

Forensic Image Analysis using Deep Learning and Quantum Computing

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Abstract

Forensic image analysis plays a crucial role in modern criminal investigations by assisting in the identification, authentication, enhancement, and interpretation of digital images obtained from crime scenes and surveillance systems. However, the increasing volume and complexity of digital evidence require advanced computational techniques capable of processing images accurately and efficiently. This study explores the application of deep learning and quantum computing for forensic image analysis. Deep learning techniques, particularly convolutional neural networks (CNNs), can automatically extract complex visual features and support tasks such as image classification, facial recognition, forgery detection, image enhancement, and identification of manipulated or synthetic content. Quantum computing offers an emerging computational paradigm that may enhance machine-learning processes through quantum algorithms and hybrid quantum-classical models. The integration of quantum computing with deep learning has the potential to improve feature processing, optimization, and computational efficiency for selected forensic applications. The proposed approach focuses on developing a hybrid framework in which deep learning models analyze forensic image characteristics while quantum-based techniques are explored for optimization and pattern recognition. Performance can be evaluated using parameters such as accuracy, precision, recall, F1-score, and processing time. Such a framework may contribute to more reliable and efficient digital forensic investigations. Nevertheless, challenges including limited quantum hardware, dataset quality, model interpretability, adversarial manipulation, and forensic evidence validation must be addressed before widespread practical adoption.

Keywords: Forensic image analysis, deep learning, quantum computing, convolutional neural networks, digital forensics, image authentication, image forgery detection, quantum machine learning.