Pastel Stego: A PyQt5-based Steganography Tool for Secure Message Hiding in Images

*Secure Message Hiding in Images*

**Introduction**

Steganography is the art of hiding information in plain sight. This project explores how images can act as carriers of secret messages using Least Significant Bit (LSB) encoding. The result is a pastel-themed GUI tool built with PyQt5 to demonstrate secure data hiding in a simple, educational format.

**Abstract**

This project presents a GUI-based steganography tool developed using PyQt5, enabling users to hide and extract secret messages within image files using the Stepic library and optional Caesar cipher encryption. The tool supports drag-and-drop functionality, image preview, and the ability to generate blank, noise, and gradient images for testing. With a user-friendly pastel-blue aesthetic and simplified interface, it provides a hands-on way to learn about information hiding and digital security practices.

**Objectives**

* To develop a GUI-based steganography tool using PyQt5 for hiding and extracting text messages in image files.
* To integrate the Stepic library for Least Significant Bit (LSB) steganography implementation.
* To implement user-friendly features such as drag-and-drop, image preview, and image generation capabilities.
* To design an intuitive and aesthetically pleasing user interface with a pastel theme.
* To gain practical experience in GUI development with PyQt5 and image manipulation with PIL.

| **Component** | **Technology** |
| --- | --- |
| Language | Python 3 |
| GUI Framework | PyQt5 |
| Image Handling | PIL (Pillow) |
| Steganography | Stepic |
| Image Gen | colorsys, random |
| UI Theme | Pastel Blue Gradient + Qt Stylesheet |
| OS Support | Cross-platform (tested on Windows and Linux) |
| **Features** | **Description** |
| Pastel UI | Gradient background with consistent blue theme and smooth buttons |
| Drag-and-Drop | Users can drag .png or .bmp images directly into the tool |
| Browse Option | Manual file selection with preview |
| Image Generation | Generate blank (color), random noise, or gradient backgrounds |
| Encode Message | Text is embedded into image using LSB-based steganography (Stepic) |
| Decode Message | Extract hidden message from selected image |
| Message Preview | Text boxes and labels for encoding, decoding, and viewing messages |
| Save & Load Support | Save newly encoded images and load images for decoding |
| Informative UI | Success/failure popups and preview updates to guide the user |

**Steps Involved in Building the Project**

1. **GUI Design (PyQt5):**  
   Built a user-friendly, pastel-themed interface using stacked screens for smooth navigation.
2. **Image Handling:**  
   Enabled users to load existing .png/.bmp images or generate new ones (blank, noise, gradient) using PIL.
3. **Drag-and-Drop Support:**  
   Added functionality to drag and drop images directly into the interface.
4. **Steganography Logic (Stepic):**  
   Used the Stepic library to encode messages into image pixels (LSB) and decode them back.
5. **Interactive Workflow:**  
   Guided users from image selection to message encoding/decoding with clear previews and feedback.

**Conclusion**

The tool provides a simplified yet powerful way to understand steganography. By combining aesthetic UI with real encoding techniques, it serves as both an educational and privacy-supportive application. Future updates may include encryption, multi-image encoding, or audio steganography to extend its real-world use.