A Comparative Review on Data Hiding Schemes

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ABSTRACT

Data hiding is a technique used to protect confidential information. The aim of a particular data hiding scheme is to make a more secure and robust method of information exchange so that confidential and private data can be protected against attacks and illegal access. The aim of this paper is to review on different data hiding schemes, covering the decoding, decrypting and extracting schemes. This paper also highlighted three major schemes that are widely used in research and real practice. The discussion include findings on the most recent work on decryption schemes.

Keywords:
Data hiding.
Decoding scheme
Decrypting scheme
Extracting scheme

1. INTRODUCTION

The rapid growth of the Internet communication calls for a specialization on security of computers network. It is imperative to protect the confidentiality and integrity of the data transmitted against unauthorized access [1]. Security and privacy issues of the transmitted data have also become an important concern in multimedia applications. This has led to the introduction of numerous novel schemes in the field of steganography and cryptography with the goals of improving security, reliability, and efficiency [2].

For instance [3] stated that the improvement in term of authentication schemes brought to smart card more protected and safe have been proposed. Evidently various schemes had suggested to overcome the current situation where the deficiency of secured. Usually previous researcher belive their scheme could endure numerous attacks [3]. Unfortunately not all the previous scheme could be withstand the attack. Only the capable schemes can be dealing.

In general, there are three main methods of information security being used; steganography, cryptography and watermarking. Steganography is a process hiding a secret message with cover message and transmit to recipient without others parties realizes the existing hidden message. It can be applied in images, text, audio, and video [4]. It is known as process to conceal secret message intended for invisible communication. In order to safely transmit information, steganography technique can be used to prevent the knowledge of the existence of secret communication between sender and receiver [5].

Meanwhile, cryptography is essentially secret writing. A cipher is a secret method of writing, where by plaintext is transformed into a cipher text. In cryptography, it is easy to found that the text consist of secret information. Cryptography shows the way to protect the content of information where originator of message is encrypted using key and shares the secret information. Receiver extracts the secret information using (key) decryption algorithm. This key can be either symmetric or asymmetric. Cryptography techniques are based on rendering the content of a message garbled to unauthorized people [6].
Then, in watermarking, data are hidden to convey some information about the cover medium such as ownership and copyright. This is carried out by inserting text or logo in digital media such as image, audio and video. The three methods of information security is similar in the sense that implementation begin with securing process to cover the important data in order to hide the hidden information or securing the availability data.

In the previous research, the securing processes are mostly in the form of encoding, encrypting and embedding process. Afterwards, the last implementation mostly is how to generate the secured data based on data before the securing process. This includes decoding, decrypting, and extracting the secret text or messages.

The remainder of this paper is organized as follows. Section 2 presents the review category of the data hiding schemes, Section 3 presents the trends of the data hiding interpreted schemes, Section 4 presents the preferred data hiding schemes and finally Section 5 discusses the reviews and concludes the paper.

2. REVIEW CATEGORY

This paper reviews different types of data hiding schemes that consist views from decoding, decrypting and extracting process. Information decoding is the process to convert a cyphered text back to plain-text while decrypting is taking an encrypted text and converting it back into original text. Meanwhile, extracting is the process of converting the cipher text into the plain text by using a secret key. Table 1 shows the classification of schemes based on the literature from the last decade.

| Type               | Schemes                                                                 | Symbol Representation |
|--------------------|-------------------------------------------------------------------------|-----------------------|
| **Decoding Schemes** | Neural-based Poetry Generation [4]                                       | neuralB               |
|                    | Arbitrary Algorithm Encryption [5]                                       | AAE                   |
|                    | Encoding Hiding the Message into An Excel Graph [6]                     | EXCELg                |
|                    | RJDA Algorithm [7]                                                      | RJDA                  |
|                    | Alphabet Index Matrix (English & Malayalam) [8]                         | ALPHAIAM              |
|                    | Encoding of Hindi Text [9]                                              | EnHindiT               |
|                    | Visual Cryptography Schemes [10]                                         | VCryptS               |
|                    | Homomorphic Encryption Scheme [11]                                       | HES                   |
|                    | A Boots Trappable Encryption Scheme [12]                                | trapEnS               |
|                    | Huffman Coding Algorithm [13]                                           | HCA                   |
|                    | Elliptic Curve CryptographyEcc [14]                                     | ECC                   |
|                    | DWT Domain of A Carrier Image [15]                                       | DWT                   |
|                    | Watermark [16]                                                          | Ws                    |
|                    | Encapsulation Schemes [17]                                              | ENCAPs                |
|                    | Hybrid Scheme [18],[21] [18]                                            | HS                    |
|                    | Advance Encryption Standard (AES)[22]-[25]                             | AES                   |
|                    | Rivest-Shamir-Adlema Algorithm (RSA)[11],[18],[19],[26]                 | RSA                   |
|                    | Data Encryption Standard (DES) [23],[27]                                | DES                   |
|                    | LSB [5],[12],[28]                                                       | LSB                   |
|                    | Homomorphic Encryption Scheme [21],[22],[26]                            | HES                   |
|                    | Conventional Encryption Algorithms Blowfish [23]                       | CEABW                 |
|                    | Binary RSA Encryption Algorithm (BREA) [19]                             | BREA                  |
|                    | Symmetric Key Encryption [23],[29],[30]                                 | SKE                   |
|                    | RDH Schemes [31]                                                        | RDH                   |
|                    | Huffman Encoding Algorithm [28]                                         | HEA                   |
|                    | Transposition Cryptography Algorithm [32]                              | TCA                   |
|                    | A Boots trappable Encryption Scheme [12]                                | BTRS                  |
|                    | ECC Decryption [14]                                                    | ECC                   |
|                    | ECR (Encryption with Cover Text and Reordering) [33]                     | ECR                   |
|                    | STC (Syndrome-Trellis Code) Scheme [34]                                 | STC                   |
|                    | Compression Algorithm [35]                                             | CA                    |
|                    | Random Character Scheme [36]                                            | RC                    |
|                    | Hide Text-In-Text Messages [37]                                         | HTTM                  |
|                    | Web Text Extraction [38]                                                | WTE                   |
|                    | Extract The Chinese Text [38]                                           | ECT                   |
|                    | Hybrid Algorithm [39]                                                  | HA                    |
| **Decrypting Scheme** | R DH Scheme [40]                                                       | RDH                   |
|                    | Blowfish Algorithm [40]                                                 | BWA                   |
|                    | Bwt (Burrows Wheeler Transform)                                         | BWT                   |
|                    | HHK Encoding (Hindi Hexadecimal Modified Katapayadi Encoding) Scheme [41]| HHK                   |
|                    | Advanced Data Encrypt (AES) [42]                                        | AES                   |
|                    | Data Encryption Standard (DES) [36]                                     | DES                   |
|                    | Rivest-Shamir-Adleman Algorithm [43]                                    | RSA                   |
|                    | L-R Schemes [44]                                                       | L-R                   |
|                    | Simple Text Embedding Scheme With Reversibility [43]                    | STESR                 |

Table 1. Classification of Schemes
Based on Table 1, the three types of schemes criteria are supplemented with symbol representation. Firstly, there are 14 decoding schemes available listed as a result of relevant search studies, for example Neural-based poetry generation such as neuralB, AAE, EXCELG, RJDA, ALPHAiM, EnHindiT, VcrypS, HES, trapEnS, HCA, ECC, DWT, Ws, and ENCAPs. Secondly, there are 15 decrypting schemes available listed as a result of relevant search studies, for example the HS, AES, RSA, DES, LSB, HES, CEABW, BREA, SKE, RDH, HEA, TC, BTRS, EE, and ECR. As for the extracting scheme, there are 16 schemes listed, for instance STC, CA, RC, HTTM, WTE, ECT, HA, RDH, BWA, BWR, HHK Encoding, AES, DES, RSA, L-R Schemes, and STESR.

3. TRENDS OF DATA HIDING SCHEMES

Once the data hiding schemes in decoding, decrypting and extracting have been identified, this paper reviews the implementation trend based on several years of research effort on data hiding. The trends are measured based on the most frequently used schemes in the respective categories.

3.1. Decoding Schemes

Figure 2 illustrates the number of literature specific to decoding schemes since 2001 until 2017. The most noticeable thing about Figure 1 is that, the number of studies on decoding schemes is moderate from the beginning until now. It is not applicable to choose the most used decoding schemes because each schemes type have only one contribution for each studies throughout the last decade. The trends also showed that new schemes are introduced almost on yearly basis. The literature also showed that there are substantial number of new schemes proposed under the decoding schemes. The research on encoding schemes begin from ENCAPs (2001), Ws (2006), DWT (2007), HCA (2010), ECC (2010), HES (2011), trapEnS (2011), VcrypS (2012), EnHindiT(2014), ALPHAiM (2015), AAE (2016), EXCELG (2016), RJDA (2016), and finally the latest scheme called neuralB (2017).

Furthermore, Figure 1 demonstrates that the research on decoding schemes became aggressive during 2016, where three contributions of study findings were made throughout that year. Next was back in 2010 and 2011 when HCA, ECC, HES, and trapEnS were introduced. Other years showed consistent but small contribution made every year, thus indicating that the studies in terms of decoding schemes are very much lacking.

3.2. Decrypting Schemes

Decrypting schemes consists of 15 schemes type as listed in Table 1. Figure 2 shows the research pattern in decrypting schemes within 10 years since 2008. In this figure, the development of schemes in research is growing since 2014, perhaps the awareness of the importance of study schemes is begun. Starting in 2014, the development of schemes is increasingly rising with various research schemes produced every
Moving towards 2017, the figure shows that the research trend is proposing a new scheme each year, rather than improving the performance of the schemes available from the literature. The most aggressive year is 2016 with the introduction of 11 different new schemes being proposed. Nonetheless, the following year showed a sudden decline in research on decrypting scheme.

3.3. Extracting Schemes
The extracting schemes consist of 16 schemes type as listed in Table 1. Figure 2 shows that introduction of existing schemes are moderate since 2011 throughout the last 10 years. Based on this figure, extracting schemes were first introduced in 2011 but not work has contributing to the area until 2014. In 2014, the development of schemes in research is growing gradually; perhaps due to the awareness of the importance of study schemes. There were seven types of schemes proposed in 2014. 2015 saw a decline in the study but increased again in 2016. Referring to the graph, it can be concluded that a new extracting scheme is proposed every year.
The lack of research in related schemes makes it difficult to identify the schemes that are ranked top among all the 16 underlying schemes as listed. Based on the graph, most aggressive year of research on extracting scheme was back in 2014. The year 2016 is in the second place followed by the year 2015, with 4 research studies. It is clear that the year was between years of non-aggressive study. Based on the pattern showed by Figure 3, the study on extracting schemes is not encouraging. The most widely used schemes are as CA, RC, HTTM, WTE, ECT, and HA as compared to other schemes.

4. PREFERRED DATA HIDING SCHEMES

Given the trends of research on data hiding schemes in the last decade, Figure 4 to Figure 6 shows the preference on data hiding interpreted schemes based on literature review in previous section. First, Figure 4 shows two groups of patterns, where the first group is among the widely used aspects, the second group is among the fewest groups. The figure also show a small gap of difference between each schemes type.

Symmetric Key Encryption (SKE) techniques are used to provide security at higher levels. The main advantage of SKE is that management of the key is very simple and easy since only one key is needed. SKE can take input data in sentence format, which provides a very much secure system with less vulnerability to cryptanalyst attacks. Utilizing a combination of the AES schemes of encryption/decryption along with visual cryptography, one can ensure the highest form of security. The AES is substantial secure through its variable key and structure. SKE and AES became the main schemes option to researcher compared with other schemes. But for others schemes types can be determine as the most rarely used.

Finally, Figure 6 shows the preferred extracting schemes from the literature. The findings showed that majority of the previous research used CA, RC, HTTM, WTE, and ECT and HA (9%) as compared to STC, RDH, BWA, BWT, HHK, AES, DES, RSA, L-R and STESR, which are 5% each. The figure also showed that the development of schemes are quite slow based on findings of the literature review results.
5. DISCUSSION AND CONCLUSIONS

This paper reviews interpreted data hiding schemes used in data in recent years, which are decoding, decrypting and extracting schemes between 2001 until 2017. The most noticeable finding for decoding schemes is that the number of studies is moderate throughout the decade. In general, only one algorithm is proposed in each year. Furthermore, the study demonstrates that the research becoming aggressive beginning 2016 with three contributions in the year.

As for the decrypting schemes, the most widely used in decryption schemes with the highest number of studies in data hiding are shown in Figure 7 with 15% SKE, 15% AES, 13% RSA, and 13% HES. Meanwhile for the year of aggressive research is occurs in 2016 with 15 studies.

![Figure 7. Highest decrypting schemes used](image)

Finally, for the extracting scheme, the highest number of studies in data hiding is shown in Figure 8, which include the compression algorithm (CA), random character scheme (RC), hide text-in-text messages (HTTM), web text extraction (WTE), extract the Chinese text (ECT) and hybrid algorithm (HA). All these schemes are sharing the same amount of literature studies finding. Therefore it makes these schemes is the frequently used group of schemes. Meanwhile, the research on this scheme was aggressive in 2014 with 7 newly proposed extracting schemes.

![Figure 8. Highest extracting schemes used](image)

As the conclusion, this review is a useful evaluation for researcher to identify the most widely-used data hiding interpretation and enable the researchers to choose the trend of interest in presenting a new encoding, decrypting or extracting schemes.

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