

Secure Image Sharing Comparative Insights into Visual Cryptography and Random Grid Models

GROUP 9

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Project Overview

Introduction

Presents the importance of visual data protection and the role of Visual Cryptography (VC) in secure image sharing without complex decryption.

Proposed Work

Introduces a hybrid approach combining XOR logic with meaningful shares and random grids to improve clarity, flexibility, and security.

Literature survey

Reviews key research and developments in VC and Random Grid models, including threshold schemes and share quality improvements.

Future Work

Discusses extensions like multimodal encryption, dynamic random grids, biometric verification, and blockchain-based share tracking.

Study: VCS & Randomgrid

Analyzes the working principles of basic Visual Cryptography and Random Grid techniques, focusing on their strengths and limitations.

multimodal encryption

Explores integrating text, images, and biometrics into the encryption process for enhanced privacy and data security.

Project Objective

Abstract

Visual Cryptography (VC) and Random Grid (RG) models provide robust, computation-free methods for secure image sharing. Unlike conventional encryption, they allow secret reconstruction by simply overlaying shares. This project compares XOR-based VC with RG schemes in terms of image quality, pixel expansion, and security flexibility.

introduction

- Why image security? In the age of digital data exchange, protecting visual data is critical.
- Visual Cryptography splits an image into shares which individually reveal nothing but can reconstruct the image when stacked.
- Random Grid models eliminate pixel expansion and rely purely on random binary grids.
- Both methods require no complex decryption—just the human eye.



BACKGROUND RESEARCH

Literature Survey

1

Naor & Shamir : Introduced (k,n) visual cryptography with threshold schemes

2

Kafri & Keren : First proposed the concept of random grids for image hiding.

3

Joy Jo-Yi Chang : Developed multi-secret sharing using random grids.

5

Chen & Juan : Enhanced VC with XOR logic and meaningful shares for grayscale images

4

Debasish Jena : Presented hybrid models improving share quality

Key Insight

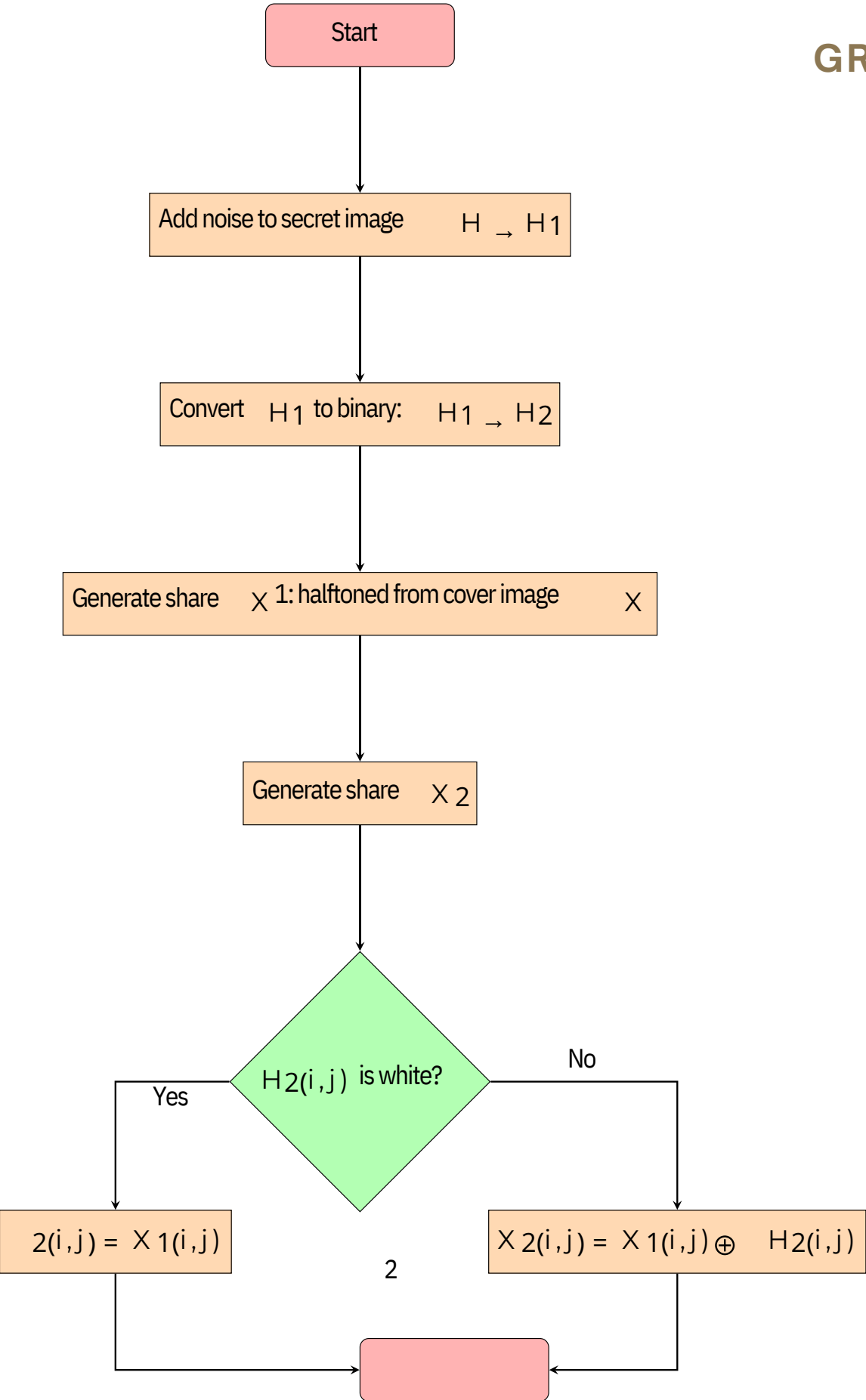
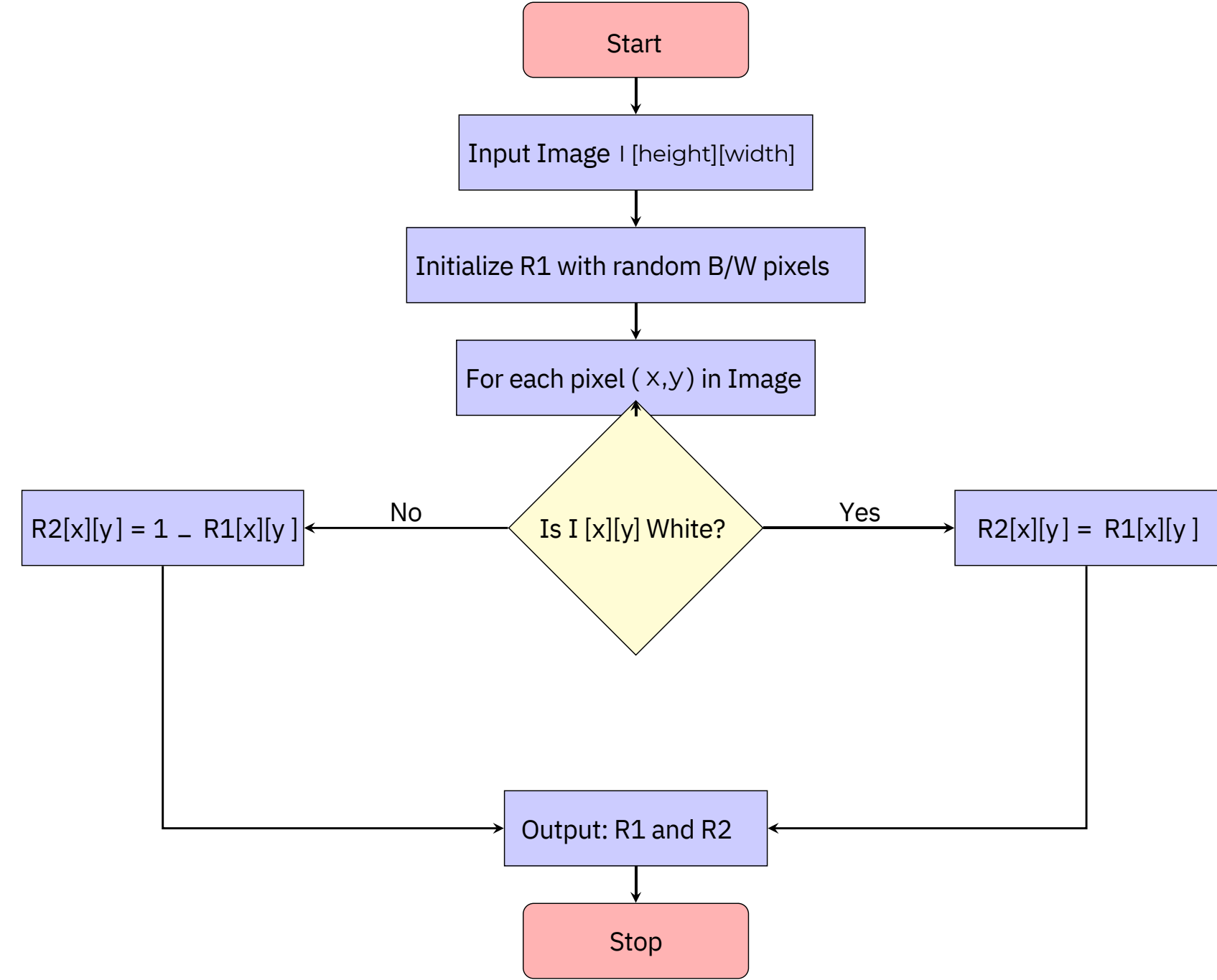
Evolving from basic black-and-white models to sophisticated, color-compatible, multi-layered schemes.

Comparative Study — VCS vs Random Grid

Feature	Halftone VC	Random Grid (RG)
Share Appearance	Meaningful using cover images	Random noise, no visual meaning
Pixel Expansion	Usually yes (can be optimized)	No pixel expansion
Security	Moderate to high (depends on design)	High (due to randomness)
Implementation	Requires dithering and alignment	Simple XOR/OR logic
Output Quality	Can preserve gray levels, more natural	Binary and high contrast

Scheme	Description	Security	Flexibility
(2,2)	Both shares required	High	No flexibility
(n,n)	All n shares required	Very High	No flexibility
(k,n)	Any k out of n shares can reconstruct	High	Very flexible

Algorithm



Our Proposed Work

- At first we'll be applying random grid method to our secret image (image which will be encrypted)
- At the very next step we will apply halftone method on the same secret image.
- Now we will combine both method and compare which one gives the best output. In times of combination we will apply recursion to generate share of cover images .

Future Work

- Implementing k out of n share generation using recursion
 - Implement recursive logic to efficiently generate all valid combinations of shares, enabling flexible and scalable access control
- Determine the optimal value of the k
 - Analyze trade-offs between security and usability to select the best k value for different use cases.

Multimodal Encryption

- VC and RG both provide strong, user-friendly image security
- XOR-based VC models improve reconstruction quality and flexibility
- Halftone shares give context to share images, making them meaningful
- RG models are lightweight and effective for storage and transmission
- Multimodal encryption (text+image+bio) is the next frontier for secure communications

References

Y.-H. Chen & J. S.-T. Juan

“XOR-Based (n,n) Visual Cryptography,” Applied Sciences, 2022

Deepa G

“Comparative Study on VC & RG,” IOSR-JCE

Debasish Jena et al

“A Novel Visual Cryptography Scheme,” IEEE

Joy Jo-Yi Chang

“Multi-Secret Sharing via RG,” Cryptography

Naor & Shamir

Visual Cryptography