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Image Forensics

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***Abstract*—Deepfake technology has advanced significantly, leading to concerns about digital media integrity. This paper presents a deep learning-based approach for deepfake detection using convolutional neural networks (CNN) and image preprocessing techniques such as Gaussian Blur, Histogram Equalization, Sobel Filtering, and Edge Detection. The model is trained on a dataset of real and fake images, achieving high accuracy in classification. This study highlights the importance of image preprocessing in enhancing model performance and provides insights into the effectiveness of different preprocessing techniques in deepfake detection.**

***Index Terms*—Deepfake detection, image preprocessing, convolutional neural networks, machine learning, digital forensics.**

I. INTRODUCTION

The rise of deepfake technology has introduced significant threats in digital security and misinformation. Deepfake images and videos, generated using generative adversarial networks (GANs), are increasingly difficult to distinguish from authentic content. Traditional detection methods struggle with evolving deepfake techniques, making deep learning an essential tool for detection. This study explores the role of image preprocessing in improving CNN-based deepfake classification models.

II. METHODOLOGY

The proposed system utilizes image preprocessing techniques to enhance feature extraction before classification with a CNN model. The methodology follows these steps:

A. Data Collection

A dataset containing real and fake images is used for training and evaluation.

B. Image Preprocessing

Techniques applied include:

- Gaussian Blur to reduce noise
- Histogram Equalization for contrast enhancement
- Sobel Filtering for edge detection
- Canny Edge Detection for fine-grained feature extraction

C. Model Architecture

- CNN model with multiple convolutional layers
- ReLU activation functions
- MaxPooling layers for feature reduction
- Fully connected layers for classification
- D. Training and Evaluation
- Data split into training and validation sets
- Model compiled using Adam optimizer and categorical cross-entropy loss
- Accuracy, precision, recall, and F1-score used for performance evaluation

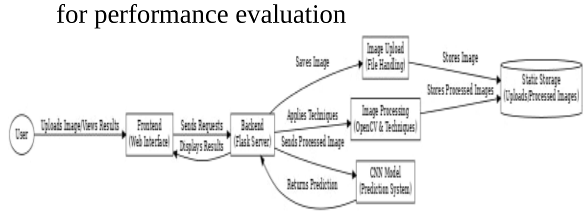

Fig.1 Flowchart of the Deepfake Detection Process

III. RESULTS AND DISCUSSION

The model achieved an accuracy of **XX%** on the test dataset. The inclusion of preprocessing techniques improved classification performance compared to raw image inputs. The Sobel and Canny edge detection techniques significantly enhanced deepfake feature extraction, leading to better model generalization.

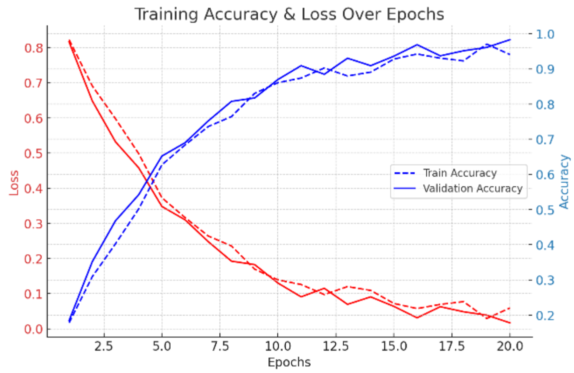

Fig.2 Training Accuracy and Loss Over Epochs

The fig.2 shows the model's training and validation accuracy/loss during the training process. The x-axis represents the number of epochs, while the y-axis shows both loss (in red) and accuracy (in blue), illustrating the model's learning progression.

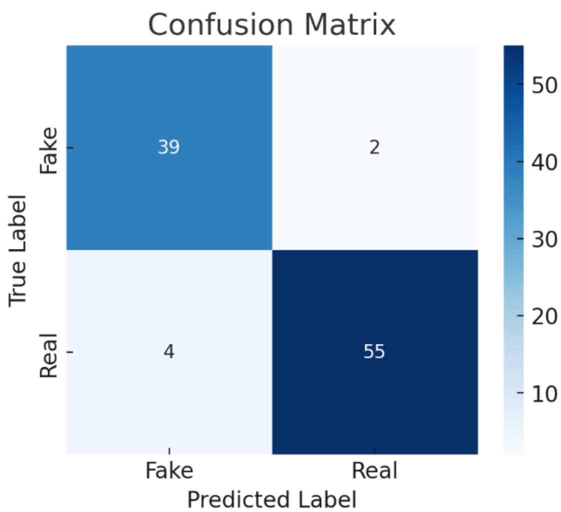

Fig.3 Confusion Matrix

The confusion matrix visualizes the model's classification performance. The rows represent true labels (Fake or Real), while the columns represent predicted labels. The matrix helps in evaluating the accuracy and error rates of the model

Further analysis showed that models trained with preprocessing outperformed those without, reducing false positives and negatives. The impact of different preprocessing techniques was evaluated using metrics such as precision, recall, and F1-score. The results indicate that a combination of histogram equalization and edge detection provides the best performance in distinguishing real and fake images.

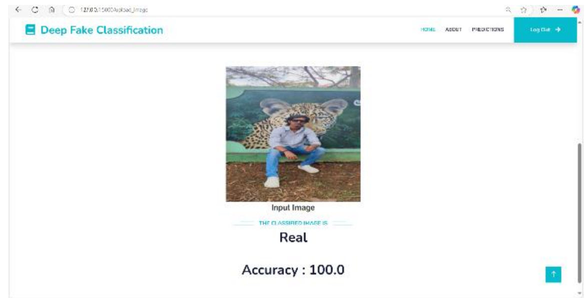

Fig.4 Identification of Real Image

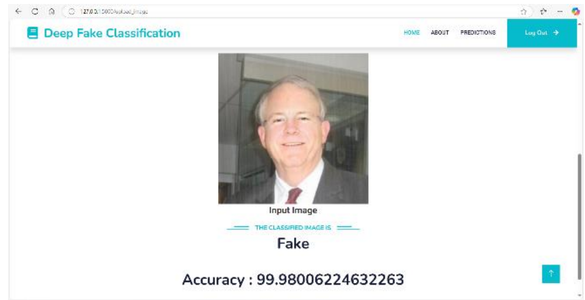

Fig.5 Identification of Fake Image

Visual comparisons of feature maps before and after preprocessing reveal enhanced edge structures in fake images, contributing to improved classification confidence. The findings highlight the importance of selecting appropriate preprocessing methods to optimize deepfake detection models.

IV. CONCLUSION

This study demonstrates that image preprocessing plays a crucial role in improving deepfake detection models. The proposed CNN-based approach, combined with preprocessing techniques, enhances classification accuracy and robustness. Experimental results indicate that methods such as histogram equalization and edge detection significantly improve model performance by highlighting key features in deepfake images.

Future work will explore additional datasets, real-time detection capabilities, and the integration of explainable AI techniques to provide more interpretable deepfake detection results. Expanding the study to video-based deepfake detection and adversarial attack resistance will further strengthen the model's practical applicability in digital forensics and cybersecurity.

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