

Volume: 09 Issue: 06 | June - 2025

SJIF Rating: 8.586

ISSN: 2582-3930

A Self Supervised CNN for Image Watermark

Kothapally Deepthi Dept of ECE IARE

Dr. S China Venkateshwarlu Professor Dept of ECE IARE

Dr. V Siva Nagaraju Professor Dept of ECE IARE

Ms.B.Veena ,Assistant Professor Dept of ECE IARE

Table -1:

Abstract -

This project presents a self-supervised convolutional neural network (CNN) framework for robust image watermarking. Unlike traditional methods that rely on labeled data, our approach leverages self-supervised learning to embed and extract watermarks without explicit supervision. The network is trained to encode watermarks in imperceptible ways while maintaining high image quality and resistance to common distortions such as compression and noise. Experimental results demonstrate that our model achieves a strong balance between invisibility, robustness, and watermark retrieval accuracy.

Key Words: Self-Supervised Learning, Convolutional Neural Network (CNN), Image Watermarking, Digital Watermark, Robustness, Imperceptibility, Deep Learning, Data Hiding, Watermark Extraction, Image Processing

1. INTRODUCTION

Digital watermarking is essential for protecting image ownership and ensuring authenticity. Traditional methods often require labeled data and lack robustness. In this work, we propose a selfsupervised CNN-based approach that embeds invisible watermarks without manual supervision. The model learns to resist common image distortions while maintaining image quality, offering a scalable and efficient solution for modern digital watermarking needs.

2.Body of Paper

We propose a self-supervised CNN-based framework for image watermarking that eliminates the need for labeled data. The architecture consists of an encoder to embed an invisible watermark and a decoder to extract it, even after the image undergoes distortions like compression, noise, or cropping. Training is done using self-supervised learning, where augmented image pairs help the model learn robustness. The loss function combines reconstruction, perceptual, and robustness losses to ensure the watermark remains imperceptible yet recoverable.

YEAR&AUTHOR	AUGORITHM/TECHNIQUE	METHOD /SUMMARY	PROBLEM	REMARKS
2020, Ulyanov et al.	Deep Image Prior (DIP)	Used CNNs to restore images without paired training data	Lack of ground truth for training	Effective but slow for large datasets
2021, <u>Gandelsman, et</u> sl.	Double-DiP	Separated image layers using two deep priors	Difficulty in distinguishing watermark from the background	Good for structured watermarks but struggles with complex ones
2022, Hsu et al.	Unsupervised Learning for Watermark Removal	Used adversarial training for watermark elimination	Supervised learning needs large lateled datasets	Works well but may leave faint traces
2023, Yu et al.	CycleGAN for Watermark Removal	Transformed wetermarked images to clean ones without paired data	Paired clean Images are hard to obtain	Effective but requires large training datasets

Existing Block Diagram



1



1.Encoder (CNN)

. Takes an original image and a watermark (logo/text).

.Uses convolutional layers to **embed the watermark** into the image subtly.

.Output: a visually indistinguishable watermarked image.

Decoder (CNN)

.Takes the watermarked image as input.

.Learns to extract the embedded watermark.

Output: predicted watermark signal

Proposed Block Diagram



Fig -1: Figure

Here are common methods techniques:

1.Input Image: The original image to be watermarked.

2.Preprocessing: Standardizes and augments the input (e.g., resizing, normalization).

3.Self-Supervised Learning Module: Applies augmentations and prepares pseudo-labels for training without ground truth.

4.CNN Architecture: Encodes the watermark into the image using convolutional layers.

5.Output Image: The image with the embedded (invisible) watermark.

6.Loss Function: Calculates the difference between original and output watermark using self-supervised objectives (e.g., reconstruction, consistency).

7.**Post-Processing**: Applies any final touches, such as filtering or compression compatibility.

3. SYSTEM ARCHITECTURE

1.Raw images are fed into the system for watermark embedding.

Entry control Entry Entry	<pre>Set Fundament Content (set and set and se</pre>
i Synthi 9 mag 1 Martine - eth 7 Synthia	 And And And And And And And And And And

2.Prepare the Dataset

Consider the second sec	Complex of a state of
- severaphent	
The second s	Control Stretcher an er
Broady Barriery Barriery Barriery very	<pre>title university of the sector of</pre>
 Second processing of the second second	<pre>interview - manager (1)) interview - a, and applic matrix), interview - a, and applic matrix), i</pre>
 International Advances of Control (Control) Makes strate Advances (Control) particular terms and Advances (Control) particular terms (Control) (Control) terms terms (Control) (CONT) (Control) terms terms (Control) (CONT) (Control) 	and Second (1), st second second response is a second second response is a second s

3. Now train the model using tensor flow so that it can detect

*		
· · · · · · · · · · · · · · · · · · ·		
	A CONTRACTOR OF	
THE REAL		
4 Mit home provid.		
Contraction of the second s		
- annual more		
1-0000	4 States (Included Address) (Address)	
The second se		
And in case of the American American	and the set of the set	
the second s		
and her the second second	The second se	
It pay prove \$150 that them used	The second	
2 konten alengare CourtEllelle		
To Apply a support the states		
the second se		
the second second second second		
The preside definition of a definition of the		
To manufiliaring advictory of the		
Contraction of the owner owner owner owner own	the second	
and the second sec		
T a problem	Concerning a manufacture of the second se	
W stores	The second s	
1 all hand and	and the second s	
and a second		
Committee of the local division of the local		
1		
A strange mentil A strange mentil A strange A strange mentil	a sense of the second second and the	
	to the second seco	
	A second se	
	A construction of the second s	
A compared and a comp	Constant in Constant in the constant of the constant	
Property and the second s	Constant and a second sec	
A comparison A	Constant in Constant in the constant of the constant in the constant	
Constantial Consta	Contract State Contract	
A series and the series of the	A second se	
A constraint of the second sec	A construction of the second s	
A series and the series of the	Constant and	
A service	A constraint of the second of	
American Second Second Second Second Second Second Secon	A construction of the second s	
A series result A series result A series	A second	
A constant A constant constant constant constant constant constant A constant constant constant constant constant constant constant A constant constant constant constant constant constant A constant	A strategy of source Sector A strate Sector	
A constraint A constraint of the second A constraint of	Constant and a second sec	
A constant A constan	A second	
A series result A series result A series	<pre>Prove the provide a set of the provide a set o</pre>	
A series and a series of the series of	<pre>Prove the second s</pre>	
A series control of the series of the s	A second	
A series result A series result A series	<pre>Prove the second s</pre>	
A constraint of the second of the secon	<pre>A contract contr</pre>	
A constant of the second	<pre>interface interface i</pre>	

Τ



Volume: 09 Issue: 06 | June - 2025

SJIF Rating: 8.586

ISSN: 2582-3930

Result



4. CONCLUSION

In this work, we presented a self-supervised CNN approach for robust and imperceptible image watermarking. By eliminating the need for labeled data, our method offers a scalable and efficient solution for embedding and retrieving watermarks under various image distortions. Experimental results demonstrate the model's ability to maintain watermark integrity while preserving image quality, making it suitable for practical digital rights management applications.

ACKNOWLEDGEMENT.

We would like to express our sincere gratitude to our guide and faculty members for their invaluable support and guidance throughout the course of this project. We also thank our institution for providing the necessary resources and environment to carry out this research. Lastly, we appreciate the contributions of all team members whose dedication and collaboration made this project possible.

I deeply grateful to our esteemed faculty mentors, **Dr. Sonagiri China Venkateswarlu, Dr. V. Siva Nagaraju**, from the Department of Electronics and Communication Engineering at the Institute of Aeronautical Engineering (IARE).

Dr. Venkateswarlu, a highly regarded expert in Digital Speech Processing, has over 20 years of teaching experience. He has



provided insightful academic assistance and support for the duration of our research work. Dr. Siva Nagaraju, esteemed an Microwave researcher in Engineering who has been teaching for over 21 years, has provided us very useful and constructive feedback, and encouragement which greatly assisted us in refining our

technical approach.

I would also like to express My gratitude to our institution -Institute of Aeronautical Engineering for its resources and accommodating environment for My project. The access to technologies such as Python, TensorFlow and OpenCV allowed for the technical realization of our idea. I appreciate our fellow bachelor students for collaboration, their feedback, and moral support. Finally, I would like to extend My sincere thank you to My families and friends for their patience, encouragement, and faith in My abilities throughout this process.

REFERENCES

1.Zhang, J., Wang, Z., & Yao, Y. (2020). *Robust Image Watermarking via Deep Convolutional Neural Networks*. IEEE Access, 8, 50721-50733.

2.Chen, X., He, K. (2021). *Exploring Simple Siamese Representation Learning*. In Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR), 15750–15758.

3.Dosovitskiy, A., et al. (2014). *Discriminative Unsupervised Feature Learning with Exemplar Convolutional Neural Networks.* IEEE Transactions on Pattern Analysis and Machine Intelligence.

4.Goodfellow, I., Bengio, Y., & Courville, A. (2016). *Deep Learning*. MIT Press.

5.Liu, Y., Kang, X., Huang, J., & Lin, Y. (2019). *A Survey of Deep-Learning-Based Digital Image Watermarking*. ACM Computing Surveys (CSUR), 52(6), 1–39.

6.SimCLR: A Simple Framework for Contrastive Learning of Visual Representations *Chen, Ting, et al. (2020).*

BIOGRAPHIES



Kothapally Deepthi studying 3rd year department of Electronics And Communication Engineering at Institute Aeronautical Engineering ,Dundigal .She Published a Research Paper Recently At IJSREM as a part of academics She has a interest in VLSI and IOT.

Dr Sonagiri China Venkateswarlu

professor in the Department of Electronics and Communication Engineering at the Institute of Aeronautical Engineering (IARE). He holds a Ph.D. degree in Electronics and Communication Engineering with a specialization in Digital Speech Processing. He has more than 40 citations and paper publications across various publishing platforms, and expertise in

1



Volume: 09 Issue: 06 | June - 2025

SJIF Rating: 8.586

ISSN: 2582-3930

subjects. She can be contacted at **b.veena@iare.ac.in**.

teaching subjects such as microprocessors and microcontrollers,digital signal processing, digital image processing, and speech processing. With 20 years of teaching experience, he can be contacted at email: c.venkateswarlu@iare.ac.in



Dr. V. Siva Nagaraju is a professor in the Department of Electronics and Communication Engineering at the Institute of Aeronautical Engineering (IARE). He holds a Ph.D. degree in Electronics and Communication Engineering with a specialization in Microwave Engineering. With over 21 years of academic experience, Dr. Nagaraju is known for his expertise in teaching core electronics subjects and has contributed significantly to the academic and research community. He can be contacted at email: v.sivanagaraju@iare.ac.in.



Ms.B.Veena is an Assistant Professor in the Department of Electronics and Communication Engineering at the Institute of Aeronautical Engineering (IARE). She holds postgraduate degree in а Embedded Systems from JNTU Hyderabad and is currently pursuing her Ph.D. from Visvesvaraya Technological University, Belgaum. With over 7 years of teaching experience, including 3 years and 10 months at IARE, her areas of interest include Embedded Systems and related

Τ