ByteSpector: Data Manipulation and Analysis Toolkit

Project Synopsis Submitted

to

MANIPAL ACADEMY OF HIGHER EDUCATION

For Partial Fulfillment of the Requirement for the

Award of the Degree

Of

Bachelor of Technology

in

Computer and Communication Engineering

by

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August 2025

Objective:

- To develop a web-based application with a clean, intuitive user interface for real-time data manipulation.
- To implement a core set of data transformation functions, including common encoding/decoding schemes (Base64, Hex), hashing algorithms (SHA-256), and logical operations (XOR).
- To build a steganography module capable of embedding and extracting hidden data within image files using the Least Significant Bit (LSB) technique.
- To create a forensic analysis module for steganalysis, including an LSB visualizer to detect potential hidden patterns in images.
- To build the system using a robust client-server architecture with a Python backend for logic processing and a modern JavaScript frontend for user interaction.

Scope:

The project will focus on creating a fully functional toolkit with a selected set of core features. The application will be able to perform various encoding, decoding, and hashing operations on text-based input. The steganography module will be limited to LSB manipulation of PNG and JPEG image files. The steganalysis module will provide visual LSB analysis for these image types. The project will not include network traffic analysis, advanced cryptographic cracking, or support for audio/video steganography, which are considered out of scope for this version.

Need for the Application:

Digital data analysis often involves a fragmented workflow. An analyst might use one tool to decode a Base64 string, another to calculate a file hash, a third to hide a message in an image, and a fourth to check a file for hidden data. This lack of a centralized, multi-functional tool leads to wasted time, increased complexity, and a higher chance of errors. There is a need for an integrated environment that provides a comprehensive suite of tools for both data transformation and covert channel analysis, which ByteSpector aims to fulfill.

Project Description:

ByteSpector is a unified, web-based toolkit designed to streamline the workflow for security analysts, penetration testers, and digital forensics investigators. It integrates a "CyberChef-style" data transformation engine with advanced steganography and steganalysis capabilities, providing a single, cohesive platform for a wide range of security tasks.

The application is composed of three primary modules:

a. **Data Transformation Module:** Provides tools for common operations like encoding/decoding (Base64, Hex), hashing (MD5, SHA-256), and logical byte operations (XOR).

b. **Steganography Module:** Allows users to embed secret text messages into image files and extract them later.
c. **Forensic Analysis Module:** Includes tools to detect hidden data, such as an LSB Visualizer that can reveal patterns in an image's least significant bits, and a Magic Byte Analyzer to identify true file types.

The expected outcome is a fully functional application that serves as a versatile toolkit for information security tasks, demonstrating key concepts in data encoding, steganography, and digital forensics.

Hardware Requirements:

- **Client side:** Any modern computer (desktop, laptop) with at least 4GB of RAM and an internet connection.
- **Server side:** A standard development machine with at least 8GB of RAM and 10GB of free disk space to run the Python backend and associated libraries. No specialized hardware is required.

Software Requirements:

- **Client:**
  - A modern web browser such as Google Chrome, Mozilla Firefox or Apple Safari.
  - An operating system like Windows, Linux or MacOS.
- **Server:**
  - **Operating System:** Windows, Linux or MacOS.
  - **Backend:** Python 3.8 or higher.
  - **Web Framework:** Flask, or FastAPI
  - **Python Libraries:** Pillow, Numpy, SciPy, piexif, PyCryptodome, PyCrypto and more
  - **Code Editor:** Visual Studio Code, Jetbrains Pycharm, or similar.
  - **Version Control:** Git

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