time has become a part of our life to monitor the usage of face mask by everyone to protect our environment from corona virus by using the concept of Deep Learning [5] which adopts a

technique called Generative Adversarial Network (GAN) [6] for generating synthetic images. Another advanced GAN which deals purely with image processing using Convolutional Neural Network (CNN) called Deep Convolutional Generative Adversarial Neural Network (DCGAN) [7] which generates high resolution photorealistic images from human sketches is one of the most progressive and fast rising digital identification method adopted in all crime sectors. DCGAN can generate realistic images

even if the input sketch is not clear, quality of sketch is very poor and the image is partial or incomplete. It improves the overall performance of a network by training the network with sufficient amount of balanced input images and makes the network to perform better when compared with other existing methods. It is also used in image generation [8], image translation, shown in Figure 1.

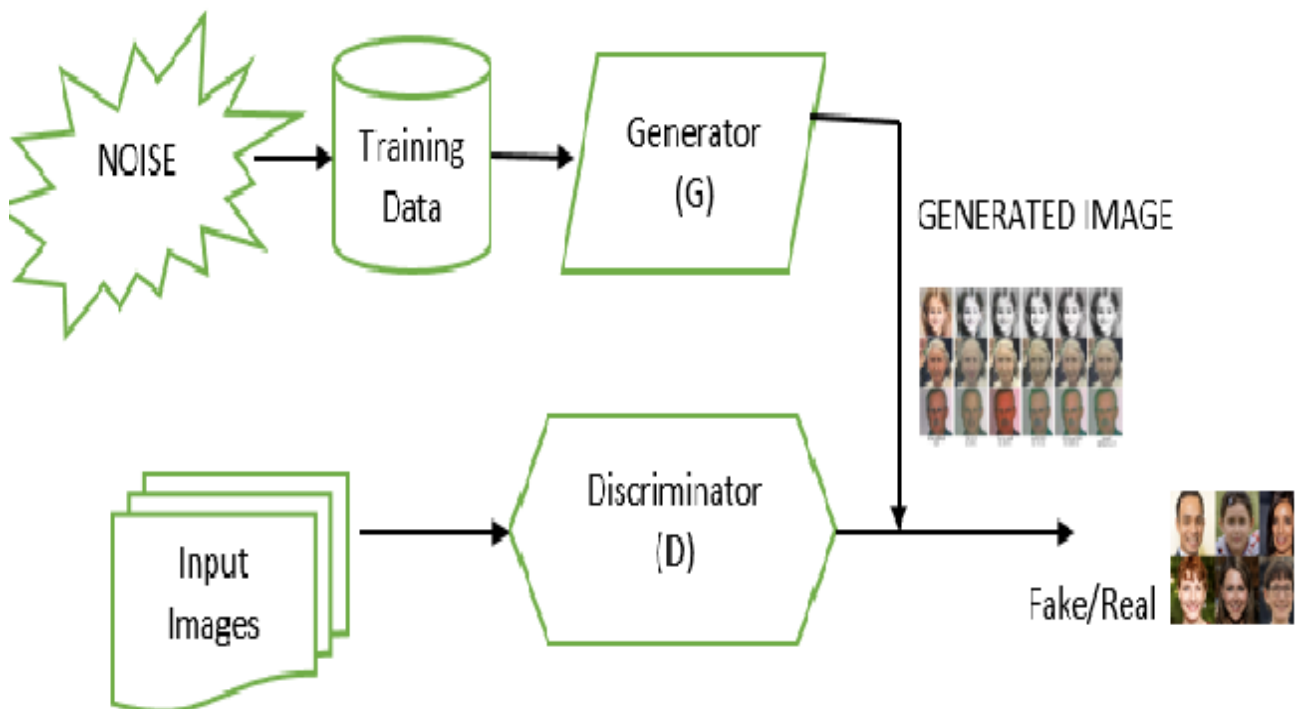


Figure 1 Generating Photo Realistic Facial Image from Sketch Using GAN

1.1. Generative Adversarial Networks (GANs) in solve the mystery

The advent of GANs revolutionized image generation, and their application to solve the mystery scenarios has yielded compelling results. Studies such as "Image-to- Image Translation with Conditional Adversarial Networks" (Isola et al., 2017) showcase the efficacy of GANs in transforming images across domains, enabling the mixing of styles, textures, and content [9-13].

1.2. Objectives

Enhance Fidelity in Facial Feature Reproduction: Develop a DCGAN model optimized for accurately

reproducing intricate facial features from forensic sketches to real face images, prioritizing high fidelity in both appearance and structure.

Ensure Adaptability to Diverse Sketching Styles: Implement techniques and mechanisms within the DCGAN architecture to ensure robustness and adaptability to various forensic sketching styles, fostering a model capable of generalizing across a wide spectrum of artistic representations.

2. Method

The forensic sketch-to-real-image converter uses a methodical approach to transform hand-drawn sketches into lifelike faces, aiding detectives in

solving crimes. It begins by analyzing the sketch and then applies advanced computer techniques to fill in details, creating clearer suspect images. The process involves understanding law enforcement needs and gathering a comprehensive dataset of real human images paired with sketches for model training. Images are standardized, normalized, and augmented to enhance model compatibility and robustness. A Generative Adversarial Network (GAN) is typically chosen for its image generation capabilities, with possible integration of Variational Autoencoders (VAEs) for varied outputs. The model is trained and validated on the dataset to ensure realism and accuracy. An intuitive user interface is developed for uploading sketches, viewing converted images, and providing feedback. Continuous user feedback is used to refine the model, improving accuracy and overall user experience. The platform is then deployed as a web application for global accessibility. DCGANs (Deep Convolutional GANs) are particularly effective in this transformation, learning from numerous examples to generate realistic images, with applications extending to medical imaging predictions and sensor node duplication in wireless networks, shown in Figure 2.

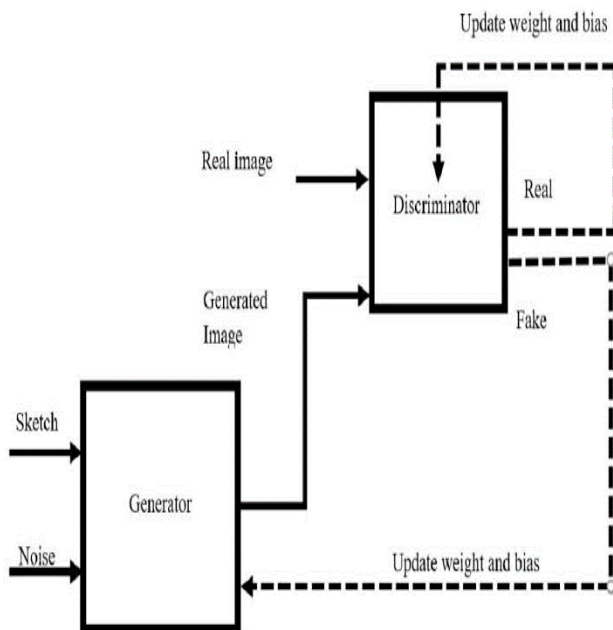


Figure 2 Generative Adversarial Networks Architecture

3. Results and Discussion

3.1. Results

3.1.1. Sketch to Face Transformation

DCGANs (Deep Convolutional Generative Adversarial Networks) transform sketches into realistic faces by training on large datasets of images. They learn to generate lifelike details and textures, making the sketches appear as real, photographic faces shown in Figure 3. [14-16]

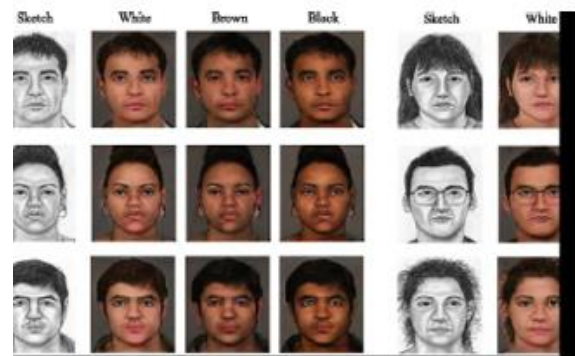


Figure 3 Snapshot of Sketch to Face Transformation

3.1.2. Output Image

The project output for "Solve the Mystery: DCGAN-Based Sketch to Real Face Conversion" demonstrates the transformation of a hand-drawn or digital sketch into a photo-realistic facial image using Deep Convolutional Generative Adversarial Networks (DCGANs), shown in Figure 4.



Figure 4 Deep Convolutional Generative Adversarial Networks (DCGANs) Generated Output

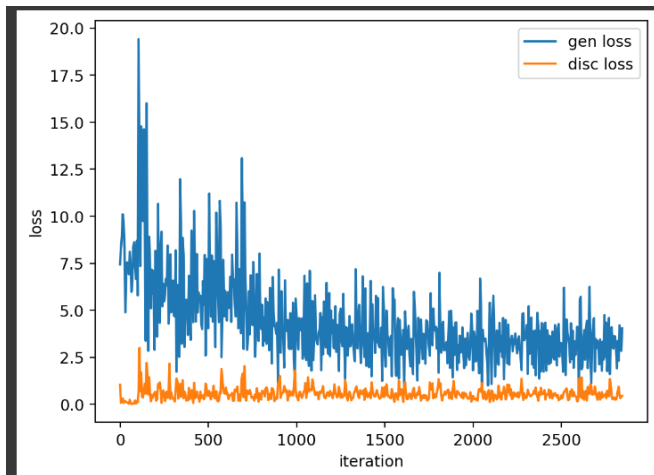


Figure 5 Matplotlib Image: Clipping Input Data to The Valid Range for Show with RGB Data

When you see the message "Clipping input data to the valid range for with RGB data" in Matplotlib, it means some pixel values in your image are outside the normal range of 0 to 255 for RGB colors. Matplotlib automatically adjusts these out-of-range values so they fit within the expected range: values below 0 are set to 0, and values above 255 are set to 255. This ensures the image can be displayed correctly, even if there are errors in the image data, shown in Figure 5.

3.2. Discussion

The application of DCGANs in sketch-to-real-face conversion has demonstrated significant advancements in forensic science and law enforcement. By transforming sketches into lifelike images, detectives and investigators can more effectively identify and apprehend suspects, ultimately enhancing public safety and reducing crime rates. Moreover, the technology has broader applications beyond law enforcement, including medical imaging, cybersecurity, and even creative arts.

Conclusion

The papers discussed various ways to improve how we find and identify people in criminal investigations using sketches and photos. They looked at using different techniques to make this process more accurate and efficient. Some explored using specific features in sketches for better search results, while

others focused on combining different facial features to identify suspects. Additionally, they examined using advanced technology, like computer-generated images, to transform sketches into realistic faces. Overall, these studies aim to help law enforcement agencies better identify suspects and solve crimes faster.

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