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HYPOTHESES

RESEARCH METHODOLOGY

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- Sharma T., Kwatra, G. (2008) Effectiveness of Social Advertising: A Study of Selected Campaigns, Corporate Social Responsibility, Edited by David Crowther & Nicholas Capaldi, Ashgate Research Companion to Corporate Social Responsibility, Chapter 15, pp 287-303.

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- Schemenner, R.W., Huber, J.C. and Cook, R.L. (1987), "Geographic Differences and the Location of New Manufacturing Facilities," Journal of Urban Economics, Vol. 21, No. 1, pp. 83-104.

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AN ENHANCE SECURITY OF PLAYFAIR CIPHER SUBSTITUTION USING A SIMPLE COLUMNAR TRANSPOSITION TECHNIQUE WITH MULTIPLE ROUNDS (SCTTMR)

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ABSTRACT

In this paper, we have made use of a traditional Playfair cipher technique with Simple Columnar Transposition Technique with Multiple Rounds (SCTTMR). After applying SCTTMR we got the actual cipher. Our main focus is on the Playfair Cipher, its advantages and disadvantages. Finally, we have proposed methods to enhance the Playfair cipher for more secure and efficient cryptography which provide difficulty in identifying individual diagram.

KEYWORDS

Playfair Cipher, Simple Columnar Transposition Technique, SCTTMR, Substitution Cipher.

INTRODUCTION

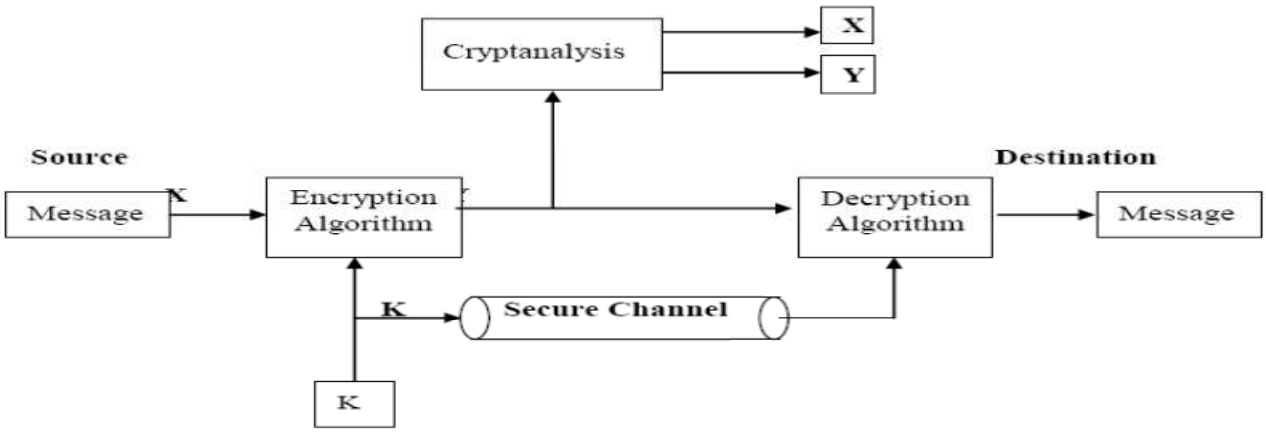
From the beginning of human society, people have been very much concerned with the privacy of their communications. In contemporary societies, the growing use of computer has made the security of digital files of outmost concern against those users with malevolent intentions, especially on the internet. To protect the digital files either in the computer or in the transmission [2],

Cryptography is the science which deals with all the means and methods for converting an intelligible message into an unintelligible or secret form and for reconverting the secret form into the intelligible message by a direct reversal of the steps used in the original process [1]. Even though encryption is very powerful among these two, the cryptanalysts are very intelligent and they were working day and night to break the ciphers. To make a stronger cipher it is recommended that to use: More stronger and complicated encryption algorithms with more number of rounds, Keys with more number of bits (Longer keys), secure transmission of keys [3].

CRYPTOGRAPHY SCIENCE

The word is derived from the Greek crypto's, meaning hidden. Cryptography is a science of devising methods that allow information to be send in a secure from in such a way that the only person to able retrieve this information is the intended recipient. Encryption is based on algorithms that scramble information (Plaintext or Clear Text) into unreadable (Cipher Text) form. Decryption is the process of restoring the scrambled information to its original form. Cryptography includes techniques such as microdots, merging words with images, and other ways to hide information in storage or transit. Cryptographic systems are used to provide privacy and authentication in computer and communication systems. Modern cryptography intersects the disciplines of mathematics, computer science, and electrical engineering. Applications of cryptography include ATM cards, computer passwords, and electronic commerce. [9]

FIGURE 1: CRYPTOGRAPHIC SYSTEM



All Cryptographic algorithms are based on two general principles: substitution, in which each element in the plaintext (bit, letter, and group of bits or letters) is mapped into another element and in transposition, the elements of the plaintext have simply been re-arranged in different order; their position with relation to each other have been changed. [4]

CLASSIC CRYPTOGRAPHY

The earliest forms of secret writing required little more than local pen and paper analogs, as most people could not read. More literacy, or literate opponents, required actual cryptography. The main classical cipher types are transposition ciphers, which rearrange the order of letters in a message (e.g., 'hello world' becomes 'ehlol owrdl' in a trivially simple rearrangement scheme), and substitution ciphers, which systematically replace letters or groups of letters with other letters or groups of letters (e.g., 'fly at once' becomes 'gmz bu podf' by replacing each letter with the one following it in the Latin alphabet). [9]

- **Substitution Technique**

In cryptography, a substitution cipher is a method of encryption by which units of plaintext are replaced with cipher text according to a regular system; the "units" may be single letters (the most common), pairs of letters, triplets of letters, mixtures of the above, and so forth. The receiver deciphers the text by performing an inverse substitution.

There are a number of different types of substitution cipher available like Caesar Cipher, Mono-alphabetic Cipher, Homophonic Substitution Cipher, Polygram Substitution Cipher, Polyalphabetic Substitution Cipher, Playfair Cipher and Hill Cipher. [9]

- **Transposition Technique**

In cryptography, a transposition cipher is a method of encryption by which the positions held by units of plaintext (which are commonly characters or groups of characters) are shifted according to a regular system, so that the cipher text constitutes a permutation of the plaintext. That is, the order of the units is changed. Mathematically a bijective function is used on the characters' positions to encrypt and an inverse function to decrypt.

There are a number of different types of Transposition cipher available like Rail Fence Cipher, Simple Columnar Transposition, Vernam Cipher, Double transposition, Myszkowski Transposition, Disrupted Transposition. [9]

PLAYFAIR CIPHER

The Playfair cipher or Playfair square is a manual symmetric encryption technique and was the first literal digraph substitution cipher. The scheme was invented in 1854 by Charles Wheatstone, but bears the name of Lord Playfair who promoted the use of the cipher. The technique encrypts pairs of letters (digraphs), instead of single letters as in the simple substitution cipher and rather more complex Vigenère cipher systems then in use. The Playfair is thus significantly harder to break since the frequency analysis used for simple substitution ciphers does not work with it. Frequency analysis can still be undertaken, but on the 600 possible digraphs rather than the 26 possible monographs. The frequency analysis of digraphs is possible, but considerably more difficult – and it generally requires a much larger cipher text in order to be useful. [8]

The Playfair cipher uses a 5 by 5 table containing a key word or phrase. Memorization of the keyword and 4 simple rules was all that was required to create the 5 by 5 table and use the cipher.

To generate the key table, one would first fill in the spaces in the table with the letters of the keyword (dropping any duplicate letters), then fill the remaining spaces with the rest of the letters of the alphabet in order (usually omitting "Q" to reduce the alphabet to fit; other versions put both "I" and "J" in the same space). The key can be written in the top rows of the table, from left to right, or in some other pattern, such as a spiral beginning in the upper-left-hand corner and ending in the center. The keyword together with the conventions for filling in the 5 by 5 table constitute the cipher key.[8]

To encrypt a message, one would break the message into digraphs (groups of 2 letters) such that, for example, "Hello World" becomes "HE LL OW OR LD", and map them out on the key table. If needed, append a "Z" to complete the final digraph. The two letters of the digraph are considered as the opposite corners of a rectangle in the key table. Note the relative position of the corners of this rectangle. Then apply the following 4 rules, in order, to each pair of letters in the plaintext:

1. If both letters are the same, add an "X" after the first letter. Encrypt the new pair and continue. Some variants of Playfair use "Q" instead of "X", but any uncommon monograph will do.
2. If the letters appear on the same row of your table, replace them with the letters to their immediate right respectively.
3. If the letters appear on the same column of your table, replace them with the letters immediately below respectively.
4. If the letters are not on the same row or column, replace them with the letters on the same row respectively but at the other pair of corners of the rectangle defined by the original pair. The order is important – the first letter of the encrypted pair is the one that lies on the same row as the first letter of the plaintext pair. [8]

To decrypt, use the INVERSE (opposite) of the last 3 rules, and the 1st as-is (dropping any extra "X"s (or "Q"s) that don't make sense in the final message when finished).

Example:-

Key is "Playfair example" the table becomes

TABLE 1

P	L	A	Y	F
I/J	R	E	X	M
B	C	D	G	H
K	N	O	Q	S
T	U	V	W	Z

Message is "Hide the gold in the tree stump":

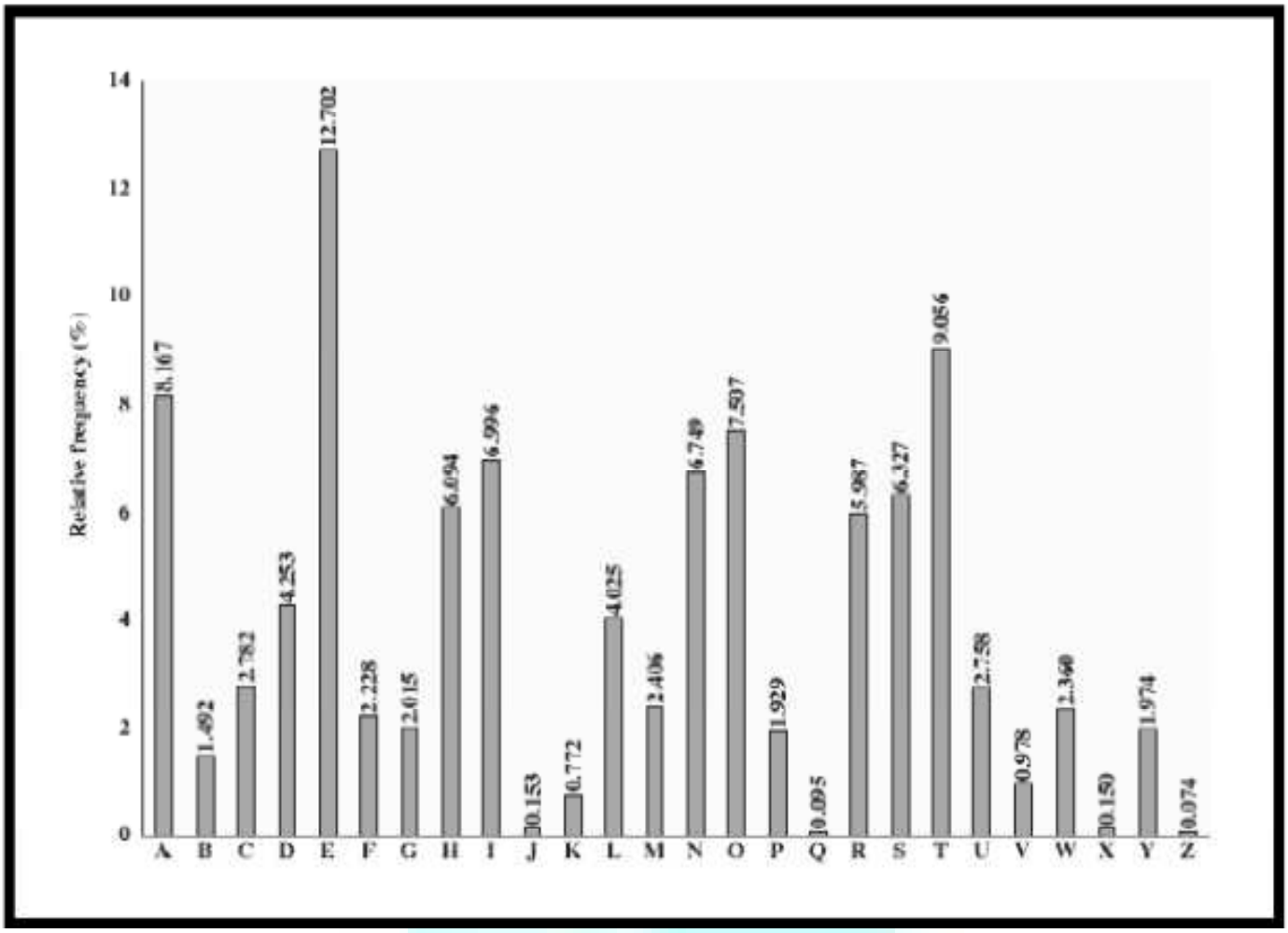
To encrypt a message, one would break the message into digraphs (groups of 2 letters) such that, becomes “HI DE TH EG OL DI NT HE TR EX ES TU MP”

Thus the Message (Plain Text) "Hide the gold in the tree stump" becomes "BMNDZBXDKYBEJVDMUIXMMNUVIF".

PRAPOSED PLAYFAIR CIPHER

From the Figure-2, we can notice that, the frequency of the letter I is 6.996 and J is 0.153. These are widely used letters in normal text and considered as a single letter in the Playfair Table-I. It may leads to the confusion at the receiving side whether to use I / J for decryption. [4]

FIGURE 2: RELATIVE FREQUENCY OF LETTERS IN ENGLISH TEXT



To reduce the ambiguity at the receiving end, it is better to combine the less frequency letters as a one letter in the Table-I rather than using I/J as single letter. So, that the less frequency letters appears very rare in the text and hence we can reduce the confusion level while decrypting at the receiving end. For this we recommend to combine Q (0.095) and Z (0.074) as a single letter in the Playfair Table 2.

For constructing the Table-2 we rearranged the 26 letters in 5X5 matrix by considering the frequency of letters from the Figure-2. Use the keyword and fill the keyword characters from left to right and top to bottom in the matrix, then fill the least frequency letters Q/Z count as one letter, after that fill the remainder of the matrix with the remaining letters in alphabetic order. [4]

TABLE 2

A	B	C	D	E
F	G	H	I	J
K	L	M	N	O
P	Q/Z	R	S	T
U	V	W	X	Y

In above metrics we apply a Simple Columnar Transposition Technique with Multiple Rounds.

HOW TO APPLY MULTIPLE ROUNDS

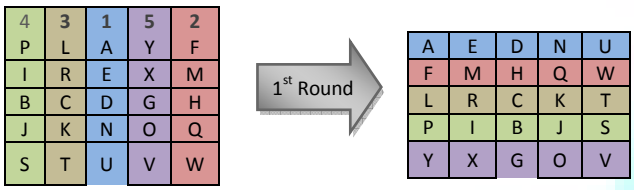
1. Using the keyword we arrange the keyword character from left to right and fill the 5X5 matrices with remaining character.
2. We mark the first row of matrices with 1, 2,3,4,5 according the dictionary order.
3. Rearranged the first marked column in first row which makes the first round.
4. In next round we mark the second row according to step 2.
5. Then fallow the steps 2 to 4.
6. Follow the steps 2 to 5 for 5 round.

Example

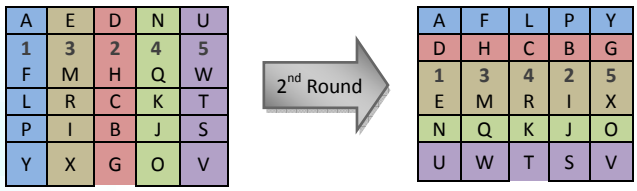
Key is "Playfair example" the table becomes

P	L	A	Y	F
I	R	E	X	M
B	C	D	G	H
J	K	N	O	Q/Z
S	T	U	V	W

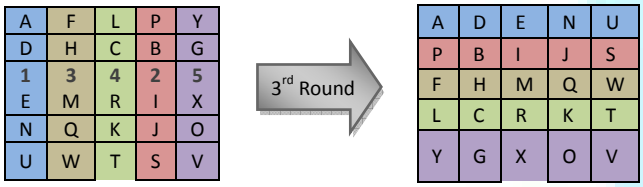
1st Round



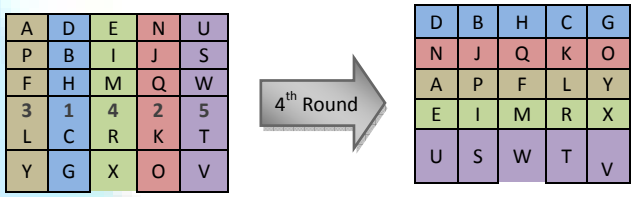
2nd Round



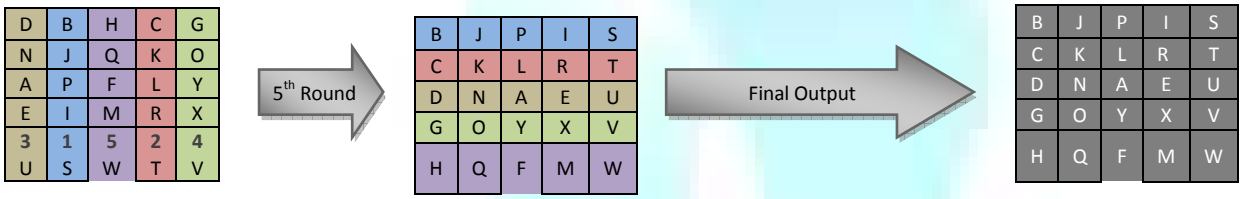
3rd Round



4th Round



5th Round



Message is "Hide the gold in the tree stump":
In this Message (Plain Text) we apply all rules of existing Playfair cipher in section 4 of this paper.
"HI DE TH EG OL DI NT HE TR EX ES TU MP" becomes
"MBNUCWDXYKEBUKMDCTXMUIUVFI".

RESULT

With our enhanced Playfair Cipher Technique with SCTTMR is observed that, it can be used for the plaintext with Multiple Rounds which makes the encryption complex and difficult to identify individual diagram. It is also noticed that, by combining less frequency character 'Q/Z' instead of 'I/J' the ambiguity at receiving end will be reduced.

ADVANTAGE OF PRAPOSED PLAYFAIR TECHNIQUE

- Identification of individual diagrams is difficult.
- Frequency analysis difficult.

CONCLUSION

In this paper we have combine two different approach Substitution and Transposition Technique including Simple Columnar Transposition Technique with Multiple Rounds (SCTTMR). To solve the de merits in Playfair we have proposed and explained methods with examples. For this, we provide multiple rounds which make the complex encryption. Finally we named it as: '**An Enhance Security of Playfair Cipher Substitution Using a Simple Columnar Transposition Technique with Multiple Rounds (SCTTMR)** '. The present version of the play fair technique will consider only text in English for conversion; we can also extend it to numbers and symbols for wide range of use.

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