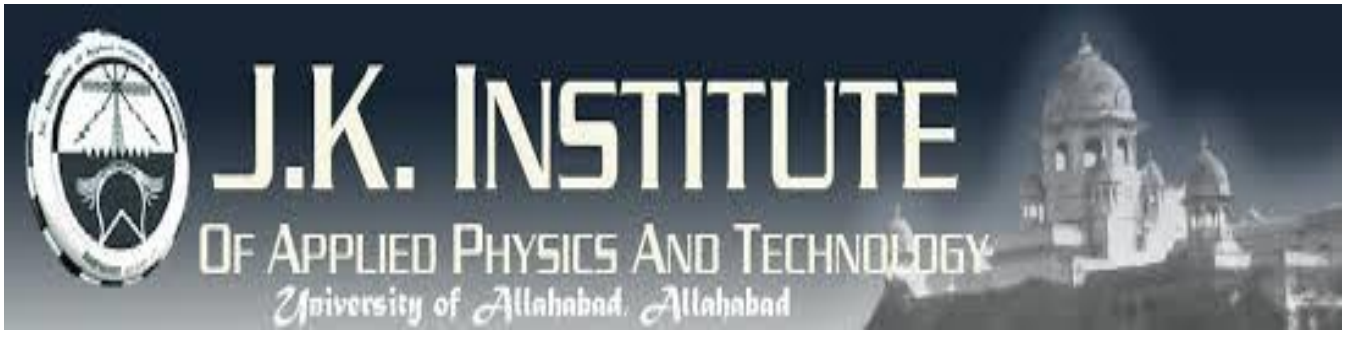

PROJECT REPORT

For

Steganography

Prepared by

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B.TECH (6th Semester)

Computer Science & Engineering

Guided By:

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Table of Contents

Revision History

Name	Date	Reason For Changes	Version

Acknowledgement

During the construction of my project, I had to take the help and guidelines of some respected persons, who deserve my utmost and sincere gratitude. The completion of this project gives me much pleasure. I would like to show my gratitude to Prof. Rajiv Ranjan Tewari, University Of Allahabad for giving me a good counsel and guidance for my project throughout its numerous consultations. I would also like to expand my deepest gratitude to all those who have directly and indirectly guided me in making this project a success.

In addition, to everything Professor Rajiv Ranjan Tewari, who introduced me to the Methodology of work, and whose passion for the “underlying structures” had an everlasting effect on my attitude towards such consignments. I would also like to thank the University of Allahabad and other universities included in my prototype for their consent to include their copyrighted pictures as a part of my project.

Many people, especially my classmates and seniors themselves, have made many invaluable comment suggestions on this proposal which gave me the inspiration needed to improve my assignment. I thank all the support staff of my institute and the internet whose help directly and indirectly helped me complete my assignment.

Polamuri Mohana Krishna

B. Tech (6^{th} Semester)

Computer Science & Engineering

1. Introduction:

1.1 Purpose:

One of the most important property of (digital) information is that it is in principle very easy to produce and distribute unlimited number of its copies. This might undermine the music, film, book and software industries and therefore it brings a variety of important problems concerning the protection of the intellectual and production rights that badly need to be solved. The fact that an unlimited number of perfect copies of text, audio and video data can be illegally produced and distributed requires to study ways of embedding copyright information and serial numbers in audio and video data. Steganography bring a variety of very important techniques how to hide important information in an undetectable and/or irremovable way in audio and video data.

Steganography is main part of the fast developing area of information hiding. Data security is the essential in the today's world of internet and networking. In any organization information is critical. In today's world people are ready to spend millions of money in order to ensure high level of information security. In spite of spending such a huge amount, still the objective of securing the information is not achieved as the data somehow gets in the hands of hacker. As the technology for securing the data is advancing, hackers are also keeping pace with this technology. Hackers now make use of certain algorithm or other techniques to decode the data encoded by the senders. One of the ways to ensure security is to ensure that data is not visible to the hacker. This can be done by hiding the message itself behind some other objects. Here we are achieving this data security concept through the technique of Steganography.

1.2 Document Conventions

- The asterisks (*) are used denote that the specifications are particular.
- The digits from 1-9 are used to denote the priority among the data from high to low respectively.
- Items that are intended to stay in as part of your document are in **bold**
- Explanatory comments are in *italic* text.
- Plain text is used where you might insert wording about your project

1.3 Product Scope

The project 'Steganography' will basically deal with data security. It will provide security of data by mechanism which is popularly known as 'Steganography' in the world of internet security.

- It will embed any text data into any other suitable file such as image, audio, video, text file, without actually changing the content of the carrier file.
- It will also allow user to transfer the file containing the information to other machine through LAN.
- Consequently will also retrieve the information from file in which information is embedded.
- It will also provide a mechanism for embedding a whole text file in other files.
- It will provide the mechanism to retrieve the text, image and audio file as it was embedded without changing the format or look of the file in which it was embedded.
- It will also enable the digital data to embed multiple files simultaneously at the same time and during extraction the same files are retrieved with negligible loss of data and information

1.4 References

- IEEE SRS Format
- Complete Reference in Mathworks.com for implementation in MATLAB
- Rational Application Developer Tutorial, IBM Publications
- http://publib.boulder.ibm.com/
- IEEE Std 830-1998 IEEE Recommended Practice for Software Requirements Specifications, In IEEE Xplore Digital Library. http://ieeexplore.ieee.org/.
- Image Processing & its implementation in MATLAB by Gonzalez.

1.5 Technologies used:

- Language: MATLAB programming language.
- Platform Used: MATLAB 2013Rb

- MATLAB Script Files Technology
- Hex File Editor
- Image Processing SDK Technologies including LEADTOOLS, CVPI Tools

1.6 Definitions, Acronyms and Abbreviations:

- **SRS:** Software Requirements Specification.
- **WWW:** World Wide Web.
- **GUI:** Graphical User Interface.
- **DIP:** Digital Image Processing.
- **PSNR:** Peak-Signal to Noise Ratio
- **UDF:** User-Defined Function
- **MSE:** Mean Square Error

- **MATLAB** (**Mat**rix **Lab**oratory) is a multi-paradigm numerical computing environment and fourth-generation programming language. A proprietary programming language developed by MathWorks, MATLAB allows matrix manipulations, plotting of functions and data, implementation of algorithms, creation of user interfaces, and interfacing with programs written in other languages including C, C++, Java, Fortran and other programming languages.

- **Maintenance:** Client/Customer information's are maintained in a separate Log for maintenance and periodic reviews for the system administrator.

- **Portfolio:** A set of Securities.

- **Embedding:** Something to be hidden in something else

- **Embedder/Extractor:** An entity or person that embeds and extracts is called an embedder or an extractor, respectively.

- **LSB:** Least Significant Bit

- **AWGN:** Additive White Gaussian Noise

1.7 Time Plan

System Planning is an important for any successful project. Without proper planning the project is doomed. Good planning can be done after the requirements for the project are available. The input to the project planning activity is the requirement specification. The output of this phase is the project plan, which is the document describing the different aspects of the plan. The project plan is instrumental in driving the development process through the remaining phases. The major issues the project plan addresses are:

- Selection of technology.
- Development of modules.
- Cost Estimation//still to include
- Average Duration Estimation //still to include
- Gantt chart various models have been proposed for the software planning. E.g. COCOMO (**Co**nstructive **Co**st **Mo**del) developed by Boehm. The model fits the large scale projects and can be implemented with few modifications for the small projects.

1.8 Intended Audience

The software is intended to be used by organisations involved in Multimedia, Multinational IT-companies, Health sector where the authenticity of medical images including MRI scans is crucial to the treatment analysis for patients admitted into the respective hospitals. The range of clientele encompasses both public and private-sector companies.

1.9 Goals

The software which will be developed should have the following capabilities:

- ✓ It should be capable of distinguishing the authorized and un-authorized users.
- ✓ It should be capable of embedding text message into image file, audio file and video file.
- ✓ Before embedding the message, the message should be first encrypted.
- ✓ On embedding the message, the format and look of the image, audio, video should not be distorted.

- ✓ Reverse to embedding the message, it should also retrieve the message from image/audio/video file as it was embedded.
- ✓ After embedding the message, it should retrieve the message from the file in the same format in which the message was previously embedded.
- ✓ It should also decrypt the message which was encrypted by the sender.
- ✓ After retrieving the message from the file, the look and the format of the image, audio, video should not change.
- ✓ It should be capable of embedding the whole text file into the image file, audio file and the video file, so that user could be able to embed large message in the form of text file.
- ✓ The format of data in file should not change during the process of transfer.
- ✓ When the file is embedded in the image file, audio, video the visual interface of the file holding the file should not change.
- ✓ Before embedding the file, the data of the file should be encrypted.
- ✓ It should also decrypt the content of the file which was encrypted by the sender.
- ✓ After retrieving the file from the image, audio, video file which holds the message the format of the image, audio, video file should not change.
- ✓ There should be mechanism for alerting the receiver when any file is send to him.
- ✓ There should be mechanism for alerting the sender when any file is accepted by the receiver.
- ✓ There should be mechanism for alerting the sender if any file is rejected by the receiver.
- ✓ Since this software is responsible for the data security, the software should be safe enough that it does not get misused.

2. Overall Description

2.1 Product Perspective

The transmission of secure information/confidential information through covert channels is concerned with Image Steganography. This discipline of image processing further creates a divagation concerning the field of Steganalysis which is used to detect and decrypt the covert channels and means of

communication being used by extremist organizations in their modes of communication.

2.2 Product Function

LSB substitution - the Least Significant Bit of a i-th binary block cki is replaced by the bit mi of the secret message.

The methods differ by techniques how to determine ki for a given '*i*'. For example, ki+1 = ki + ri, where ri is a sequence of numbers generated by a pseudo-random generators.

- Substitution into parity bits of blocks. If parity bit of the block cki is mi, then the block cki is not changed; otherwise one of its bits is changed.
- Substitution in binary images. If image ci has more (less) black pixels than white pixels and mi = 1 (mi = 0), then ci is not changed; otherwise the portion of black and white pixels is changed (by making changes at those pixels that are neighbors of pixels of the opposite color).
- Substitution in unused or reserved space in computer systems.

In image steganography the Exclusive-OR operation is performed on the last significant bit of the data in all three planes RGB since the mechanism is being performed in colored image.

2.3 Software Interfaces:

- **Client on Internet:** Web Browser, Operating System (Windows 7, 8 and all other compatible operating systems)
- **Client on Intranet:** Client Software, Web Browser, Operating System (Windows 7, 8 and all other compatible operating systems)
- **Development End:** MATLAB 2013Rb
- **Tool Box Used:** Image Processing Toolbox available in MATLAB Version 8.2 with all its inherent (built-in) user-defined function files

2.4 Hardware Interfaces

- Processor: Intel® Core™i5-4200U CPU @2.3GHz
- System Type: 64-bit operating system, x64-based processor
- Ram: 6GB(5.89 GB usable)

- Hard disk: 1TB
- Keyboard: 105 standard

2.5 Communication Interfaces:

- MATLAB Command Window
- MATLAB Script File Editor/Command History Window
- MATLAB Variables Workspace
- MATLAB Figure Window
- MATLAB Help Window

2.7 User Classes & Characteristics:

- **2.7.1 User Characteristics**
  As this is a product for preventing a prevailing unlawful act in the digital society, user does not provide much information as input to the product. The algorithm against cropping attack asks the user to specify the most important portion of his image and the watermark is embedded in the centre of that portion. This embedding is not sequential, unlike the basic algorithm, but in a spiral pattern. Similarly at the time of recovery the user is asked to specify the pixel-location from where to start recovering the watermark.
  2.7.2 User Classes
- Private-Sector Clients personalised as users.

- Research Sector pertinent to the field of Data Embedding, Encryption, Image Watermarking, Steganography and Steganalysis.

- Health Sector Organisations requiring legal authentication and validity of their intricate medical scans etc.

- Cyber Security for countries in dire need of it.

2.8 Constraints

2.8.1 Design & Implementation Constraints:

- GUI is only in English.
- MATLAB should be completely installed in the system along with the Image Processing Toolbox

- The static and the dynamic content should be synchronized.
- No checks of time line are being implemented.
- *Security:* The files in which the information regarding securities and portfolios and other valuable information should be secured against malicious deformations and copyright attackers/hackers.
- *Fault Tolerance*: Data should not become corrupted in case of system crash or power failure
- Only text and image files can be embedded in the image, audio and video file. No other files (audio and video) can be embedded.
- The MATLAB platform being used is only for a 64-bit processor henceforth a system with 32-bit processor or less will not be able to optimally implement and design the algorithms and codes devised.

2.8.2Memory Constraints

Hardware memory: The programs are computationally very heavy and henceforth a sizeable amount of RAM (minimum 2 GB) for its efficient implementation in the MATLAB platform.

2.9 Adaptation requirements

No site adaptation is necessary in this project because the implementation of Image Steganography is to be made portable. The entire system will have the capability to be transported to wherever it is needed. No external dependencies are in place and operation of the system will never change due to its varying locations.

3. System Requirements & Analysis

The following sections will introduce the numerous requirements of the system from the point of view of different users and will introduce a number of decisions that have been made regarding implementation. These sections also attempt to somewhat describe the role of each user group in the system, discussing their individual roles through the functions they can perform.

3.1 User Interface

No specific GUIs needed to be developed for this product. This is due to the fact that the program code developed for this project has been implemented in MATLAB which has a convenient built-in GUI (Figure Window, Command Window etc.) and has efficient interfacing functions which makes the use of GUI in this project futile. Although the pop-up boxes of recovered watermarks

are shown in the results section. For Example, the functions used in this product are psnr () to calculate the PSNR values of the outputs as shown below:

psnr (image, secret, y, x)

3.2 Performance Requirements:

- The imperceptibility of the product image should be maintained in order to make it indistinguishable with the original image.

- The PSNR values for the output image should be considerable enough and noise other types of distortions should not be detected in the image unless it has been simulated.

- The image should be robust to the general type of compression attacks protecting its information at all costs.

- In the process of steganography maximum number of text files, image files, audio files etc. must be embedded into the original image data to ensure the capacity of the system and its capabilities

3.3 Learning Methodologies Adopted:

- Familiarity with the domain: Worldwide research activities and the industrial interest in digital watermarking and steganography is increasing dramatically in today's world owing to the increasing popularity of internet. The field of digital image processing is very vast and steganography is only a subset of it. Understanding the interdependence and correlation of these three fields was very crucial to my project. In this phase I studied about the real time applications of steganography and the ways in which people exploit the vulnerability of digital data on the net. For example, some employees hide their resumes inside an image to avoid interception by the organization's e-mail server.

- Gather Information: With the help of various research papers and internet, we learnt the concepts of steganography: Steganography techniques and different embedding algorithms. But these methods alone are not a solution to the problem of illegal copying because people generally destroy the data embedded in the image by various attacks. We studied the commonly used attacks on the watermarked and

steganographed image and existing methods to retain the crucial digital data even after these attacks.

- ❖ Learn MATLAB: MATLAB is a high level technical computing language and interactive environment for algorithm development, data visualization, data analysis, and numerical computation. Using MATLAB, you can solve technical computing problems faster than with traditional programming languages such as C, C++. One can use MATLAB in a wide range of applications, including signal and image processing, neural networks, communications, control design, test and measurement, and computational biology. Add-on toolboxes (collections of special-purpose MATLAB functions, available separately) extend the MATLAB environment to solve particular classes of problems in these application areas.

3.4 Future Extensions:

- The system can integrate itself with the implementation of artificial intelligence which includes artificial neural networks, fuzzy networks etc. which can help introduce a learning aspect to the system. This can help introduce other aspects of image processing which includes image recovery and regeneration.

- The system can adopt more robust algorithms which are in the DCT and DWT domain which introduce much more efficient watermarking methods although the complexities regarding the algorithms will also increase.

- The system can be made robust to JPEG compression by introducing quantization and can be tested with different quality factors of the image to test its efficiency under different compression attacks performed on the product.

- An efficient algorithm can be introduced such that the features of the image which is to be embedded can be embedded in the image itself with maximum imperceptibility. This will further help in image authentication and ease the process of watermarking.

- Image steganography can be made versatile to all types of image formats including (.png, .bmp and .tif) for increasing the adaptive nature of the algorithm being implemented.

3.5 System

- ✓ **Validation:** On the completion of each iteration in the system computes, the system will use a set of validation functions to ensure the embedded information is safe along with the original carrier's imperceptibility. Even thought, this seems like a tedious job it will ensure the efficiency of the method being used and also ensures carefree access from the receiver's end where they will have to decrypt the information already stored.

- ✓ **Ease in Navigation:** The MATLAB script window will ensure the safe navigation of the user in its implementation which will guarantee resolute transparency between implementation and client.

- ✓ **Help-Interface-** It will help in almost all aspects of the system including specifying the operability and the characteristic attributes to the different functions both inherent and user-defined which are being used in the implementation.

- ✓ **Statistics:** If the Image Analyst so wishes, clients would be able to view statistics gathered by the images regarding the discrepancies and inconsistencies between the original image and produced image. These statistics could be displayed on a page with individually expandable sections, otherwise they can be meticulously accessed by the Figure Window of MATLAB©. The client should be obviously cognitive of the certain intricacies involved in image processing during the process of watermarking and image steganography.

- ✓ **Report Generation:** Generate reports based on the desired criteria pertaining to sections including scope for improvement, customer satisfaction, anomalies still persistent in the existing code and in accordance with the fulfilment of different/distinguishable objective demands of the client.

4. Supplementary Requirements

4.1 Have hours of operation that are 24 x 7 - Because system can be an automated process, so it can stay open for 24 hours a day. If the base is now the entire world, staying open 24 hours a day becomes critical. System is required to be available 24X7 so UPS support must be on server site for at least 8 hours in case of power failure. System will remain inaccessible to users at 2:00 to 4:00 am for backup and maintenance purpose.

4.2 Make the existing program codes more dynamic in nature – This is mainly concerned with broadening the limited aspects concerning the project since the work is narrowly focused on implementation of EX-OR operations with the least significant bits of the digital data in the image in steganography. We can devise algorithms for other multitude of methods available and a comparative analysis of all these methods can be based on different parametric values to test their efficiency against each other and eventually finding out the best and modifying it to make it as effective as possible.

5. Nonfunctional Requirements

5.1 Security Requirements

The system, at any time, should be accessed only by the authenticated clients. This implies that the copyright information which has been embedded in the should be recovered only by the specific client for which the information was embedded. Also the message hidden during Image steganography should not be tampered with by external factors due to which the manipulation of information may take place which will consequently lead to corruption of information authenticity.

5.2 Software Quality Attributes

5.2.1 Reliability

The system is to work reliably, with automatic backup and recovery features. In case of unexpected malicious damage to the message/Image copyright information, the information should be embedded such that retrieval of the information is possible at all costs. The embedded image copyright information should be robust against the common malicious attacks generally deployed by Image copyright violators.

5.2.2 Availability

The entire system is being available round the year, except for a periodic maintenance. The maintenance period should be pre scheduled and short. The clients should be reminded of the unavailability period, well in advance.

5.2.3 Maintainability

The documentation is to be made easy for the users who execute the systems day to day, for the developers who wish to edit or develop further, and for the personnel who is in charge of the maintenance.

5.2.4 Portability

The program will be subsequently supported in newer, developed versions of MATLAB. The functions and methodologies used are standard and supported by most platforms.

5.2.5 Usability

The GUI is being easy to learn and use by users of any technical background. A built-in help feature in the MATLAB© programming platform is sufficient enough, to guide the users with the available functions and their functionalities. An easy to understand documentation is provided along with the system. System may support several languages because of inter-portable platforms available for translating MATLAB codes in to the required/desired language.

6. Change management Process

As a team, we will update and evaluate our SRS document every week as we make changes in our design and requirements. We will add new detailed information which will include: research, references, charts and graphs, and more specifications and requirements that we find along the way in the designing and implementation of the product.

7. Document Approvals

We have no document approvals as of this time.

8. Supporting information

Appendix A:

1. **Exclusive-OR Operation Truth Table:-**

Input 1	Input 2	Output
0	0	0
0	1	1
1	0	1
1	1	0

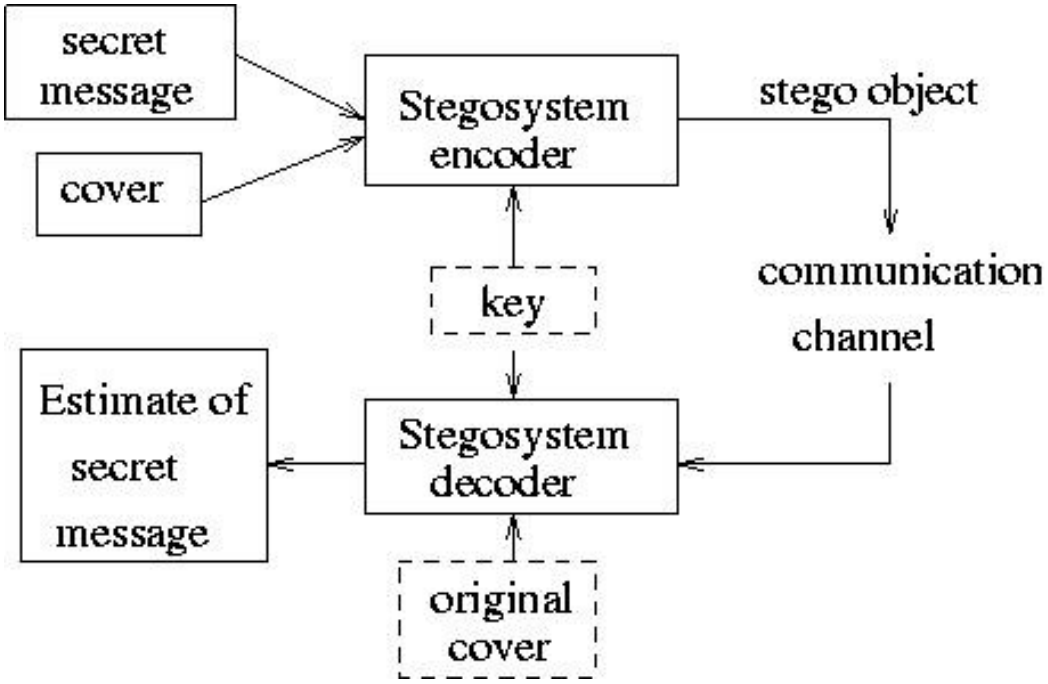
2. **PSNR Calculation:-**

$$\mathrm{PSNR} = 10 \cdot \mathrm{Log}_{10}\left(\frac{255^2}{\mathrm{MSE}}\right)$$

where

$$\mathrm{MSE} = \frac{1}{M \cdot N}\sum_{x=1}^{M}\sum_{y=1}^{N}\left(\left|I_o(x,y) - I_t(x,y)\right|^2\right)$$

3. Steganography Systems



9. Historical Overview

Steganography

The first steganographic technique was developed in ancient Greece around 440B.C... Herodotus's Histories describes two types of the earliest steganography. The first type involved the shaving of a slave's head, and then a tattoo was inscribed on the scalp. When the slave's hair had grown back and hidden the message, the slave was sent to warn of the Persians' impending invasion. The recipient once again shaved the slave's head and retrieved the important warning. Another method was to modify ancient writing tablets. The layer of wax covering the tablets was the surface upon which messages were written. However Demeratus, a Greek exiled into Persia, devised a plan to hide a message by removing the layer of wax and writing directly on the underlying wood a warning to Sparta that the Persians were planning an invasion. The tablets were then covered again with wax and appeared unused to the examiners of the shipment.

10. Technologies & Softwares Used

MATLAB©:

Once the program starts, the MATLAB desktop window opens. The window contains four smaller windows: the Command Window, the Current Folder Window, the Workspace Window, and the Command History Window. This is the default view that shows four of the various windows of MATLAB. The Start button on the lower left side can be used to access MATLAB tools and features.
Four of the windows—the Command Window, the Figure Window, the Editor Window, and the Help Window—are used extensively

Command Window: The Command Window is MATLAB's main window and opens when MATLAB is started. It is convenient to have the Command Window as the only visible window, and this can be done by either closing all the other windows (click on the x at the top right-hand side of the window you want to close) or by first selecting the Desktop Layout in the Desktop menu, and then selecting Command Window Only from the submenu that opens.

Figure Window: The Figure Window opens automatically when graphics commands are executed, and contains graphs created by these commands.

Editor Window: The Editor Window is used for writing and editing programs. This window is opened from the **File** menu.

Help Window: The Help Window contains help information. This window can be opened from the Help menu in the toolbar of any MATLAB window. The Help Window is interactive and can be used to obtain information on any feature of MATLAB.**NOTE:-**Some of the characteristics have been explained in section **1.6.**

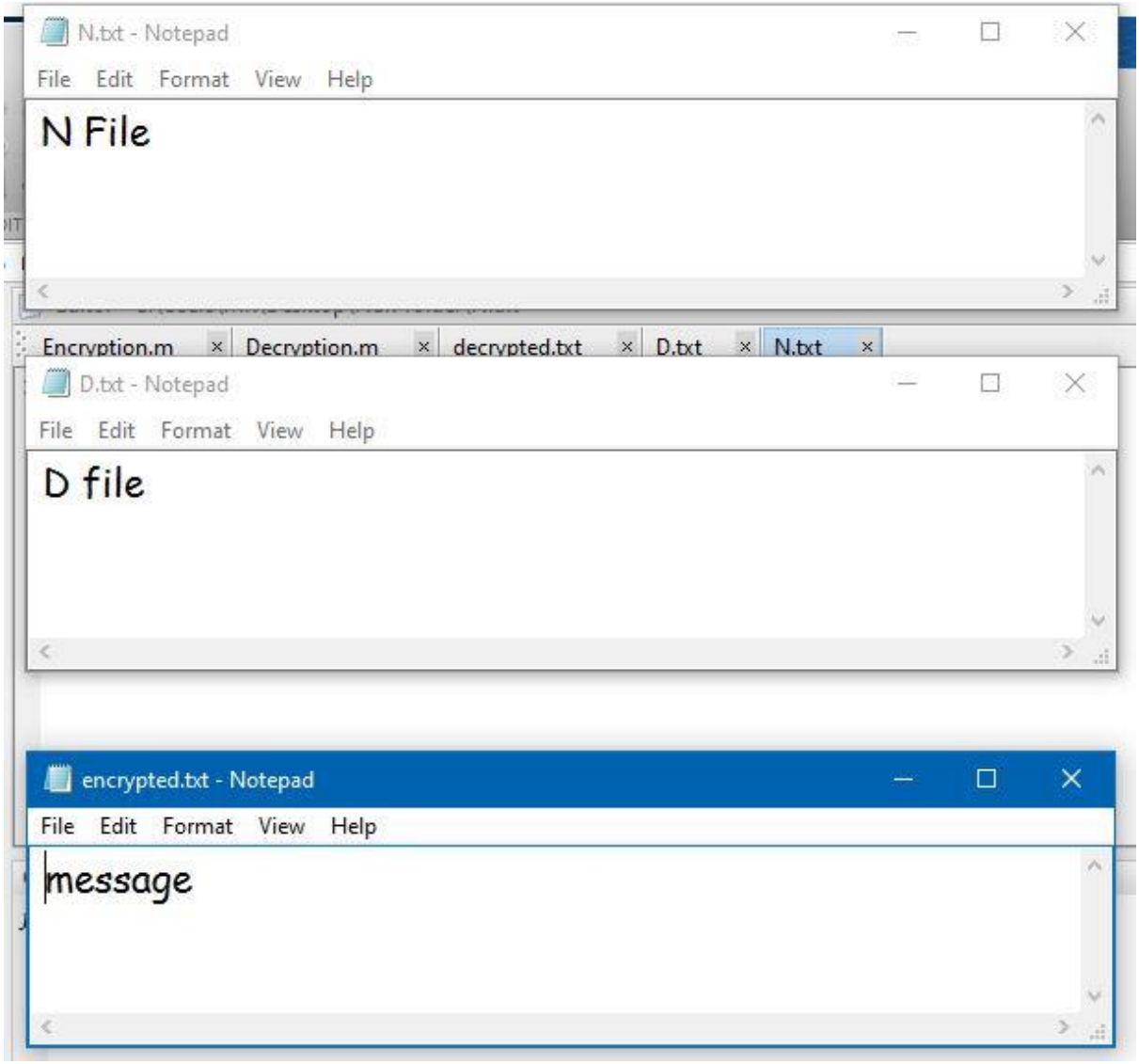
11. Experimental Results

Steganography

Steganographed Image

Original Image

Files that were encrypted



Code for Encryption

```
clc;
close all;
clear all;

msg = fileread('C:\Users\MK\Desktop\New folder\encrypted.txt');
oriImage = imread('C:\Users\MK\Desktop\New folder\origimg.bmp');
[row, col, pl] = size(oriImage);
%for Sending encrypted.txt file

len = length(msg);
msgTemp = uint8(msg);
k = 1;
stegoImage = oriImage;
% imshow(oriImage);
for i = 1:row
    for j = 1:col

        stegoImage(i, j, 1) = bitxor(msgTemp(k), oriImage(i, j, 1));
        k = k + 1;
        if(k > len)
```

```
            break;
        end
    end
    if(k > len)
            break;
    end
end

% %for Sending D.txt file
msg1 = fileread('D.txt');
len1 = length(msg1);
msgTemp1 = uint8(msg1);
k = 1;

% imshow(oriImage);
for i = 1:row
    for j = 1:col

        stegoImage(i, j, 2) = bitxor(msgTemp1(k), oriImage(i, j, 2));
        k = k + 1;

        if(k > len1)
            break;
        end
    end
    if(k > len1)
            break;
    end
end
% %for Sending N.txt file
msg2 = fileread('N.txt');
len2 = length(msg2);
msgTemp2 = uint8(msg2);
k = 1;

% imshow(oriImage);
for i = 1:row
    for j = 1:col
        stegoImage(i, j, 3) = bitxor(msgTemp2(k), oriImage(i, j, 3));
        k = k + 1;

        if(k > len2)
            break;
        end
    end

    if(k > len2)
            break;
    end
end
%Results
imwrite(stegoImage, 'stegoimg.bmp');
```

Code for Decryption:

```
clear all;
clc;
close all;

encImage = imread('C:\Users\MK\Desktop\New folder\stegoimg.bmp');
inputImage = imread('C:\Users\MK\Desktop\New folder\origimg.bmp');

[row, col, pl] = size(encImage);

% % for recovering encrypted.txt file
x = 1;
for i = 1:row
    for j = 1:col
        if(encImage(i,j,1) == inputImage(i,j,1))
            break;
        end
        decMsg(x)= bitxor(encImage(i,j,1), inputImage(i,j,1));
        x = x + 1;
    end
    if(encImage(i,j,1) == inputImage(i,j,1))
            break;
    end
end

charMsg = char(decMsg);
 %code to save recovered cipher  text
edit('decrypted.txt');   %new file is created
fileID = fopen('decrypted.txt','w');
fprintf(fileID,'%s',charMsg);
fclose(fileID);

% % % for recovering D.txt file
y = 1;
for i = 1:row
    for j = 1:col
        if(encImage(i,j,2) == inputImage(i,j,2))
            break;
        end
        decMsg1(y)= bitxor(encImage(i,j,2), inputImage(i,j,2));
        y = y + 1;
    end
    if(encImage(i,j,2) == inputImage(i,j,2))
            break;
    end
end

charMsg1 = char(decMsg1);
 %code to save recovered cipher  text
edit('D.txt');   %new file is created
fileID = fopen('D.txt','w');
fprintf(fileID,'%s',charMsg1);
fclose(fileID);

% % % for recovering N.txt file
z = 1;
for i = 1:row
    for j = 1:col
```

```
        if(encImage(i,j,3) == inputImage(i,j,3))
            break;
        end
        decMsg2(z)= bitxor(encImage(i,j,3), inputImage(i,j,3));
        z = z + 1;
    end
    if(encImage(i,j,3) == inputImage(i,j,3))
            break;
    end
end

charMsg2 = char(decMsg2);
 %code to save recovered encrypted  text
edit('N.txt');   %new file is created
fileID = fopen('N.txt','w');
fprintf(fileID,'%s',charMsg2);
fclose(fileID);
```

12. Conclusions

- Multiple data-embedding techniques were explored in the process of implementation and their importance in the field of cyber-security was realized in a generation where information is too fragile and in dire need of protection and security.

- Various intricacies involving digital image processing establishing a strong research foundation to exploring the subject ahead as a major for research prospects.

- This project enabled me to create a clear distinction between two similar data hiding techniques: Steganography is very confusing to a layman and hence this project is very instructive regarding the two and significant differences between them.

- The ancient implementation of data security and its essentials has been realised in the modern day-generation in the digital image and this project stands out as one of the innumerable practical evidences for it.

CERTIFICATE

- This is to certify that Mr. Polamuri Mohana Krishna has successfully prepared and completed the project under my direct and close supervision and that this is a bonafide piece of work done by him.
- Class: B.Tech , VIth semester
- Branch: Computer Science Engineering
- Academic Year: 2015-2016
- Institution Name: J.K. Institute of Applied Physics & Technology

Signature of Examiner: _____

Date: _____

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Examiner's Remarks