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Application of the DCT Algorithm to Protect Image Files with Key Symbols

Setia Hariati[1*], A M H Pardede[2], Marto Sihombing[3]

[1,2,3]*STMIK Kaputama*

rhariati2707@gmail.com[1], akimmhp@live.com[2] , martosihombing@yahoo.com[3]*

Abstract

Image file protection is an important aspect in managing and transmitting visual data in the current digital era. One effective method for protecting images is to use the Discrete Cosine Transformation (DCT) algorithm based on the principle of randomization with key symbols. This research aims to describe the application of the DCT algorithm in the context of image protection using key symbols as a security method.

This study includes the main stages, namely randomization of the original image using predetermined key symbols, transformation of the image to the DCT domain, and storage of the scrambled image. By scrambling the image using key symbols known only to authorized parties, the original image can be changed significantly making it difficult to reconstruct by unauthorized parties.

In addition, the results of this DCT transformation can also be encrypted using a strong cryptographic algorithm, increasing the security level of image protection. The research results show that this methodis effective in protecting image files from unauthorized access and unwanted surveillance. The final result of implementing the DCT algorithm with this key symbol is an image that is protected with a high level of security and can be restored correctly by authorized parties using the appropriate key symbol.

This research has broad potential applications in a variety of contexts, including data security, confidential image storage, and secure image transmission over communications networks. Thus, this method can make a positive contribution in overcoming information security challenges in an increasingly complex digital era.

Keywords: *Discrete Cosine Transform, Cryptography*

1. Introduction

There is a lot of data that needs security, one of which is image data. Images have a very important role in modern technology and are used in various ways, for example to show a person's identity. However, images are often misused for the purpose of manipulation or fraud, such as digitally edited images to create fake news or illegally breaking into security with other people's identities [2], [3].

Therefore, image protection is becoming increasingly important in protecting privacy and preventing misuse. The solution to this problem is to secure the image, and one of the algorithms that can be used to secure the image is Discrete Cosine Transform (DCT) [4], [5].

The DCT algorithm is a digital signal processing technique that is used to transform signals in the spatial domain into the frequency domain, which can then be processed more efficiently. Basically, theDCT algorithm works by dividing the signal into small overlapping blocks. Furthermore, the DCT coefficient can be used to remove redundant or unimportant information in the signal, so that the sizeof the data file can be reduced. In image security, this process is carried out by randomizing the order of the DCT coefficients in the original image with a selected formula and protected with a secret key.

2. Theoretical Basis

2.1 Cryptography

The word cryptography comes from Greek, namely "kryptós" which means hidden and "gráphein" which means writing. So cryptography can be interpreted as "hidden writing". According to the RFC (Request for Comments), cryptography is a mathematical science that deals with the transformation of data to hide its meaning, prevent its unauthorized modification, or prevent its unauthorized use. If conversion can be translated, then crypto can also be interpreted as the process of returning encrypted data into an understandable form [6], [7]. In other words, cryptography can be interpreted as a data protection process in a broad sense [8].

2.2 *Discrete Cosine Transform* (DCT)

The DCT (Discrete Cosine Transform) algorithm transformation method is a technique used in signal processing and data compression. DCT converts signals or data in the spatial domain into the frequency domain, where the frequency information is represented by DCT coefficients. The DCT algorithm is often used in image processing and data compression applications, especially in the JPEG compression format [9], [10].

The DCT algorithm operates by dividing data into smaller pixel blocks, generally 8x8 pixels in size. Each pixel block is then transformed using a DCT transformation, where each pixel value in the block is converted into a DCT coefficient that represents the frequency contribution to that block. The resulting DCT coefficient has the ability to effectively compress high-frequency energy in a pixel block [11].

3. Research Methods

The research methodology is carried out to seek information systematically using scientific methodsand clear sources. In the course of this research is expected to provide useful results for users [12].

Based on the methodology used in this study, a flow of research work method activities was formed,namely as follows:

1. Preparation
   The initial stage in conducting research begins with compiling the background of the problem, which is then followed by formulating the problem to be solved and determining the benefits of the research. Once that stage is complete, the author will determine how to encode the image so that it cannot be accessed by third parties.
2. Theory Study
   At this stage, the authors collect various theories as research support. These theories include image security, the discrete cosine transform algorithm, and the use of Visual Basic. Theoretical sourcescome from library books, scientific journals, and various sources on the internet. This theory collectionaims to provide a strong and in-depth knowledge base in research development.
3. Theory Collection
   The Library Research stage is an important step in research. This process involves searching for information sources such as books, journals and internet sites that are relevant to the problem you wantto solve. By conducting literature studies, the author can obtain strong references and appropriate methods to support research and enrich the theoretical foundation in this thesis.
4. Design
   At this stage, the author carried out manual calculations using the discrete cosine transform algorithm method. After the calculations are complete, the author designs a system that will be built based on the results of these calculations. This process involves making detailed designs and plans for the implementation of the system to be developed.
5. Testing and Implementation
   a. At this stage, the discrete cosine transform algorithm is implemented into the Microsoft Visual Basic .NET 2010 programming language. Next, testing is carried out to ensure the system functions according to the design and specifications that have been determined previously. This stage is important because it converts the algorithm into executable code and ensures the system is ready foruse by end users.
   b. Do and run the program to see the results of the encrypted image.

4. System Planning

In designing this image application the author uses the DCT algorithm method to solve the problem. This design uses a flowchart to find out how the encryption and decryption process will be designed in a system [8].

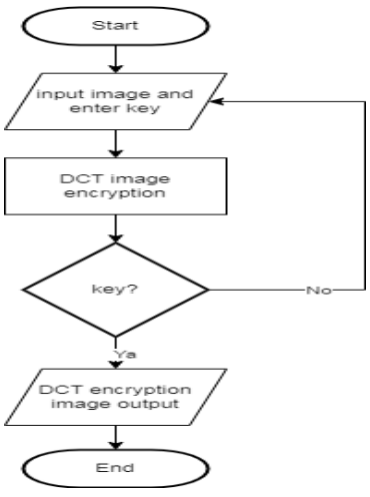

Fig.1: Flowchart Enkripsi

In Figure 1. several processes will be carried out in the encryption process, namely [8], [10]:

1. Start
2. Insert original image and key
3. Carry out the Discrete Cosine Transform encryption process
4. If the key does not meet the requirements, then return to image and key input. If you meet therequirements, you can proceed to the next stage.
5. The image has been successfully encrypted using the DCT method
6. Done.

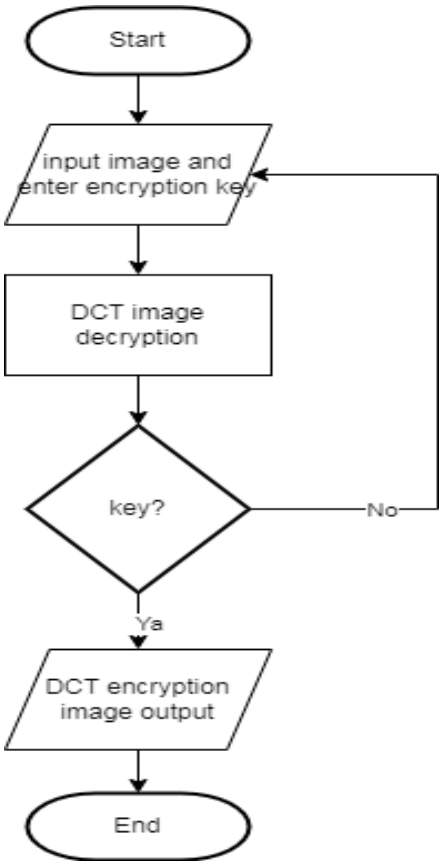

Fig. 2: Flowchart Dekripsi

In Figure 2, several processes will be carried out in the decryption process, namely:

1. Start
2. Enter the encryption image and key
3. Carry out the DCT decryption process
4. If the key does not meet the requirements, then return to image and key input. If you meet therequirements, you can proceed to the next stage.
5. The image has been successfully decrypted using the DCT method
6. Done.

5. System Planning

The design is a description of the system and working methods that the author designed, where in designing this image security system the author used the DCT (Discrete Cosine Transform) algorithm to solve the problem. In this research the author used UML, and the explanation can be seen in the nextsub-chapter [6], [7].

1. Use Case Diagrams

Use Case Diagrams or Use Case diagrams are modeling to describe the behavior of the system that will be created. This diagram describes an interaction between one or more actors and the system to be created. The process that will be described will take place in a structured manner. The following is an illustration of the use case diagram for the system to be built.

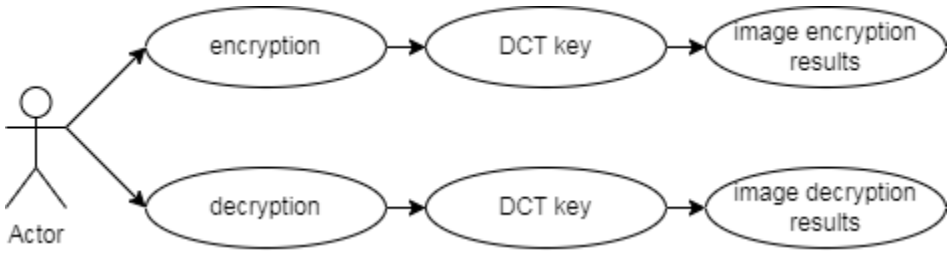

Fig. 3: Use Case

Figure 3. shows a cryptographic system use case diagram for image coding.
This Use Case explains how the encryption and decryption process uses the DCT algorithm method. Encryption which produces a password image and decryption which produces the original image to encode the image that you want to keep confidential.

5. Results And Discussion

5.1 Image Encryption Calculation Using the DCT AlgorithmSelected image:

Fig. 4: Encryption

Figure 4 is an image that will be encrypted, to find the value of the pixels by using additional Photoshop software.

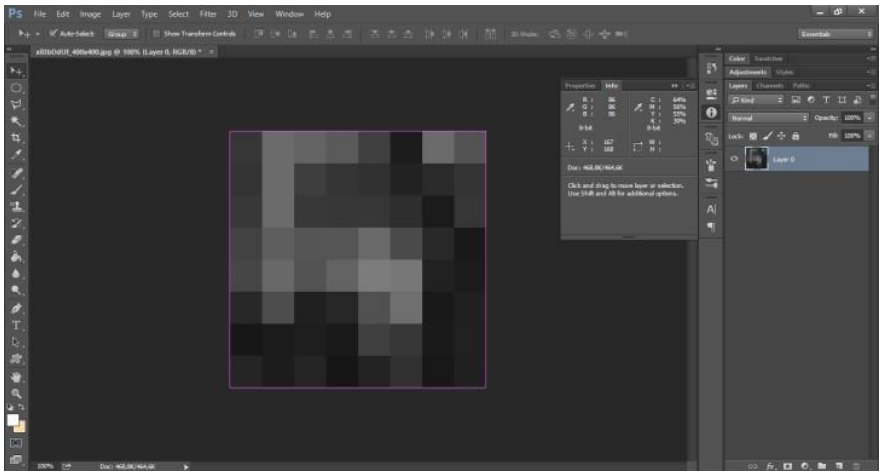

Fig. 5: Matrix

6. Testing

The main form is the form used to call the encryption and decryption forms. The following is a designof the main form that will be built:

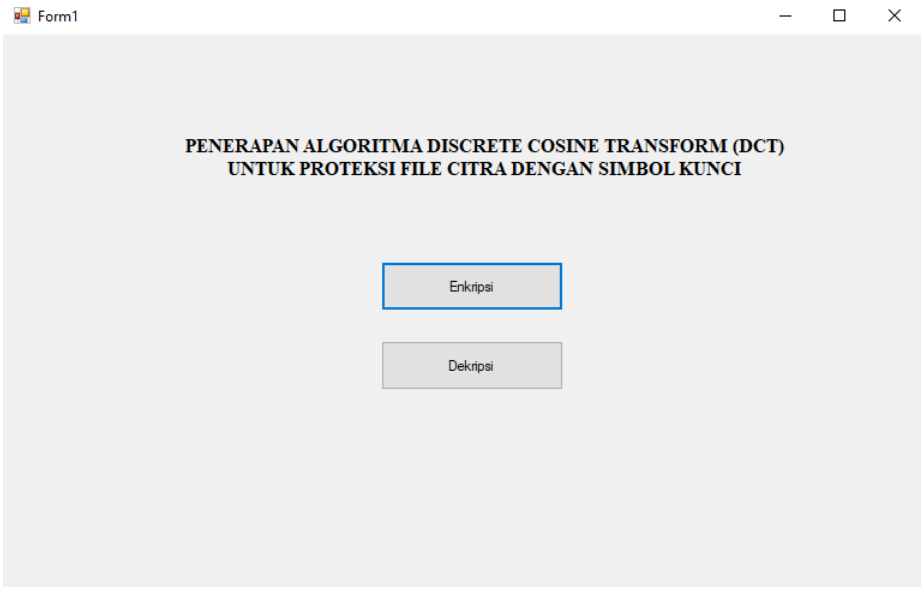

Fig. 6: Home

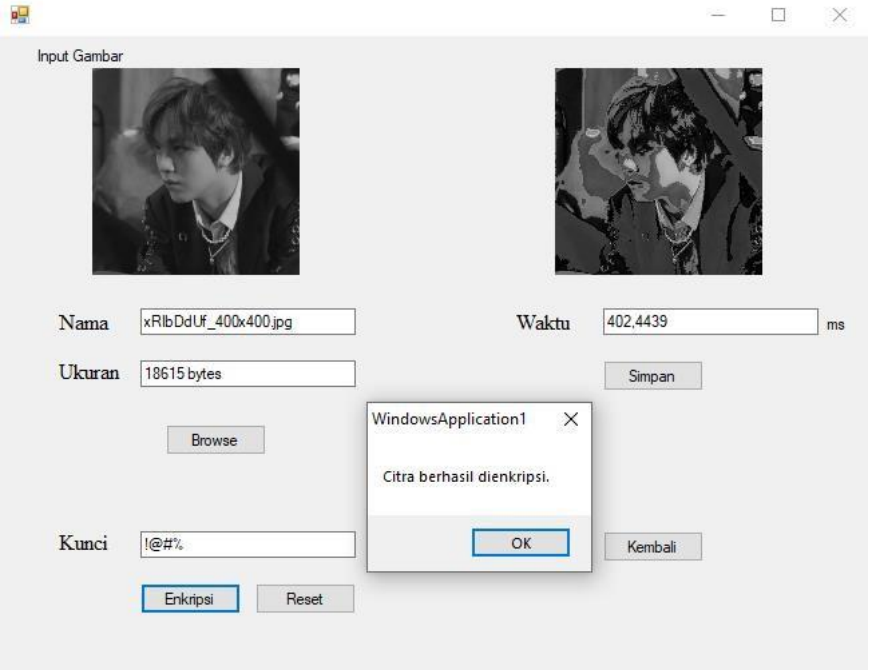

Fig. 7: Menu Encryption

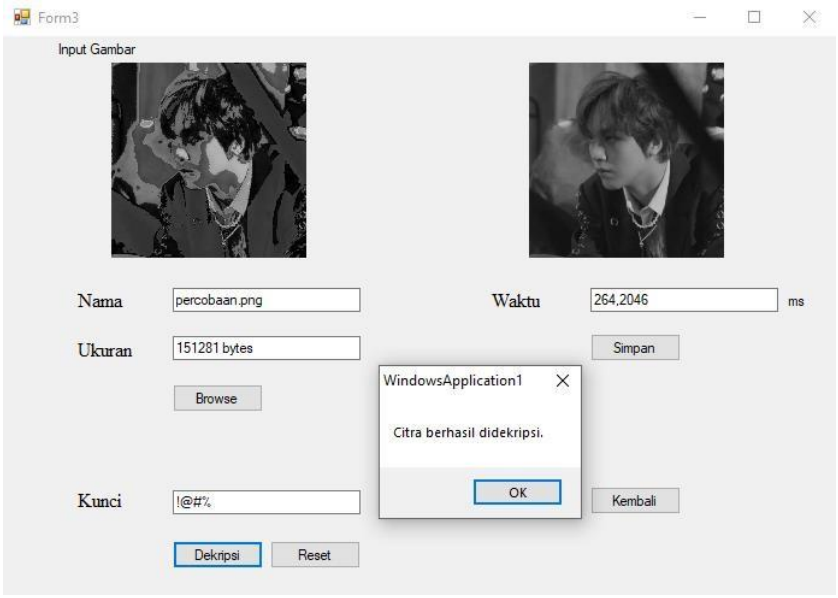

Fig. 7: Menu Decryption

7. Conclution

This research succeeded in implementing the Discrete Cosine Transform (DCT) algorithm to protect image files with symbol keys. The results show that the use of symbol keys can improve the security and integrity of image files, making them accessible only to users who have the correct key. This is an important step in improving image file protection and securing visual information from unauthorized access.

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