National Conference on Advanced Research in Science, Engineering, Management and Humanities
(NCARSEMH – 2025)
27th July, 2025, Jharkhand, India.

CERTIFICATE NO : NCARSEMH /2025/ C0725728

A Study of Generative Deep Learning Approach for Forensic Facial Reconstruction

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ABSTRACT

A generative deep learning approach for forensic facial reconstruction represents a significant advancement in the field of forensic science and human identification. Traditional facial reconstruction methods rely on manual sculpting techniques and anatomical guidelines, which are often time-consuming and dependent on expert interpretation. In contrast, generative deep learning models such as Generative Adversarial Networks (GANs) and Variational Autoencoders (VAEs) can automatically learn complex relationships between skull structure and corresponding facial features from large datasets. In this approach, 3D skull scans or cranial images are used as input, and the generative model predicts soft tissue thickness, facial landmarks, and surface textures to produce realistic facial approximations. The generator network creates facial images, while the discriminator network evaluates their authenticity, leading to improved reconstruction accuracy. Data augmentation and transfer learning techniques further enhance model performance, especially when limited forensic datasets are available. This AI-driven method reduces human bias, improves reconstruction consistency, and accelerates the identification process. Although challenges such as dataset diversity, ethical considerations, and model interpretability remain, generative deep learning provides a powerful, scalable, and efficient solution for forensic facial reconstruction in modern criminal investigations and disaster victim identification.