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Cryptography Involving Musical Notes and Genetic Algorithm

Amit Kumar Mandle, Varsha Namdeo

Abstract: ***The object of this paper is to established a symmetric key algorithm for encryption and decryption of a message involving musical notes (India and Western) and genetic algorithm. This algorithm does not only encrypt the message but it also reduces the chance of deciphering from hackers.***

Keywords: Encryption, Decryption, Musical Notes, Genetic Algorithm.

I. INTRODUCTION

In today's life communication has become a very important aspect. Cryptography is the way to secure the information. Therefore, in transferring the data security plays an important role. In real-world applications, the digital information has been applied to many areas. By employing various techniques, we can hide the information from unauthorized users. So by encryption technique, we transform the data into such form which can be understandable only authorized users. For privacy purpose and unauthenticated user cannot modified at receiver end, we need to hide the information. We have already various encryption and decryption algorithms for encrypting and decrypting the data. [1, 2, 5]. Beside them here we introduce a new technique for encryption and decryption of a message involving musical note and genetic algorithms.

MUSICAL NOTE:

There are seven basic keys in any musical note. The seven keys Sa, Re, Ga, Ma, Pa, Dha, Ni are reside in Indian traditional music system, while western music is made by seven keys C, D, E, F, G, A, B. Music is developed by using these as the basic notes. For encrypting and decrypting of a message, we are not widely used musical notes. Therefore proposed algorithm involving musical notes and genetic algorithm will be difficult for any hacker to break the code.

In the Indian music note seven music notes Sa, Re, Ga, Ma, Pa, Dha, Ni are called SuddaSwar. The representation of sound with symbols is known as musical notation. Using these symbols any music can be represented.

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***** Correspondence Author
Amit Kumar Mandle*, Research Scholar in the Department of Computer Applications (MCA) at SRK University, Bhopal, India.
Varsha Namdeo, Associate Professor in the Department of Computer Science and Engineering at SRK University, Bhopal, India.

C, D, E, F, G, A and B are the basic notes in western notes in western music. Symbol ' – ' denote a pause in the music system.

GENETIC ALGORITHM:

An algorithm which is based on the mechanics of natural selection and natural genetics is known as Genetic Algorithm. The operations which are based on Bio-inspired operators (Selection, Crossover and Mutation) are contained by Genetic Algorithms. In this paper we will use crossover and mutation operations.

In crossover process we take two chromosomes or two attributes, on taking some part of first chromosomes and rest from second chromosomes the resultant chromosome (new) is formed. In genetic algorithm there are various crossover operation i.e. Single-Point Crossover, Two- Point Crossover and Multipoint Crossover etc. In this paper we will use two point crossover operations. In this operation, by taking two points, we divide selected chromosome into three parts. After that one part of each chromosomes are swapped and form a new chromosome.

To create genetic diversity from one generation to its successive generation biological mutation is used. Therefore mutation is a genetic operation. These are various mutation techniques i.e. flipping of bit, inversion of bit, swapping of bits etc. In this paper we will use swapping of the bits. In this type of mutation select two positions on the chromosome at random and interchange the values. In the permutation based encoding, this operation is common.

II. LITERATURE REVIEW:

There are various researchers were introduced the cryptographic techniques using musical notes and Genetic algorithms time to time. Some works are as follows:

(1) Kumar Chandan et.al. [3] Proposed a genetic algorithm based symmetric key musical cryptography algorithm to obtain an optimal sequence of musical patterns as a cipher message.

(2) Surya S et.al. [6]; discussed on genetic algorithm based symmetric key musical generation is used to obtain the optimal solution.

(3) Patil Shraddali N. Et.al [4]: proposed an algorithm for encrypting the message using musical notes by genetic algorithm.

III. METHODOLOGY:

(1) To encrypt the message firstly we will use genetic algorithm, which gives the intermediate cipher and then apply the Indian traditional music notes, finally after applying western music notes. We get the cipher text.

(2) To decrypt the message firstly we will use western music notes and Indian traditional music notes, after that applying genetic algorithm we get the original plain text.

IV. ALGORITHM:

Table – 1Conversion to Indian Musical Notes

Alphabet/ Number	Music Conversion	Alphabet / Number	Music Conversion	Alphabet / Number	Music Conversion
A	NI	N	SADHA	0	NISA
B	DHA	O	NIDHA	1	DHAGA
C	PA	P	DHAPA	2	PARE
D	MA	Q	PAMA	3	MASA
E	GA	R	MAGA	4	GANI
F	RE	S	GARE	5	REDHA
G	SA	T	RESA	6	SAPA
H	NIPA	U	SANI	7	NIMA
I	DHAMA	V	REGA	8	DAARE
J	PAGA	W	GAMA	9	PASA
K	MARE	X	MAPA	Space	MANI
L	GASA	Y	PADHA	[	NIGA
M	RENI	Z	DHANI	]	REMA

Table – 2Conversion to Western Musical Notes

Indian Musical Notes	Keyboard Notation
SA	E
RE	F
GA	G
MA	A
PA	B
DHA	C
NI	D

Space between two letters of same word – 0
Space between two different words – 1

Conversion of alphabets and numbers into Indian musical notes is provided by Table 1, while conversion into western music notes is provided by Table 2.

The choice of designing Table 1 and 2 is depend upon the sender who sends the message. In Table 1 there are 26 characters from A to Z, 10 numbers from 0 to 9 and two special characters, therefore they can be arranged in 38! ways. We can arrange the music notes in 38! ways for each choice of these 38! ways. In the same way Table 2 can be also designed by 7! ways.

Also music notes can be arranged in 7! ways for each choice of these 7! ways. We see that in table 1 the basic music notes Sa, Re, Ga, Ma, Pa, Dha, Ni are assigned by 7 alphabets G, F, E, D, C, B and A respectively. The numbers from 0 to 9, remaining alphabets from H to Z and two special characters [,] are assigned by the combination of the seven music notes. Such type of designing is depended upon the choice of sender and receiver.

For encryption of a message which contains a string of alphabets and numbers, Table 1 is the main key.

4.1 ENCRYPTION:

1. Convert the plain text into corresponding numeric values and 7-bit binary form using ASCII 7-bit code.
2. After converting binary bits into two segments Appling genetic algorithm (Two-point crossover and swap mutation) on desired bits which is shared between sender and receiver.
3. Convert the binary bits into corresponding characters using ASCII 7-bit character code, to get Intermediate cipher.
4. Convert the intermediate cipher into Indian music notes according to choice of sender and receiver.
5. Convert the Indian music notes into keyboard notation, to get encrypted message and send this cipher text and key to sender through secure channel.

4.2 DECRYPTION:

Appling the reverse process of encryption, to get the plain text. Example –

ENCRYPTION:

1. Consider the plain text
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2. Correct each alphabet of plaintext into corresponding numeric values using ASCII table, we get

77 85 83 73 67 65 76 32 67 82 89 80 84 79 71 82 65 80 72 89

3. Convert these numeric values to their binary equivalent using ASCII 7-bit code, we have

1001101 1010101 1010011 1001001 1000011 1000001 1001100 0100000 1000011 1010010 1011001 1010000 1010100 1001111 1000111 1010010 1000001 1010000 1001000 1011001

4. Convert above binary bits into two segments, we get

10011011010101101001110010011000011100000110011000100001000011010010

10110011010000101010010011111000011110100101000001101000001011001

5. Appling two points crossover on above at the points 29 and 42, we get

10011011010101101001110010011000011110100101001100010000010000111010010

10110011010000101010010011111000011100000110000011010000010011001

6. Appling the swap mutation on each 7-bit segment at random chosen two positions (3rd and 5th in each 7-bit segment) on the chromosome, we get

10110011010101100011110010011000111100011010110000100000010000111000110

10011011000100101010010110111000011100000110000011000010010011001101

7. Convert them into their corresponding character using ASCII 7-bit character code, we get the following intermediate cipher text:
   YUGIGFXQCFMDT[CAADHM
8. Convert above intermediate cipher into Indian Music notes using table 1, we get –

GASA NIPA SA DHAMA SA RE MAPA MANI PA RE RENI MA RESA PADHA PA NI NI MA NIPA RENI

9. Using table 2, converted above into keyboard notation, we get the following cipher text

GE0DB0E0CA0E0F0AB0AD0B0F0FD0A0FE0BC0B0D1D0A0DB0FD

The encrypted message, crossover points and mutation position send to receiver through secure channel, while the main key table 1 is send by different channel.

DECRYPTION:

1. Convert the cipher text
   GE0DB0E0CA0E0F0AB0AD0B0F0FD0A0FE0BC0B0D1D0A0DB0FD
   into Indian Music Note using table 2, we get
   GASA NI PA SA DHAMA SA RE MAPA MANI PA RE RENI MA RESA PADHA PA NI NI MA NIPA RENI
2. Convert the above Indian Musical Note into their corresponding character using table1, we have the following intermediate decipher text:
   YUGIGFXCFMDT[CAADHM
3. Convert the above intermediate decipher text into 7-bit binary form using ASCII 7-bit character code, we get –
   1011001101010110001111001001100011110001101011000010000010000111000110
   1001101100010010101001011011100001110000011000001100010010001001101
4. On each 7-bit segment applying the swap mutation on choosing two positions sending by the sender, we get –
   1001101101010110100111001001100011110100101001100010000010000111010010
   1011001101000010101001001111100001110000011000001100100001001011001
5. Convert above binary bits into two segments and applying two points crossover on above at the chosen points given by the sender, we have –
   1001101101010110100111001001100001110000011001100010000010000111010010
   1011001101000010101001001111100011110100101000001100100001001011001
6. Convert these binary number into their corresponding numeric values using ASCII table, we get –
   77 85 83 73 67 65 76 32 67 82 89 80 84 79 71 82 65 80 72 89
7. Convert these numeric values into their corresponding characters using ASCII Code, we have the original message as follows:
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V. RESULT AND DISSCUSSIONS:

In this paper we use the genetic algorithm (crossover and mutation) and musical notes for encrypting and decrypting the message. Genetic algorithm keeps the strength of the key to be long. The proposed algorithm has the proper selection, crossover, mutation and sequencing of the musical notes. The resultant musical piece is hard to break because the key is usually like a onetime pad. It is hard to get the message without the key. To decrypt the message combination of the seven music notes is required which is completely depended upon the choice of the sender and receiver. Therefore, decryption of the message is very hard task for any code breakers.

VI. CONCLUSION:

Here we have three level of encryption. Firstly, we use Genetic algorithm (crossover and mutation), secondly Indian music notes are used and finally using usual keyboard notes. If the conversion order into alphabets is not known, then it will be very difficult for any hacker to break the code. Here, we also used 38 alpha numeric characters which can be arranged in a minimum of $(38!)^2$ways. Similarly, 7 key music notes are also can be arranged in $(7!)^2$ways. Therefore, we can generate a table of our choice. This arrangement worked as a key for encryption and decryption and this increase the safety of the encrypted message. Hence for encoding of any message, the proposed encryption scheme is safe.

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AUTHORS PROFILE

Amit Kumar Mandle is a Research Scholar in the Department of Computer Applications (MCA) at SRK University, Bhopal, India. He completed his Master in Computer Application from MPBOU, Bhopal (M.P.) in 2006.

Varsha Namdeo is an Associate Professor in the Department of Computer Science and Engineering at SRK University, Bhopal, India. She is a teacher and researcher in the field of computer science and information technology. She earned her Master in Computer Application from Barkatullah University Bhopal (M.P.) in 2000 and in Computer Science and Engineering from Barkatullah University Bhopal (M.P.) in 2009 and PhD degree from Maulana Azad National Institute of Technology, Bhopal (M.P.) in 2015.She had a long career in teaching and research.