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Volume 14, Issue 5, May 2025 |DOI: 10.15680/IJIRSET.2025.1405474| Image Steganography System

B. Tejaswini, Mrs. Rajeswari RP

U.G. Student, Department of CSE, Rao Bahadur Y Mahabaleshwarappa Engineering College, Karnataka, India

Assistant Professor, Department of CSE, Rao Bahadur Y Mahabaleshwarappa Engineering College, Karnataka, India

ABSTRACT: In an era dominated by digital communication, protecting sensitive information extends beyond encryption to concealment of the message itself. Steganography offers such concealment by embedding secret data within ordinary media files, thereby hiding the existence of the communication altogether. This study presents an implementation of image-based Steganography utilizing the least significant bit (LSB) technique. The method involves modifying the least significant bits of pixel values in a cover image to encode a secret message. These alterations are minimal and do not visibly degrade the image, making the method highly imperceptible and effective for secure data hiding. A light weight python based tool has been developed to perform both encoding and decoding processes. The focus is placed on maintaining high visual fidelity of the image while ensuring message confidentiality.

KEYWORDS: Pixel level encoding, least significant bit, stego image generation

I. INTRODUCTION

In today's digital age, secure communication is more important than ever. While cryptography protects the content of a message by converting it into an unreadable format, steganography takes a different approach: it hides the very existence of the message. Steganography is the science and art of embedding secret information within a non-secret file (such as an image, audio, or video) in a way that does not draw attention. The goal is to prevent third parties from even detecting that a hidden message exists. This makes it highly useful in scenarios where secrecy is crucial. In this project, we explore image-based steganography, specifically using the Least Significant Bit (LSB) method. In this technique, the smallest bits of the pixel data in an image are altered to store bits of the secret message. Since the change in pixel value is minimal, it is typically imperceptible to the human eye, making this method effective and discreet. The project involves creating a simple tool in Python to encode (hide) and decode (retrieve) messages within image files

II. LITERATURE SURVEY

Steganography, the art of concealing information within non-secret media, has gained significant attention in the field of secure communication. While cryptography protects message content, steganography hides the message's existence, offering a discreet form of data security. Among various techniques, the Least Significant Bit (LSB) substitution method is widely adopted due to its simplicity, efficiency, and imperceptibility to human vision.

Researchers have demonstrated that LSB-based steganography introduces minimal distortion to the host image, making it ideal for scenarios where visual quality must remain unchanged. Studies have also shown that lossless image formats like PNG and JPG are preferable to avoid data loss during compression.

Additionally, the integration of steganographic systems with Python programming, leveraging libraries like Pillow for image handling and Tkinter for GUI, has made such tools more accessible for real-world applications and research.

Existing work confirms the practical utility of LSB steganography in secure communication, while also highlighting areas for further improvement such as capacity enhancement, tamper resistance, and application in multimedia files beyond images.



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III. METHODOLOGY

The methodology adopted in this project involves a structured process to securely hide and retrieve secret messages within digital images using the Least Significant Bit (LSB) steganography technique. The first step is to define the hardware and software requirements. The project requires a system with a minimum of 4 GB RAM, 1 GB free disk space, and any standard operating system such as Windows, Linux, or macOS. Python 3.x is used as the programming language, along with libraries like Pillow for image processing, Tkinter for optional GUI development, and NumPy for advanced array handling.

The process begins with accepting a secret text message from the user. This message is then converted into its binary representation to allow bit-level manipulation. A cover image in a lossless format such as PNG or BMP is loaded using the Pillow library to avoid any compression-related data loss. During encoding, each pixel of the image is processed, and the least significant bits of the red, green, or blue channels are replaced with bits from the binary message. A special delimiter is appended to the end of the message to indicate completion during the decoding phase. The modified image, now called the stego image, is then saved while ensuring no visible change is apparent.

This methodology effectively demonstrates how LSB-based steganography can be implemented in a practical tool using Python, achieving secure and imperceptible data hiding.

IV. EXPERIMENTAL RESULTS



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This section presents the experimental evaluation of the proposed image steganography technique. And the selection of the image of adding a text message which is to be hidden.



The selection of image for the hiding the text data.



The message is encoded



Entering a secrete message to hide the data

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Select Images to Scan for Hid	iden Messages		
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The message is decoded



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V. CONCLUSION

The steganography project successfully demonstrates how secret information can be hidden within digital images using the Least Significant Bit (LSB) technique. By altering only the smallest bits of pixel data, the system embeds a message without noticeably changing the image's appearance. Through this project, we explored the concepts of data hiding, image processing, and basic security. We developed a functional Python program that: Accepts a message and image from the user, Embeds the message into the image, and later retrieves the hidden message accurately.

The implementation proves that steganography is a simple yet effective method of secure communication, especially when the presence of the message itself needs to remain hidden. Although the current project is basic, it lays a strong foundation for more advanced developments, such as using encryption, hiding in audio/video files, or adding password protection. Overall, this project achieved its objectives and provided hands-on experience with practical data security techniques.

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