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Explainable AI (XAI) for Forensic Analysis: Image Forgery Detection and Deepfake Video Identification

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Abstract: *Their most recent development has made it possible to create high-quality forgeries and deepfakes videos: the swift advancement of generation models, including Generative Adversarial Networks (GANs) and diffusion models, has facilitated their production. The digital forensics, legal evidence validation and trust of the people is under serious challenge because they can not be easily detected by the customary forensic methods. Detecting such manipulations with deep learning methods has high accuracy due to convolutional and recurrent neural networks. Nevertheless, their opaque, black-box character makes them less applicable in forensic as well as judicial settings, where transparency, interpretability and traceable evidence are vital.*

The study presents an Explainable Artificial Intelligence (XAI)-driven system of forensic analysis, which is a combination of CNN-based image forgery detection and hybrid CNN-LSTM-based deepfake video detection. The framework uses the post-hoc and intrinsic XAI methods including Grad-CAM, LIME, and SHAP to produce human-readable explanations on both visual and feature scales. Through experimental assessment on benchmark datasets, it is shown that the proposed XAI-enhanced models not only attain competitive levels in detection but also present understandable evidence. Such perfect accuracy and transparency make the framework applicable to forensic inquiry and legal proceedings..

Keywords: Explainable AI, Digital Forensics, Image Forgery Detection, Deepfake Videos, CNN, XAI

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