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Machine Learning Based Scalable Hybrid Approach to Deepfake Image Detection with EfficientNetB0 and XGBoost

Abstract

Deepfake technology is powered by improvements in generative adversarial networks and synthetic media technologies. It has raised significant issues on the dependencies on digital content, fake information, identity theft, and social manipulation. Deepfakes, especially face manipulations in photos and videos have become harder to identify through human senses alone because they are realistic and evolve quickly. Current deepfake detection models tend to be computation-intensive, not well generalizable to diverse datasets, and not applicable in real-time, hence calling for fast and accurate yet light-weighted solutions.

This research work addresses the deepfake image detection issue by introducing an efficient and scalable hybrid model that incorporates deep learning and ensemble machine learning. The proposed method combines EfficientNetB0, a pre-trained convolutional neural network that enjoys the best performance-to-parameter ratio, to learn robust spatial features from face images. These are then classified with XGBoost and gradient-boosted decision tree algorithm, which is suitable for processing structured input and is robust against overfitting while still achieving high accuracy. This proposed experimental process training and testing, a balanced dataset of 10,000 real and 10,000 fake images are taken. Performance metrics, such as confusion matrix and Receiver Operating Characteristic (ROC) curve are showing that proposed XGBoost model has excellent classification performance with respect to precision, recall, and AUC. The existing DenseNet and Explainable AI methods, the accuracy is 95 to 96%, whereas proposed hybrid model has a slightly higher accuracy but with reduced computational complexity and faster inference. The proposed model is more suitable for real time application in digital forensics, authentication of media, and social media content moderation applications.