Advanced Deep Learning Framework for Secure Transmission of Sensitive Images in National Security Scenarios

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Introduction

- Proposal of a deep learning-based framework for secure image transmission in national security contexts
- Emphasis on data integrity and confidentiality, particularly concerning warfare and border security.
- Advanced encoding and decoding techniques employed to protect sensitive image data during transmission.

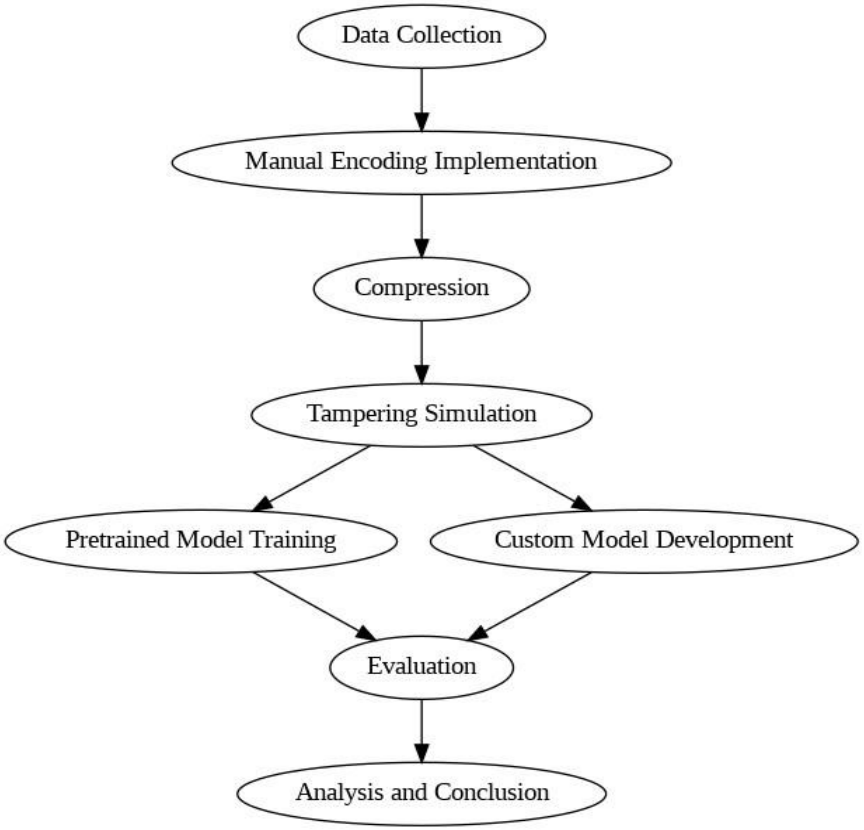
Motivation

- Secure transmission of sensitive data, especially images related to national security like war and border security.
- Traditional encryption methods fall short in addressing modern security threats, requiring more advanced solutions.

Literature Review

- Deep learning-based approaches in diverse fields, like medical imaging and satellite imagery, underscore the importance of securing sensitive data.
- Various encryption schemes utilizing deep learning techniques offer promising avenues for safeguarding image data during transmission and storage.
- Integration of deep learning with traditional cryptographic methods enhances security in image transmission protocols.
- Advancements in deep learning not only improve image classification accuracy but also offer innovative solutions for agricultural and environmental monitoring tasks.

Methodology



Methodology

- **Manual Encoding Implementation**: Utilization of deep learning, specifically the ResNet50 model, for encoding original images with secret codes or messages using LSB modification, ensuring imperceptibility while maintaining integrity.

- **Compression:** Application of compression techniques, including lossy and lossless methods, to reduce file size while preserving the integrity of the encoded information.

Methodology

- **Tampering Simulation:** Simulation of various tampering scenarios, such as Gaussian filtering and blurring, to assess the robustness of encoding and compression techniques against potential attacks.

- **Pretrained Model Training:** Training state-of-the-art deep learning models like ResNet50, Inception_v3, and VGG16 to classify images into tampered and untampered categories using transfer learning.

- **Custom Model Development:** Exploration of architectures such as Attention models, Siamese networks, and Generative Adversarial Networks (GANs) to develop a custom model optimized for detecting tampered images, trained on the same dataset as pretrained models for consistency and comparability.

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Summary of Custom Model

Layer (type)	Output Shape	Param #
inception_v3 (Functional)	(None, 5, 5, 2048)	21802784
global_average_pooling2d_15 (GlobalAveragePooling2D)	multiple	0
dense_49 (Dense)	multiple	2049
dense_50 (Dense)	multiple	2049
dense_51 (Dense)	multiple	2049
dense_52 (Dense)	multiple	2049

Total params: 21810980 (83.20 MB)
Trainable params: 21776548 (83.07 MB)
Non-trainable params: 34432 (134.50 KB)

Results And Analysis

Model	Non Encoded Images Accuracy	Encoded Images Accuracy	Encoded Images	
			Lossy Compressed Accuracy	Lossless Compressed Accuracy
ResNet50	86.0%	54.0%	50.0%	50.0%
inception_v3	96.0%	48.0%	51.0%	53.0%
vgg16	100.0%	47.0%	44.0%	51.0%
Custom Model (with Attention Layers)	-	-	60.0%	55.0%

Conclusion

- The study's outcomes underscore the critical role of meticulous model selection and customization, particularly evident in the integration of attention mechanisms for precise image tampering detection.

- The demonstrated effectiveness of varying image manipulations not only advances the sensitive image transmission but also furnishes invaluable insights into the intricate landscape of digital image forensics.

References

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