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# Text encryption and decryption with first-order Bézier curve added (MKTEXT-5)

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**Abstract.** We utilized Bézier curve technology in our research, titled "Simulating a First-Order Bézier Curve in Image Encryption," to encrypt images. This technology will also be employed for encrypting texts in all languages. The first-order Bézier curve equation, although simple in structure, poses challenges for image encryption due to the privacy of its coefficient variables. However, it holds promise for encrypting texts, as it only requires changes in numerical values representing letters and symbols. The formula we will employ from Bézier curve technology for text encryption is:

$$r = k_1 * (p - 1) + k_2 * p \quad : \ 0 < |p| < 1$$

It's worth noting that we will generate

$$h = [h_1 \ h_2] \quad : \ |h_1| < |h_2| \quad such\ that\ p = \frac{h_1}{h_2}$$

p-values through a vector containing only two digital components:

This method differs from the one used in our image encryption research, "Simulating a First-Order Bézier Curve in Image Encryption," as we intentionally updated the Bézier curve technique's specifications. Thus, the resulting Bézier equation is now suitable for encrypting any text. In this research, we provide detailed algorithmic descriptions, along with comparisons of results, criteria, and findings from our previous works..

**Keywords**. text encryption; Bézier curve.

## 1. *Introduction*

It deals with the science of information, which is in the form of simple text when storing on various storage media or when transferred on plaintext text networks so that it becomes unreadable to anyone except for those who have special knowledge or a private key to convert the encoded text into readable text [1][2][3]. This decryption process is done through what is called an encryption key. The result of the encryption process is that the information becomes encrypted and is not available to anyone for military, political, or security purposes [4].

**Types of encryption algorithms according to data entry method**: Encryption algorithms are divided according to the way they work on the parts and symbols of the data into two types: sectional and connected [4].

**Sectional encryption** is based on the principle of splitting the original content (text, images, or anything else) into equal-length groups of bits called blocks or sections and then encrypting each section separately. Most cipher algorithms are based on sectional encryption, such as EAS, DES, 3DES, RSEMD, TIGER, and others [5].

**Connected encryption** is based on the principle of encrypting data continuously or in a connected spreadsheet. A continuous key is generated that is combined with the original data using a symmetric key encryption algorithm, often with a logical XOR process. Among the connected encryption algorithms, for example, is RC4, which is the most widely used connected encryption algorithm [5].

**Types of encryption algorithms according to the type of encryption key and decryption**: Cryptographic algorithms are divided according to the type of encryption key and decryption type into two types: symmetric and asymmetric, in addition to the type that does not need an encryption key, which is the Hash function encryption [5].

**Symmetric Encryption (Symmetric key encryption)**: A symmetric encryption algorithm uses the same key for encryption and decryption. One of the advantages of symmetric encryption is that it is easy to use and fast, but it has an important disadvantage, especially when used in large networks. It is permissible between the two parties in the communication process on the network to use the encryption process. Examples of algorithms that use the symmetric key are EAS, DES, 3DES, and others [6].

**Asymmetric encryption (Asymmetric key encryption)**: An asymmetric algorithm, or public key, uses one key for encryption and another for decryption. Asymmetric systems generate different keys and then use them to encode and decode a couple of protection keys. By using these two key pairs, one public and the other private, only one of the keys can decode the other. Knowing only one key is unlikely to determine the other, so the asymmetric cryptography system is used to create digital signatures and transfer identical keys. Examples of algorithms that use the symmetric key are the RSE algorithm. Most encryption systems in the past used the symmetric system only, and the problem with this system lies in the difficulty encountered in distributing keys to specific people. Given that symmetric encryption depends on the use of the same key in encryption and decryption, one has to use innovative and difficult methods together to prevent others from intercepting the key. However, if someone can intercept the key, they will have the ability to use it to decode (in the case of symmetric encryption only) anything that the key encrypted [6].

**Hash encryption function**: The hash cryptographic function, also known as the hash function, takes any number of data segments and returns a fixed-length chain of bits called the hash cryptographic value. Any change in the original data, whether accidental or intentional, will significantly alter the hash cryptographic value with a very high probability. The encrypted data is typically referred to as "the message," and the hash encryption amount is called the digest. This type of algorithm does not require an encryption key because it is not used to encrypt texts but rather to ensure the reliability and integrity of the message content. By comparing the sent summary with the abstract generated from the message, the content needs to be verified. Examples of hash cryptographic functions include MD5, BBR, SHA1, and SHA2 algorithms. Hash functions are used to save passwords and verify the integrity of file downloads over the network [7].

**My previous research in the field of text encryption**: I have had successful experiences in designing algorithms for encrypting texts in all languages using modern methods that do not follow the old classic approaches. These methods rely on the digital revolution and matrix science, utilizing advanced mathematical tools. The algorithms I have developed for encrypting text, images, or any other information are strong, fortified algorithms that are resistant to intruders and free from errors. They are as follows:

1- Text Encryption Based on Singular Value Decomposition: This algorithm, named MKTEXT-1, is the first to adopt SVD technology in text encryption [8].
2- Use of Singular Values Decomposition in Text Encryption with a Real Number Encryption Key: MKTEXT-2 is a development of MKTEXT-1, where a real number is used as an encryption key [9].
3- Text and Image Encryption via Text and Image Keys using Singular Value Decomposition: MKTEXT-3 is a comprehensive algorithm for encoding text and images, offering users several options for encryption and choice in the encryption key [10].
4- A Proposed Method for Text Encryption using Symmetric and Asymmetric Cryptosystems: MKTEXT-4 utilizes symmetric and asymmetric keys and is characterized by its complexity and accuracy in readings of the accuracy criteria [11].

Our upcoming algorithm, MKTEXT-5, will adopt the technology of the first-order Bézier curve, a development of the same technology used in our research on image encoding titled "Simulate a First-order Bézier Curve in Image Encoding."

## 2. Bézier curve [12]:

This mathematical technique has been briefly discussed in a previous research titled "Simulating a First-Order Bézier Curve in Image Encoding." We provided concise explanations about this technique and referenced sources for further details on the topic. To maintain the focus of our research, we will only mention the sources of this technique and delve into the heart of the topic we are explaining, providing detailed explanations. This approach ensures that our research is highly informative for the reader, aiming to seek the pleasure of God, in accordance with the noble Hadith that emphasizes the dissemination of knowledge [13].

### 3. A proposed method for text encryption:-

We will first explain the algorithm using the MATLAB template and then reinforce it through an example.

The algorithm's purpose is to transform the numerical values of letters and constituent symbols of the text into different numerical values that do not represent the original values. Suppose we have a specific text that we want to encrypt into a numerical vector.

**Algorithm steps: -**

**First / Encryption: - The Encryption Procedure**. We have the text vector that we want to encryption A.

$A = TEXT_{(befor\ encryption)}$

1- Check the number of letters and symbols of the text vector, where the number should be even.

```
D=length(A)
if (d/2)==floor(d/2)
A=A
else
A=[A '   ']
End
```

That is, we add a single space to the text vector if the number is odd, so that the number is even, because the algorithm is designed on texts whose numbers letters and symbols are prepared by even

2- We give the components of the text (letters or symbols) numbers to turn the text vector into a numerical vector and take advantage of the numerical values for each letter or symbol stored in the computer memory.

```
A1=double (A)
```

3- We adopt an encryption key for the Bézier curve, which is a vector with four numerical values:

Key=$[k_1\ k_2\ k_3\ k_4]$: $|k_1| < |k_2|$ & $|k_3| < |k_4|$

$$t_1 = \frac{k_1}{k_2} \ \& \ t_2 = \frac{k_3}{k_4}$$

4- We divide the vector A1 into diodes $[A1(1) \quad A1(2)]$ and we separate each pair independently as follows: -

$$[A1(1) \quad A1(2)]$$
$$p_1 = A1(1) * (t_1 - 1) + A1(2) * t_1$$
$$p_2 = A1(1) * (t_2 - 1) + A1(2) * t_2$$
$$A1(1)_{encryption} = p_1$$
$$A1(2)_{encryption} = p_2$$

If the vector of numerical values A1 corresponding to the letters and the constituent symbols of the text that we want to encryption, it will turn into an encrypted vector that includes new numerical values unrelated to the original numerical values and this encrypted vector is P.

The encryption steps is finished.

**Second / decryption: -The Decryption Procedure.** We have the encrypted text vector P and it has an even number of encoded numerical values.

The steps for decryption are as follows: -

1- We adopt the same ciphering key for the Bézier curve that we used for encryption, which is a vector with four numerical values:

key=$[k_1 \ k_2 \ k_3 \ k_4]$: $|k_1| < |k_2|$ & $|k_3| < |k_4|$

$$t_1 = \frac{k_1}{k_2} \ \& \ t_2 = \frac{k_3}{k_4}$$

2- We divide the vector P into diodes $[P(1) \quad P(2)]$ and retrieve the original values for each binary independently, as follows: -

$$n1 = \frac{p_1 * t_2}{t_1}$$
$$n2 = p_1 - n1$$
$$n_3 = \frac{(t_1 - 1) * t_2}{t_1}$$
$$n_4 = (t_2 - 1) - n_3$$

$$AA1(1) = \frac{n_2}{n_4}$$
$$n_5 = p(1) - AA1(1) * (t_1 - 1)$$
$$AA1(2) = \frac{n_5}{t_1}$$

Thus, we obtained a new binary after the most important step in decryption, which is the binary $[AA1(1) \quad AA1(2)]$ and so work, continues with the other binaries for encryption vector P and we can represent what happened during the encryption and decryption steps for each pair in the following table:

Table 1: Explanation of what is going on during the coding and decryption steps for each pair of the binaries of the numerical values vector.

| | |
|---|---|
| Duo before encryption | $A1 = \begin{bmatrix} A1(1) \\ A1(2) \end{bmatrix}$ |
| Encryption by our algorithm | Using the encryption key $key = \begin{bmatrix} k_1 \\ k_2 \\ k_3 \\ k_4 \end{bmatrix}$ |
| Encoded Duo | $P = \begin{bmatrix} p(1) \\ p(2) \end{bmatrix}$ |
| Decryption by our algorithm | Using the same encryption key $key = \begin{bmatrix} k_1 \\ k_2 \\ k_3 \\ k_4 \end{bmatrix}$ |
| Duo after encryption | $AA1 = \begin{bmatrix} AA1(1) \\ AA1(2) \end{bmatrix}$ |

We note here that the vector of numerical values after decryption, denoted as AA1, does not precisely match the vector of numerical values before encryption, denoted as A1. This discrepancy arises because the values include decimal fractions, whereas they are assumed to be integers. The reason for this discrepancy is the computational operations performed by the computer, which involve approximation errors that occur in the results of the calculations. After conducting numerous applications of this algorithm, we observed that the absolute difference between the original value and its corresponding value after encryption and decryption is always less than 0.5. This allowed us to address the error by treating the numerical values of vector AA1 and rounding them to the nearest integer. We will illustrate this with the following example: -

Table 2: An illustrative example of the error in numerical values after decoding and how to correct it

| | |
|---|---|
| Vector of numerical values before encryption | $A1 = \begin{bmatrix} 45 \\ 85 \\ 12 \\ 37 \\ 41 \\ 99 \\ 34 \end{bmatrix}$ |
| Vector of numerical values after encryption And decryption | $AA1 = \begin{bmatrix} 44.6 \\ 85.3 \\ 11.9 \\ 36.6 \\ 40.5 \\ 99.4 \\ 33.8 \end{bmatrix}$ |
| $E = AA1 - floor(AA1)$ | $E = \begin{bmatrix} 44.6 - 44 = 0.6 \\ 85.3 - 85 = 0.3 \\ 11.9 - 11 = 0.9 \\ 36.6 - 36 = 0.6 \\ 40.5 - 40 = 0.5 \\ 99.4 - 99 = 0.4 \\ 33.8 - 33 = 0.8 \end{bmatrix}$ |
| if E>=0.5<br>AA1=floor(AA1)+1<br>else<br>AA1=floor(AA1)<br>End | $AA1 = \begin{bmatrix} floor(44.6) + 1 \\ floor(85.3) \\ floor(11.9) + 1 \\ floor(36.6) + 1 \\ floor(40.5) + 1 \\ floor(99.4) \\ floor(33.8) + 1 \end{bmatrix}$ |

| | |
|---|---|
| Final Vector of numerical values after encryption And decryption | $AA1 = \begin{bmatrix} 45 \\ 85 \\ 12 \\ 37 \\ 41 \\ 99 \\ 34 \end{bmatrix}$ |

We note that the final result after decryption is exactly the same as the numerical values of the original vector before decryption.

The final step in decryption is to retrieve the original letters and symbols based on the last numerical value vector that we obtained through the above decryption stages, and we can do this by using the Matlab program as follows: -

TEXT_((after decryption) )=char(AA1)

**4. Application for the proposed algorithm: An Illustration Of This Method Using MATLAB:**

We will apply the steps of the algorithm above to two illustrative examples (the first with an even letters number and the second with an odd letters number) using the same tables.

First: - encryption:The Encryption Procedure: We have a first text vector that we want to encryption it A with an even letters number.And we have a second text vector that we want to encryption it B with an odd letters number

A=[Mohammed]

B=[Hasan]

We apply the steps of the above algorithm accurately and summarize the results in the following table:

Table 3: - the application of the algorithm in two examples (Muhammad) and (Ali).

| No | The text | $A = [Mohammed]$ | $B = [Hasan]$ |
|---|---|---|---|
| 1 | Check the number of letters | 8 (even) | 5 (odd) |

| | | | |
|---|---|---|---|
| 2 | Text processing after checking | $A = [Mohammed]$ (Text unchanged) | $B = [Hasan\ ]$ (Add space) |
| 3 | The number of letters after checking and processing | 8 (even) | 6 (even) |
| 4 | Numerical values for text letters from computer memory | 77 111 104 97 109 109 101 100 | 72 97 115 97 110 32 |
| 5 | Encryption key | 142 -2214 -74 -1010 | 201 -2014 410 987 |
| 6 | Numerical values after encryption | -89.0578 -63.2257 -116.8916 -89.2733 -122.9819 -93.0277 -113.8916 -86.2733 | -88.8664 -1.7974 -136.1579 -26.9352 -124.1718 -51.0132 |
| 7 | Numerical values after decryption and before error handling | 77.0000 111.0000 104.0000 97.0000 109.0000 109.0000 101.0000 100.0000 | 72.0000 97.0000 115.0000 97.0000 110.0000 32.0000 |
| 8 | floor(7) | 77 111 104 97 109 109 101 100 | 72 97 115 97 110 32 |
| 9 | Decimal fractions in (7) | 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 | 0.0 0.0 0.0 0.0 0.0 0.0 |
| 10 | Add on (8) | 0 0 0 0 0 0 0 | 0 0 0 0 0 0 |
| 11 | Final numerical values after decryption | 77 111 104 97 109 109 101 100 | 72 97 115 97 110 32 |
| 12 | The error=abs(4-11) | 0 0 0 0 0 0 0 0 | 0 0 0 0 0 0 |
| 13 | Text after decryption | Mohammed | Hasan |
| 14 | Encryption time | 0.0070 sec | 0.0040 sec |

| | | | |
|---|---|---|---|
| 15 | Decryption time | 1.0930 sec | 1.2120 sec |
| 16 | The length of the original text before processing | 8 | 5 |

The above table is special for two examples of two short texts. We return the table same an example special with applying this algorithm to a long Arabic text and the results will be in the form of steps to multiply data.

The text

انا وقبل الانتكاسه الصحية كنت اعلم حقيقة مهمة وهي ان الانسان مهما كان موقعه في المجتمع فهو لا يساوي شيء بدون اخوة يتالمون لالمه ويفتقدونه اذا غاب ويسالون عنه اذى ابتعد ... يفرحون لفرحه ويحزنون لحزنه ... يعيشون معه لحظاته بحلوها ومرها وما هذه الانتكاسه التي مررت بها الى (عبرة ودرسا وبرهانا) فهي عبره تقول يا انسان انت احقر واضعف من ان تتجبر لانك تنطرح ارضا ذليلا مهانا بمجرد وعكة صحيه ربما تكون بسيطة ... وهي درسا يعلمنا بان الدنيا زائلة ولا امان لها فالغني من قدّم لاخرته من الامر بالمعروف والنهي عن المنكر وباقي العبادات وان يترك الانحدار والذوبان في ملذات الدنيا ... وهي برهانا يثبت لي من هم الاخوة الحقيقيون الذين تفتخر بهم ... فانتم يا اعزائي واحبابي قد اخجلتموني بعذوبة ما علقتموه وطيب الاماني وصدق الدعاء وانا اتمنى من كل قلبي ان اقبل اقدامكم الكريمة وادعو الله لكم دوام الصحة والعافية وان يمكنني الله من الوقوف معكم في افراحكم واتراحكم فانتم نعم الاخوة والله.

1- Check the number of letters:- 867 (odd) (so Add space).
2- Text processing after checking:- The text itself and add space for it.
3- The number of letters after checking and processing:- 868 (even).
4- Numerical values for text letters from computer memory:

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1575 | 1606 | 1575 | 32 | 1608 | 1602 | 1576 | 1604 | 32 | 1575 | 1604 | 1575 | 1606 | 1578 | 1603 |
| 1575 | 1587 | 1607 | 32 | 1575 | 1604 | 1589 | 1581 | 1610 | 1577 | 32 | 1603 | 1606 | 1578 | 32 |
| 1575 | 1593 | 1604 | 1605 | 32 | 1581 | 1602 | 1610 | 1602 | 1577 | 32 | 1605 | 1607 | 1605 | 1577 |
| 32 | 1608 | 1607 | 1610 | 32 | 1575 | 1606 | 32 | 1575 | 1604 | 1575 | 1606 | 1587 | 1575 | 1606 |
| 32 | 1605 | 1607 | 1605 | 1575 | 32 | 1603 | 1575 | 1606 | 32 | 1605 | 1608 | 1602 | 1593 | 1607 |
| 32 | 1601 | 1610 | 32 | 1575 | 1604 | 1605 | 1580 | 1578 | 1605 | 1593 | 32 | 1601 | 1607 | 1608 |
| 32 | 1604 | 1575 | 32 | 1610 | 1587 | 1575 | 1608 | 1610 | 32 | 1588 | 1610 | 1569 | 32 | 1576 |
| 1583 | 1608 | 1606 | 32 | 1575 | 1582 | 1608 | 1577 | 32 | 1610 | 1578 | 1575 | 1604 | 1605 | |
| 1608 | 1606 | 32 | 1604 | 1575 | 1604 | 1605 | 1607 | 32 | 1608 | 1610 | 1601 | 1578 | 1602 | |
| 1583 | 1608 | 1606 | 1607 | 32 | 1575 | 1584 | 1575 | 32 | 1594 | 1575 | 1576 | 32 | 1608 | 1610 |
| 1587 | 1575 | 1604 | 1608 | 1606 | 32 | 1593 | 1606 | 1607 | 32 | 1575 | 1584 | 1609 | 32 | 1575 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1576 | 1578 | 1593 | 1583 | 32 | 46 | 46 | 46 | 32 | 1610 | 1601 | 1585 | 1581 | 1608 | 1606 |
| 32 | 1604 | 1601 | 1585 | 1581 | 1607 | 32 | 1608 | 1610 | 1581 | 1586 | 1606 | 1608 | 1606 | 32 |
| 1604 | 1581 | 1586 | 1606 | 1607 | 32 | 46 | 46 | 46 | 32 | 1610 | 1593 | 1610 | 1588 | 1608 |
| 1606 | 32 | 1605 | 1593 | 1607 | 32 | 1604 | 1581 | 1592 | 1575 | 1578 | 1607 | 32 | 1576 | 1581 |
| 1604 | 1608 | 1607 | 1575 | 32 | 1608 | 1605 | 1585 | 1607 | 1575 | 32 | 1608 | 1605 | 1575 | 32 |
| 1607 | 1584 | 1607 | 32 | 1575 | 1604 | 1575 | 1606 | 1578 | 1603 | 1575 | 1587 | 1607 | 32 | |
| 1575 | 1604 | 1578 | 1610 | 32 | 1605 | 1585 | 1585 | 1578 | 32 | 1576 | 1607 | 1575 | 32 | 1575 |
| 1604 | 1609 | 32 | 40 | 1593 | 1576 | 1585 | 1577 | 32 | 1608 | 1583 | 1585 | 1587 | 1575 | 32 |
| 1608 | 1576 | 1585 | 1607 | 1575 | 1606 | 1575 | 41 | 32 | 1601 | 1607 | 1610 | 32 | 1593 | 1576 |
| 1585 | 1607 | 32 | 1578 | 1602 | 1608 | 1604 | 32 | 1610 | 1575 | 32 | 1575 | 1606 | 1587 | 1575 |
| 1606 | 32 | 1575 | 1606 | 1578 | 32 | 1575 | 1581 | 1602 | 1585 | 32 | 1608 | 1575 | 1590 | 1593 |
| 1601 | 32 | 1605 | 1606 | 32 | 1575 | 1606 | 32 | 1578 | 1578 | 1580 | 1576 | 1585 | 32 | 1604 |
| 1575 | 1606 | 1603 | 32 | 1578 | 1606 | 1591 | 1585 | 1581 | 32 | 1575 | 1585 | 1590 | 1575 | 32 |
| 1584 | 1604 | 1610 | 1604 | 1575 | 32 | 1605 | 1607 | 1575 | 1606 | 1575 | 32 | 1576 | 1605 | |
| 1580 | 1585 | 1583 | 32 | 1608 | 1593 | 1603 | 1577 | 32 | 1589 | 1581 | 1610 | 1607 | 32 | 1585 |
| 1576 | 1605 | 1575 | 32 | 1578 | 1603 | 1608 | 1606 | 32 | 1576 | 1587 | 1610 | 1591 | 1577 | 32 |
| 46 | 46 | 46 | 32 | 1608 | 1607 | 1610 | 32 | 1583 | 1585 | 1587 | 1575 | 32 | 1610 | 1593 |
| 1604 | 1605 | 1606 | 1575 | 32 | 1576 | 1575 | 1606 | 32 | 1575 | 1604 | 1583 | 1606 | 1610 | |
| 1575 | 32 | 1586 | 1575 | 1574 | 1604 | 1577 | 32 | 1608 | 1604 | 1575 | 32 | 1575 | 1605 | 1575 |
| 1606 | 32 | 1604 | 1607 | 1575 | 32 | 1601 | 1575 | 1604 | 1594 | 1606 | 1610 | 32 | 1605 | 1606 |
| 32 | 1602 | 1583 | 1617 | 1605 | 32 | 1604 | 1575 | 1582 | 1585 | 1578 | 1607 | 32 | 1605 | 1606 |
| 32 | 1575 | 1604 | 1575 | 1605 | 1585 | 32 | 1576 | 1575 | 1604 | 1605 | 1593 | 1585 | 1608 | 1601 |
| 32 | 1608 | 1575 | 1604 | 1606 | 1607 | 1610 | 32 | 1593 | 1606 | 32 | 1575 | 1604 | 1605 | 1606 |
| 1603 | 1585 | 32 | 1608 | 1576 | 1575 | 1602 | 1610 | 32 | 1575 | 1604 | 1593 | 1576 | 1575 | |
| 1583 | 1575 | 1578 | 32 | 1608 | 1575 | 1606 | 32 | 1610 | 1578 | 1585 | 1603 | 32 | 1575 | 1604 |
| 1575 | 1606 | 1581 | 1583 | 1575 | 1585 | 32 | 1608 | 1575 | 1604 | 1584 | 1608 | 1576 | 1575 | |
| 1606 | 32 | 1601 | 1610 | 32 | 1605 | 1604 | 1584 | 1575 | 1578 | 32 | 1575 | 1604 | 1583 | 1606 |
| 1610 | 1575 | 32 | 46 | 46 | 46 | 32 | 1608 | 1607 | 1610 | 32 | 1576 | 1585 | 1607 | 1575 |
| 1606 | 1575 | 32 | 1610 | 1579 | 1576 | 1578 | 32 | 1604 | 1610 | 32 | 1605 | 1606 | 32 | 1607 |
| 1605 | 32 | 1575 | 1604 | 1575 | 1582 | 1608 | 1577 | 32 | 1575 | 1604 | 1581 | 1602 | 1610 | |
| 1602 | 1610 | 1608 | 1606 | 32 | 1575 | 1604 | 1584 | 1610 | 1606 | 32 | 1578 | 1601 | 1578 | |
| 1582 | 1585 | 32 | 1576 | 1607 | 1605 | 32 | 46 | 46 | 46 | 32 | 1601 | 1575 | 1606 | 1578 |
| 1605 | 32 | 1610 | 1575 | 32 | 1575 | 1593 | 1586 | 1575 | 1574 | 1610 | 32 | 1608 | 1575 | 1581 |
| 1576 | 1575 | 1576 | 1610 | 32 | 1602 | 1583 | 32 | 1575 | 1582 | 1580 | 1604 | 1578 | 1605 | |
| 1608 | 1606 | 1610 | 32 | 1576 | 1593 | 1584 | 1608 | 1576 | 1577 | 32 | 1605 | 1575 | 32 | 1593 |
| 1604 | 1602 | 1578 | 1605 | 1608 | 1607 | 32 | 1608 | 1591 | 1610 | 1576 | 32 | 1575 | 1604 | |
| 1575 | 1605 | 1575 | 1606 | 1610 | 32 | 1608 | 1589 | 1583 | 1602 | 32 | 1575 | 1604 | 1583 | |
| 1593 | 1575 | 1569 | 32 | 1608 | 1575 | 1606 | 1575 | 32 | 1575 | 1578 | 1605 | 1606 | 1609 | 32 |
| 1605 | 1606 | 32 | 1603 | 1604 | 32 | 1602 | 1604 | 1576 | 1610 | 32 | 1575 | 1606 | 32 | 1575 |
| 1602 | 1576 | 1604 | 32 | 1575 | 1602 | 1583 | 1575 | 1605 | 1603 | 1605 | 32 | 1575 | 1604 | |
| 1603 | 1585 | 1610 | 1605 | 1577 | 32 | 1608 | 1575 | 1583 | 1593 | 1608 | 32 | 1575 | 1604 | |
| 1604 | 1607 | 32 | 1604 | 1603 | 1605 | 32 | 1583 | 1608 | 1575 | 1605 | 32 | 1575 | 1604 | 1589 |
| 1581 | 1577 | 32 | 1608 | 1575 | 1604 | 1593 | 1575 | 1601 | 1610 | 1577 | 32 | 1608 | 1575 | |
| 1606 | 32 | 1610 | 1605 | 1603 | 1606 | 1606 | 1610 | 32 | 1575 | 1604 | 1604 | 1607 | 32 | 1605 |
| 1606 | 32 | 1575 | 1604 | 1608 | 1602 | 1608 | 1601 | 32 | 1605 | 1593 | 1603 | 1605 | 32 | 1601 |
| 1610 | 32 | 1575 | 1601 | 1585 | 1575 | 1581 | 1603 | 1605 | 32 | 1608 | 1575 | 1578 | 1585 | |
| 1575 | 1581 | 1603 | 1605 | 32 | 1601 | 1575 | 1606 | 1578 | 1605 | 32 | 1606 | 1593 | 1605 | 32 |
| 1575 | 1604 | 1575 | 1582 | 1608 | 1577 | 32 | 1608 | 1575 | 1604 | 1604 | 1607 | 46 | 32 | |

5- Encryption key:- [120 -1010 1001 1111]

6- Numerical values after encryption:-

| |
|---|
| 1.0e+03 * |

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والدراســـات الانســـــانية

وزارة التعليم العالي والبحث العلمي
جامعة الكوفة
كلية التربية الاساسية

-1.9529 1.2910 -1.7659 -0.1271 -1.9894 1.2842 -1.9538 1.2891 -0.2229 1.4159 -1.9817 1.2602 -1.9843 1.2628 -1.9806 1.2603 -
1.9665 1.2908 -0.2229 1.4159 -1.9834 1.2729 -1.9601 1.2941 -1.7682 -0.1273 -1.9843 1.2883 -1.7693 -0.1274 -1.9514 1.2793 -1.9853
1.2873 -0.2236 1.4213 -1.9836 1.2920 -1.9797 1.2622 -0.2265 1.4429 -1.9886 1.2870 -1.7682 -0.1273 -1.9900 1.2887 -1.8051 -0.1306 -
1.9529 1.2910 -0.2229 1.4159 -1.9817 1.2602 -1.9854 1.2709 -1.9529 1.2910 -0.2265 1.4429 -1.9886 1.2870 -1.7659 -0.1271 -1.9806
1.2603 -1.8006 -0.1302 -1.9867 1.2899 -1.9816 1.2767 -1.8017 -0.1303 -1.9825 1.2921 -0.2229 1.4159 -1.9853 1.2873 -1.9552 1.2653 -
1.9850 1.2764 -0.2260 1.4393 -1.9890 1.2897 -0.2264 1.4420 -1.7659 -0.1271 -1.9898 1.2705 -1.9532 1.2929 -1.8051 -0.1306 -1.9680
1.2934 -1.7592 -0.1265 -1.9513 1.2702 -1.9899 1.2878 -0.2229 1.4159 -1.9610 1.2922 -1.7682 -0.1273 -1.9888 1.2624 -1.9527 1.2892 -
1.9867 1.2899 -1.8006 -0.1302 -1.9817 1.2602 -1.9853 1.2873 -1.8017 -0.1303 -1.9903 1.2914 -1.9787 1.2632 -1.9804 1.2677 -1.9899
1.2878 -1.8017 -0.1303 -1.9503 1.2712 -1.7659 -0.1271 -1.9705 1.2612 -1.7670 -0.1272 -1.9903 1.2914 -1.9627 1.2619 -1.9856 1.2900 -
1.8006 -0.1302 -1.9731 1.2893 -1.8017 -0.1303 -1.9503 1.2712 -1.8040 -0.1305 -1.9494 1.2640 -1.9548 1.2790 -1.7749 -0.1279 -0.0569
0.0369 -0.0553 0.0243 -1.9915 1.2831 -1.9612 1.2675 -1.9899 1.2878 -0.2264 1.4420 -1.9795 1.2696 -1.9598 1.2914 -0.2269 1.4456 -
1.9891 1.2651 -1.9652 1.2900 -1.9899 1.2878 -0.2264 1.4420 -1.9573 1.2724 -1.9877 1.2889 -0.0413 0.0383 -0.0569 0.0369 -0.2271
1.4474 -1.9736 1.2929 -1.9677 1.2916 -1.8006 -0.1302 -1.9850 1.2764 -1.8017 -0.1303 -1.9824 1.2657 -1.9683 1.2614 -1.9564 1.2917 -
0.2230 1.4168 -1.9594 1.2887 -1.9900 1.2887 -1.7659 -0.1271 -1.9897 1.2869 -1.9642 1.2910 -1.7659 -0.1271 -1.9897 1.2869 -1.7659 -
0.1271 -1.9861 1.2681 -1.8017 -0.1303 -1.9527 1.2892 -1.9529 1.2910 -1.9559 1.2880 -1.9507 1.2739 -1.8017 -0.1303 -1.9527 1.2892 -
1.9568 1.2944 -0.2265 1.4429 -1.9616 1.2711 -1.7693 -0.1274 -1.9542 1.2919 -1.7659 -0.1271 -1.9527 1.2892 -1.8040 -0.1305 -0.2340
1.4313 -1.9516 1.2720 -1.7682 -0.1273 -1.9871 1.2671 -1.9619 1.2729 -1.7659 -0.1271 -1.9863 1.2608 -1.9642 1.2910 -1.9529 1.2910 -
1.7670 -0.1190 -0.2260 1.4393 -1.9892 1.2915 -0.2251 1.4321 -1.9516 1.2720 -1.8017 -0.1303 -1.9558 1.2871 -1.9896 1.2860 -0.2271
1.4474 -1.7659 -0.1271 -1.9529 1.2910 -1.9627 1.2619 -1.8006 -0.1302 -1.9529 1.2910 -1.7693 -0.1274 -1.9500 1.2685 -1.9807 1.2695 -
0.2269 1.4456 -1.9510 1.2766 -1.9725 1.2848 -0.2265 1.4429 -1.8006 -0.1302 -1.9529 1.2910 -0.2233 1.4186 -1.9532 1.2673 -1.9516
1.2720 -0.2264 1.4420 -1.9529 1.2910 -1.7973 -0.1299 -1.9563 1.2908 -1.9683 1.2705 -1.7726 -0.1277 -1.9504 1.2721 -1.9660 1.2616 -
0.2240 1.4240 -1.9859 1.2918 -1.9817 1.2602 -0.2265 1.4429 -1.9851 1.2600 -1.9839 1.2600 -0.2230 1.4168 -1.9834 1.2647 -1.9614
1.2693 -0.2269 1.4456 -1.9727 1.2866 -1.7682 -0.1273 -1.9656 1.2671 -1.9922 1.2885 -0.2241 1.4249 -1.9539 1.2900 -1.7659 -0.1271 -
1.9559 1.2880 -1.9899 1.2878 -0.2230 1.4168 -1.9668 1.2935 -1.9674 1.2633 -0.0413 0.0383 -0.0569 0.0369 -0.2269 1.4456 -1.9892
1.2915 -0.2239 1.4231 -1.9619 1.2729 -1.7659 -0.1271 -1.9906 1.2759 -1.9853 1.2873 -1.9839 1.2600 -0.2230 1.4168 -1.9529 1.2910 -
0.2229 1.4159 -1.9827 1.2675 -1.9881 1.2916 -1.7659 -0.1271 -1.9616 1.2620 -1.9516 1.2893 -1.7682 -0.1273 -1.9896 1.2860 -1.7659 -
0.1271 -1.9528 1.2901 -1.9529 1.2910 -0.2264 1.4420 -1.9851 1.2600 -0.2260 1.4393 -1.9527 1.2892 -1.9742 1.2892 -1.8051 -0.1306 -
1.9865 1.2881 -0.2261 1.4402 -1.9632 1.3002 -1.7995 -0.1301 -1.9817 1.2602 -1.9583 1.2714 -1.9564 1.2917 -0.2265 1.4429 -1.8006 -
0.1302 -1.9527 1.2892 -1.9528 1.2901 -1.7771 -0.1281 -1.9504 1.2630 -1.9853 1.2873 -1.9706 1.2703 -1.9893 1.2833 -0.2269 1.4456 -
1.9527 1.2892 -1.9877 1.2889 -1.8051 -0.1306 -1.9731 1.2893 -0.2229 1.4159 -1.9853 1.2873 -1.9873 1.2853 -1.7771 -0.1281 -1.9863
1.2608 -1.9525 1.2874 -1.8051 -0.1306 -1.9527 1.2892 -1.9695 1.2622 -1.9502 1.2703 -1.9496 1.2658 -0.2269 1.4456 -1.9529 1.2910 -
0.2271 1.4474 -1.9538 1.2718 -1.7973 -0.1299 -1.9527 1.2892 -1.9529 1.2910 -1.9569 1.2697 -1.9504 1.2721 -0.2269 1.4456 -1.9527
1.2892 -1.9632 1.2920 -1.9504 1.2630 -1.8006 -0.1302 -1.9825 1.2921 -0.2265 1.4429 -1.9828 1.2684 -1.9496 1.2658 -0.2229 1.4159 -
1.9827 1.2675 -1.9881 1.2916 -1.7659 -0.1271 -0.0569 0.0369 -0.0553 0.0243 -1.9900 1.2887 -1.8051 -0.1306 -1.9516 1.2720 -1.9851
1.2600 -1.9839 1.2600 -0.2271 1.4474 -1.9539 1.2636 -1.7693 -0.1274 -1.9859 1.2918 -0.2265 1.4429 -1.8006 -0.1302 -1.9886 1.2870 -
0.2229 1.4159 -1.9817 1.2602 -1.9610 1.2922 -1.7682 -0.1273 -1.9527 1.2892 -1.9592 1.2869 -1.9916 1.2840 -1.9923 1.2894 -1.8006 -
0.1302 -1.9527 1.2892 -1.9635 1.2938 -1.8006 -0.1302 -1.9557 1.2862 -1.9534 1.2691 -1.7771 -0.1281 -1.9542 1.2919 -1.7995 -0.1301
-0.0569 0.0369 -0.0553 0.0243 -1.9783 1.2605 -1.9843 1.2628 -1.7995 -0.1301 -1.9884 1.2597 -0.2229 1.4159 -1.9707 1.2712 -1.9491
1.2622 -1.8051 -0.1306 -1.9862 1.2599 -1.9561 1.2634 -1.9494 1.2640 -1.8051 -0.1306 -1.9804 1.2677 -0.2229 1.4159 -1.9577 1.2669 -
1.9821 1.2630 -1.9867 1.2899 -1.9881 1.2916 -0.2230 1.4168 -1.9705 1.2694 -1.9863 1.2608 -1.7682 -0.1273 -1.9828 1.2601 -0.2251
1.4321 -1.9849 1.2846 -1.9562 1.2899 -1.9900 1.2887 -0.2269 1.4456 -1.9713 1.2931 -1.7670 -0.1272 -1.9527 1.2892 -1.9528 1.2901 -
1.9529 1.2910 -1.8051 -0.1306 -1.9878 1.2725 -1.9614 1.2867 -0.2229 1.4159 -1.9827 1.2675 -1.9694 1.2613 -1.7592 -0.1265 -1.9862
1.2599 -1.9839 1.2600 -0.2229 1.4159 -1.9562 1.2899 -1.9880 1.2907 -0.2265 1.4429 -1.8006 -0.1302 -1.9840 1.2865 -0.2261 1.4402 -
1.9818 1.2611 -1.8051 -0.1306 -1.9529 1.2910 -0.2229 1.4159 -1.9796 1.2613 -1.7984 -0.1300 -1.9525 1.2874 -1.9582 1.2623 -1.9861
1.2854 -1.7995 -0.1301 -1.9527 1.2892 -1.9818 1.2694 -1.9920 1.2867 -1.7682 -0.1273 -1.9862 1.2599 -1.9603 1.2785 -1.8029 -0.1304 -
1.9527 1.2892 -1.9855 1.2891 -0.2264 1.4420 -1.9841 1.2874 -0.2239 1.4231 -1.9862 1.2599 -1.7995 -0.1301 -1.9527 1.2892 -1.9656
1.2671 -1.7682 -0.1273 -1.9862 1.2599 -1.9838 1.2765 -1.9523 1.2865 -1.9887 1.2615 -0.2269 1.4456 -1.9529 1.2910 -0.2271 1.4474 -
1.9861 1.2854 -1.9876 1.2880 -1.8051 -0.1306 -1.9527 1.2892 -1.9855 1.2891 -0.2265 1.4429 -1.8006 -0.1302 -1.9527 1.2892 -1.9894
1.2842 -1.9893 1.2833 -0.2265 1.4429 -1.9727 1.2866 -1.7995 -0.1301 -1.9825 1.2921 -0.2229 1.4159 -1.9795 1.2696 -1.9500 1.2685 -
1.9841 1.2874 -0.2269 1.4456 -1.9496 1.2658 -1.9604 1.2621 -1.9593 1.2878 -1.7995 -0.1301 -1.9783 1.2605 -1.9843 1.2628 -1.7995 -
0.1301 -1.9861 1.2763 -1.7995 -0.1301 -1.9527 1.2892 -1.9501 1.2694 -1.9864 1.2617 -0.2269 1.4456 -1.9527 1.2892 -1.9855 1.2891 -
0.0553 0.0243

7- Numerical values after decryption and before error handling:- The same numerical values in (4) above with decimal fractions less than (0.5).
8- floor(7):- The same numerical values in (4) above.
9- Decimal fractions in (7):- Values less than (0.5)..
10- Add on (8):- zeroes.

11- Final numerical values after decryption:- The same numerical values in (4) above.

12- The error=abs(4-11):- zeroes.

13- Text after decryption:

| |
|---|
| انا وقبل الانتكاسه الصحية كنت اعلم حقيقة مهمة وهي ان الانسان مهما كان موقعه في المجتمع فهو لا يساوي شيء بدون اخوة يتالمون لالمه ويفتقدونه اذا غاب ويسالون عنه اذى ابتعد ... يفرحون لفرحه ويحزنون لحزنه ... يعيشون معه لحظاته بحلوها ومرها وما هذه الانتكاسه التي مررت بها الى (عبرة ودرسا وبرهانا) فهي عبره تقول يا انسان انت احقر واضعف من ان تتجبر لانك تنطرح ارضا ذليلا مهانا بمجرد وعكة صحيه ربما تكون بسيطة ... وهي درسا يعلمنا بان الدنيا زائلة ولا امان لها فالغني من قدّم لاخرته من الامر بالمعروف والنهي عن المنكر وباقي العبادات وان يترك الانحدار والذوبان في ملذات الدنيا ... وهي برهانا يثبت لي من هم الاخوة الحقيقيون الذين تفتخر بهم ... فانتم يا اعزائي واحبابي قد اخجلتموني بعذوبة ما علقتموه وطيب الاماني وصدق الدعاء وانا اتمنى من كل قلبي ان اقبل اقدامكم الكريمة وادعو الله لكم دوام الصحة والعافية وان يمكنني الله من الوقوف معكم في افراحكم واتراحكم |

14- Encryption time:- 0.0400 sec.

15- Decryption time:- 1.7010 sec.

16- The length of the original text before processing:- 867.

**Application of the algorithm to equations**:-We will try to apply the algorithm to equations and see, is that possible? How can we obtain correct results?

| No | The text | $A = \left[ \sqrt[5]{A(1,1) * \left\| \sum_{2}^{8} X \right\| - \left( \frac{k_1}{k_2} - 1 \right) + B^{A(1,2)} * \frac{k_1}{k_2}} \right]$ |
|---|---|---|
| 1 | Check the number of letters | 53 (odd) |
| 2 | Text processing after checking | $A = [\sqrt(5\&A(1,1) * \|∑\_2^8▒X\| - (k\_1/k\_2 - 1) + B^A(1,2) * k\_1/k\_2 )]$ (Add space) |
| 3 | The number of letters after checking and processing | 54 (even) |
| 4 | Numerical values for text letters from computer memory | 8730 40 53 38 65 40 49 44 49 41 42 124 8721 95 50 94 56 9618 88 124 45 40 107 95 49 47 107 95 50 32 45 49 41 43 66 94 65 |

| | | |
|---|---|---|
| | | 40 49 44 50 41 32 42 107 95 49 47 107 95<br>50 32 41 32 |
| 5 | Encryption key | 14 210 85 89 |
| 6 | Numerical values after encryption | 1.0e+03 *<br>-8.1453 -0.3542 -0.0469 0.0339 -0.0580 0.0353<br>-0.0428 0.0398 -0.0430 0.0370 -0.0309 0.1165<br>-8.1333 -0.3012 -0.0404 0.0875 0.5889 9.1832 -<br>0.0739 0.1145 -0.0393 0.0362 -0.0935 0.0859 -<br>0.0426 0.0427 -0.0935 0.0859 -0.0445 0.0283 -<br>0.0387 0.0448 -0.0354 0.0392 -0.0553 0.0868 -<br>0.0580 0.0353 -0.0428 0.0398 -0.0439 0.0369 -<br>0.0271 0.0387 -0.0935 0.0859 -0.0426 0.0427 -<br>0.0935 0.0859 -0.0445 0.0283 -0.0361 0.0287 |
| 7 | Numerical values after decryption and before error handling | 1.0e+03 *<br>8.7300 0.0400 0.0530 0.0380 0.0650 0.0400<br>0.0490 0.0440 0.0490 0.0410 0.0420 0.1240<br>8.7210 0.0950 0.0500 0.0940 0.0560 9.6180<br>0.0880 0.1240 0.0450 0.0400 0.1070 0.0950<br>0.0490 0.0470 0.1070 0.0950 0.0500 0.0320<br>0.0450 0.0490 0.0410 0.0430 0.0660 0.0940<br>0.0650 0.0400 0.0490 0.0440 0.0500 0.0410<br>0.0320 0.0420 0.1070 0.0950 0.0490 0.0470<br>0.1070 0.0950 0.0500 0.0320 0.0410 0.0320 |
| 8 | floor(7) | 8729 39 52 37 64 39 49 43 48 40 41 123 8720 94<br>49 93 55 9618 88 123 44 39 107 94 48 46 107<br>94 49 31 44 48 40 42 65 93 64 39 49 43 49 40<br>31 41 107 94 48 46 107 94 49 31 40 31 |
| 9 | Decimal fractions in (7) | 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 0 1.0000<br>1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000<br>1.0000 1.0000 0 0 1.0000 1.0000 1.0000 0 1.0000<br>1.0000 1.0000 0 1.0000 1.0000 1.0000 1.0000 1.0000<br>1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 0 1.0000<br>1.0000 1.0000 1.0000 1.0000 0 1.0000 1.0000 1.0000<br>0 1.0000 1.0000 1.0000 1.0000 1.0000 |
| 10 | Add on (8) | 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0<br>0 0 0 0 0 0 0 0 0 0 0 |

| | | |
|---|---|---|
| 11 | Final numerical values after decryption | 8730 40 53 38 65 40 49 44 49 41 42 124 8721 95 50 94 56 9618 88 124 45 40 107 95 49 47 107 95 50 32 45 49 41 43 66 94 65 40 49 44 50 41 32 42 107 95 49 47 107 95 50 32 41 32 |
| 12 | The error=abs(4-11) | 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |
| 13 | Text after decryption | √(5&A(1,1)*\|∑_2^8▒X\|-(k_1/k_2 -1)+B^A(1,2) *k_1/k_2 ) |
| 14 | Encryption time | 0.0100sec |
| 15 | Decryption time | 1.1620sec |
| 16 | The length of the original text before processing | 53 |

We note from the last table that encryption and decryption have taken place but they are not correct, because the Matlab program has converted the equation that we want to encryption from its form as a mathematical equation to another image that can be considered a symbolic rabash as follows: -

$$\sqrt[5]{A(1,1) * \left|\sum_{2}^{8} X\right| - \left(\frac{k_1}{k_2} - 1\right) + B^{A(1,2)} * \frac{k_1}{k_2}}$$

$$\Rightarrow \surd(5\&A(1,1) * |\sum\_2\text{^}8▒X| - (k\_1/k\_2 \; - 1) + B\text{^}A(1,2) * k\_1/k\_2 \,)$$

The new formula does not represent a mathematical equation. Therefore, we must write the mathematical equation in a new form in the language of Matlab as follows before encryption it: -

$$\sqrt[5]{A(1,1) * \left|\sum_{2}^{8} X\right| - \left(\frac{k_1}{k_2} - 1\right) + B^{A(1,2)} * \frac{k_1}{k_2}} \quad \Rightarrow$$

(A (1, 1)*abs (sum(x) (from 2 to 8))-((k1/k2)-1)+B^A(1,1)*(k1/k2))^(1/5)

Then we encryption the equation in its new form according to the above algorithm steps as follows:

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مجلة كلية التربية الاساسية
للعلوم التربوية والنفسية
والدراسـات الانسـانية

The text

(A(1,1)*abs(sum(x)(from 2 to 8))-((k1/k2)-1)+B^A(1,1)*(k1/k2))^(1/5)

1- Check the number of letters:- 68 (even).

2- Text processing after checking:- The text itself.

(A(1,1)*abs(sum(x)(from 2 to 8))-((k1/k2)-1)+B^A(1,1)*(k1/k2))^(1/5)

3- The number of letters after checking and processing:- 68 (even).

4- Numerical values for text letters from computer memory:-

40 65 40 49 44 49 41 42 97 98 115 40 115 117 109 40 120 41 40 102 114 111 109 32 50 32 116 111 32 56 41 41 45 40 40 107 49 47 107 50 41 45 49 41 43 66 94 65 40 49 44 49 41 42 40 107 49 47 107 50 41 41 94 40 49 47 53 41

5- Encryption key:- [845 -900 900 909]

6- Numerical values after encryption:-

-138.5833 63.9604 -123.5611 48.1188 -131.3167 48.0792 -118.9278 41.1782 -280.0833 96.0693 -260.5278 38.4653 -332.8222 114.7030 -248.8944 38.5248 -271.1611 39.4059 -173.3222 100.5941 -325.2500 108.7723 -241.3833 30.6040 -126.9889 31.1881 -329.1278 108.7525 -114.6222 55.1287 -117.9889 40.1881 -124.8056 39.1584 -178.0167 105.5446 -139.1333 46.0495 -254.4056 48.4455 -121.7444 44.1485 -133.5000 40.1089 -145.3389 64.9208 -243.2833 63.4257 -123.5611 48.1188 -131.3167 48.0792 -118.9278 41.1782 -178.0167 105.5446 -139.1333 46.0495 -254.4056 48.4455 -117.9889 40.1881 -219.8111 38.6733 -139.1333 46.0495 -141.2556 40.0693

7- Numerical values after decryption and before error handling:-

40.0000 65.0000 40.0000 49.0000 44.0000 49.0000 41.0000 42.0000 97.0000 98.0000 115.0000 40.0000 115.0000 117.0000 109.0000 40.0000 120.0000 41.0000 40.0000 102.0000 114.0000 111.0000 109.0000 32.0000 50.0000 32.0000 116.0000 111.0000 32.0000 56.0000 41.0000 41.0000 45.0000 40.0000 40.0000 107.0000 49.0000 47.0000 107.0000 50.0000 41.0000 45.0000 49.0000 41.0000 43.0000 66.0000 94.0000 65.0000 40.0000 49.0000 44.0000 49.0000 41.0000 42.0000 40.0000 107.0000 49.0000 47.0000 107.0000 50.0000 41.0000 41.0000 94.0000 40.0000 49.0000 47.0000 53.0000 41.0000

8- floor(7):- The same numerical values in (4) above.

| |
|---|
| 40 65 40 49 44 49 41 42 97 98 115 40 115 117 109 40 120 41 40 102 114 111 109 32 50 32 116 111 32 56 41 41 45 40 40 107 49 47 107 50 41 45 49 41 43 66 94 65 40 49 44 49 41 42 40 107 49 47 107 50 41 41 94 40 49 47 53 41 |

9- Decimal fractions in (7):- Values less than (0.5)..

10- Add on (8):- zeroes.

11- Final numerical values after decryption:- The same numerical values in (4) above.

| |
|---|
| 40 65 40 49 44 49 41 42 97 98 115 40 115 117 109 40 120 41 40 102 114 111 109 32 50 32 116 111 32 56 41 41 45 40 40 107 49 47 107 50 41 45 49 41 43 66 94 65 40 49 44 49 41 42 40 107 49 47 107 50 41 41 94 40 49 47 53 41 |

12- The error=abs(4-11):- zeroes.

13- Text after decryption:-

| |
|---|
| (A(1,1)*abs(sum(x)(from 2 to 8))-((k1/k2)-1)+B^A(1,1)*(k1/k2))^(1/5) |

14- Encryption time:- 0.0610 sec.

15- Decryption time:- 1.4830 sec.

The length of the original text before processing:- 68

## 5. Readings and results

We will apply this algorithm to texts in English and Arabic with varying lengths and calculate the throughput, which is equal to the size of the text encrypted in kilobytes divided by the encryption time in milliseconds, as well as the size of the text decrypted in kilobytes divided by the decryption time in milliseconds. The formula is as follows:

$$Throughput = \frac{The\ size\ of\ the\ encrypted\ text\ in\ Megabyte}{The\ time\ required\ for\ encryption\ or\ decruption\ in\ seconds}$$

Furthermore, we will rely on the size of the Word document in which the text appears in the properties window in Windows (physical size and size on disk). These results will be well-organized in the table below, and we will explain the

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results with graphs showing the relationship between the number of characters, size, encryption time, and throughput specific to the encryption time with the text size (both the actual size and the size on disk), as well as the decryption time and throughput specific to the decryption time with the text size (both the actual size and the size on disk).

Table 4. The application of the algorithm for several languages and calculation (Size ×10^(-3) k.B, Size of text On disk ×10^(-3) k.B, Enc. time m.sec, throughput between size of text on disk and encryption time, throughput between free size of text and encryption time, Dec. time m.sec, throughput between size of text on disk and decryption time, & throughput between free size of text and decryption time) for forty samples of texts.

| Plaintext | number of text characters | Size $\times 10^{-3}$ k.B | Size of text On disk $\times 10^{-3}$ k.B | Enc. time m.sec | throughput between size of text on disk and encryption time | throughput between free size of text and encryption time | Dec. time m.sec | throughput between size of text on disk and decryption time | throughput between free size of text and decryption time |
|---|---|---|---|---|---|---|---|---|---|
| We took samples of texts and in several languages (Arabic, English, Farsi, and French) | 25 | 12,731 | 16,384 | 0.0019 | 8.4203 | 6.5429 | 0.0010 | 16.8574 | 13.0989 |
| | 50 | 12,954 | 16,384 | 0.0012 | 13.5917 | 10.7463 | 0.0020 | 8.1329 | 6.4303 |
| | 75 | 12,934 | 16,384 | 0.0007 | 22.7049 | 17.9239 | 0.0010 | 16.5942 | 13.1000 |
| | 100 | 12,941 | 16,384 | 0.0094 | 1.7435 | 1.3771 | 0.0095 | 1.7179 | 1.3569 |
| | 125 | 12,941 | 16,384 | 0.0072 | 2.2844 | 1.8043 | 0.0007 | 21.9807 | 17.3616 |
| | 150 | 12.955 | 16.384 | 0.0035 | 4.6639 | 3.6878 | 0.0053 | 3.1006 | 2.4517 |
| | 175 | 12.956 | 16.384 | 0.0143 | 1.1429 | 0.9038 | 0.0003 | 60.9324 | 48.1836 |
| | 200 | 12.959 | 16.384 | 0.0009 | 19.0882 | 15.0979 | 0.0034 | 4.8597 | 3.8438 |
| | 225 | 12.967 | 16.384 | 0.0146 | 1.1246 | 0.8901 | 0.0164 | 0.9976 | 0.7896 |
| | 250 | 12.979 | 16.384 | 0.0162 | 1.0143 | 0.8035 | 0.0112 | 1.4570 | 1.1542 |
| | 275 | 12.980 | 16.384 | 0.0150 | 1.0919 | 0.8650 | 0.0081 | 2.0156 | 1.5969 |
| | 300 | 12.991 | 16.384 | 0.0223 | 0.7352 | 0.5829 | 0.0057 | 2.8975 | 2.2975 |
| | 325 | 12.985 | 16.384 | 0.0223 | 0.7359 | 0.5832 | 0.0059 | 2.7540 | 2.1826 |
| | 350 | 12.995 | 16.384 | 0.0129 | 1.2736 | 1.0101 | 0.0218 | 0.7501 | 0.5950 |
| | 375 | 12.998 | 16.384 | 0.0292 | 0.5614 | 0.4454 | 0.0030 | 5.3990 | 4.2832 |
| | 400 | 13.006 | 16.384 | 0.0371 | 0.4418 | 0.3507 | 0.0310 | 0.5294 | 0.4202 |
| | 425 | 13.006 | 16.384 | 0.0206 | 0.7939 | 0.6302 | 0.0185 | 0.8867 | 0.7039 |
| | 450 | 13.015 | 16.384 | 0.0201 | 0.8169 | 0.6490 | 0.0138 | 1.1914 | 0.9465 |
| | 475 | 13.013 | 16.384 | 0.0241 | 0.6800 | 0.5401 | 0.0242 | 0.6770 | 0.5377 |
| | 500 | 13.020 | 16.384 | 0.0408 | 0.4018 | 0.3193 | 0.0396 | 0.4133 | 0.3284 |
| | 525 | 13.015 | 16.384 | 0.0337 | 0.4856 | 0.3857 | 0.0198 | 0.8263 | 0.6564 |
| | 550 | 13.024 | 16.384 | 0.0445 | 0.3680 | 0.2925 | 0.0292 | 0.5605 | 0.4455 |
| | 575 | 13.034 | 16.384 | 0.0201 | 0.8145 | 0.6479 | 0.0539 | 0.3042 | 0.2420 |
| | 600 | 13.035 | 16.384 | 0.0524 | 0.3125 | 0.2486 | 0.0329 | 0.4976 | 0.3959 |

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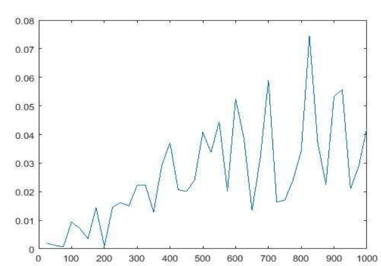
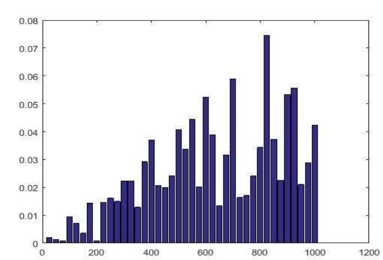
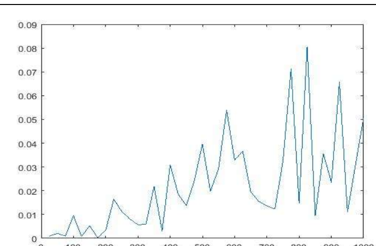
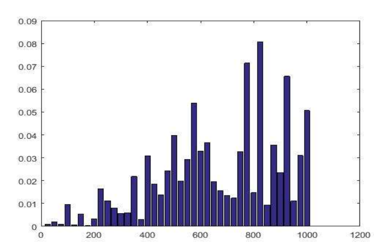
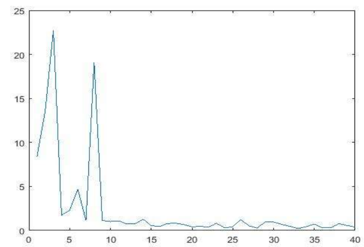
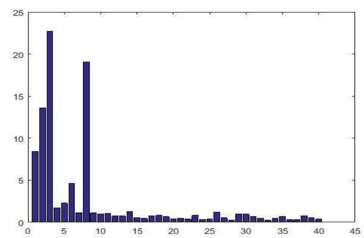
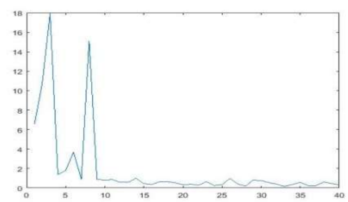
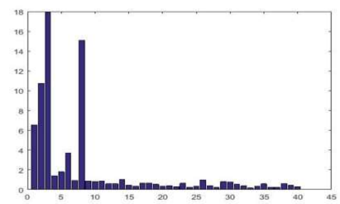
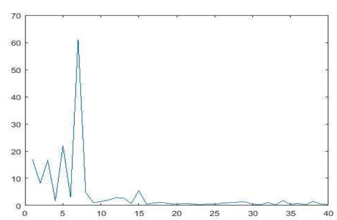
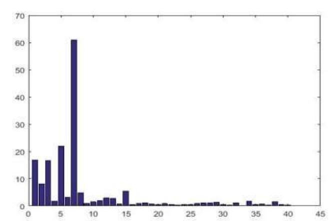
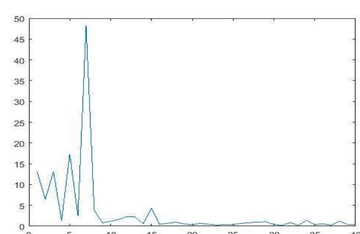
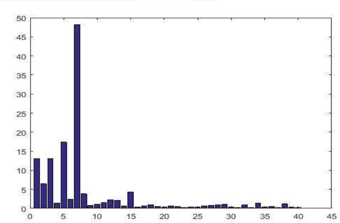
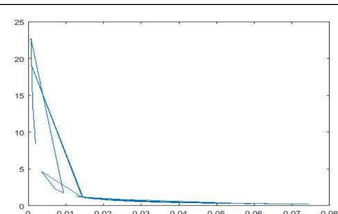
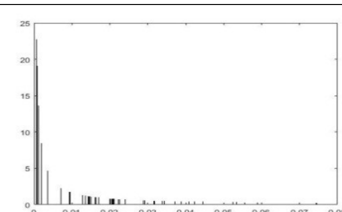
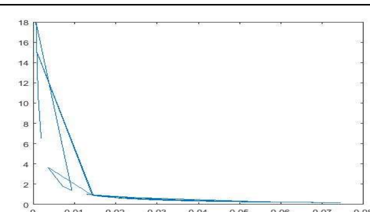
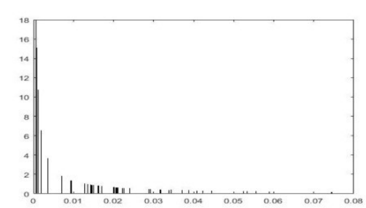
| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 625 | 13.029 | 16.384 | 0.0388 | 0.4222 | 0.3357 | 0.0366 | 0.4477 | 0.3560 |
| | 650 | 13.038 | 16.384 | 0.0135 | 1.2164 | 0.9680 | 0.0195 | 0.8388 | 0.6675 |
| | 675 | 13.041 | 16.384 | 0.0317 | 0.5167 | 0.4113 | 0.0155 | 1.0557 | 0.8403 |
| | 700 | 13.048 | 16.384 | 0.0590 | 0.2779 | 0.2213 | 0.0136 | 1.2048 | 0.9594 |
| | 725 | 13.047 | 16.384 | 0.0163 | 1.0028 | 0.7985 | 0.0123 | 1.3271 | 1.0568 |
| | 750 | 13.057 | 16.384 | 0.0170 | 0.9619 | 0.7666 | 0.0326 | 0.5026 | 0.4006 |
| | 775 | 13.061 | 16.384 | 0.0241 | 0.6812 | 0.5431 | 0.0714 | 0.2295 | 0.1830 |
| | 800 | 13.072 | 16.384 | 0.0343 | 0.4772 | 0.3808 | 0.0147 | 1.1109 | 0.8863 |
| | 825 | 13.064 | 16.384 | 0.0745 | 0.2200 | 0.1754 | 0.0806 | 0.2032 | 0.1620 |
| | 850 | 13.078 | 16.384 | 0.0372 | 0.4403 | 0.3515 | 0.0094 | 1.7390 | 1.3881 |
| | 875 | 13.070 | 16.384 | 0.0225 | 0.7274 | 0.5803 | 0.0357 | 0.4593 | 0.3664 |
| | 900 | 13.091 | 16.384 | 0.0534 | 0.3068 | 0.2451 | 0.0235 | 0.6960 | 0.5561 |
| | 925 | 13.094 | 16.384 | 0.0556 | 0.2945 | 0.2354 | 0.0656 | 0.2497 | 0.1995 |
| | 950 | 13.085 | 16.384 | 0.0210 | 0.7797 | 0.6227 | 0.0111 | 1.4725 | 1.1760 |
| | 975 | 13.104 | 16.384 | 0.0289 | 0.5678 | 0.4542 | 0.0310 | 0.5285 | 0.4227 |
| | 1000 | 13.097 | 16.384 | 0.0423 | 0.3872 | 0.3095 | 0.0507 | 0.3234 | 0.2585 |

To clarify the relationship between the concepts mentioned in the above table through iterative polygons and iterative strips we designed the figure below that gives a complete picture of all the relationships between the above concepts-:

| Describe the relationship | Repeating polygon | Histogram |
|---|---|---|
| Number of text characters & Encryption. time |  |  |
| Number of text characters & Decryption. Time |  |  |

| | | |
|---|---|---|
| Number of text characters & throughput between size of text on disk and encryption time |  |  |
| Number of text characters & throughput between free size of text and encryption time |  |  |
| Number of text characters & throughput between size of text on disk and decryption time |  |  |
| Number of text characters & throughput between free size of text and decryption time |  |  |
| Encryption. Time & throughput between size of text on disk and encryption time |  |  |
| Encryption. Time & throughput between free size of text and encryption time |  |  |

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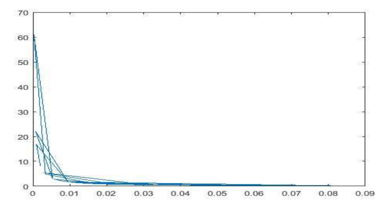
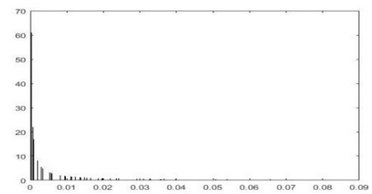
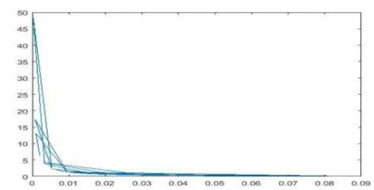
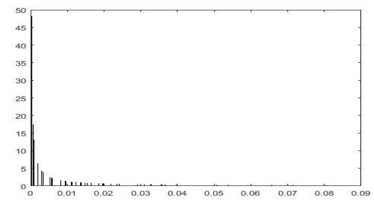
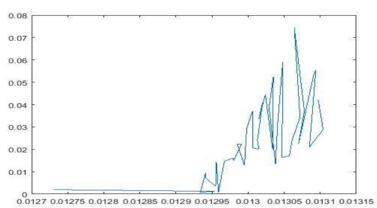
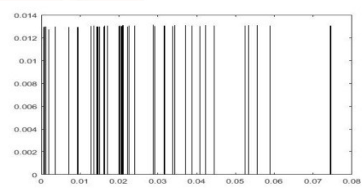
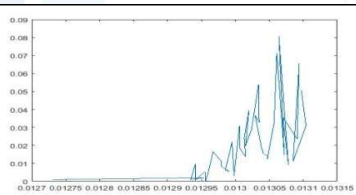
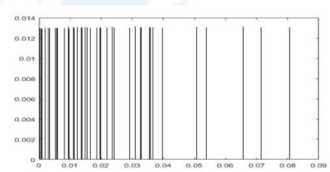
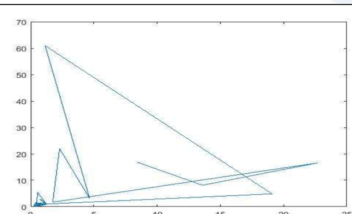
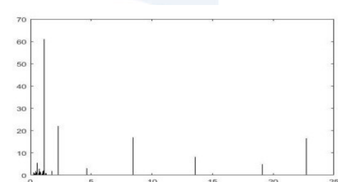
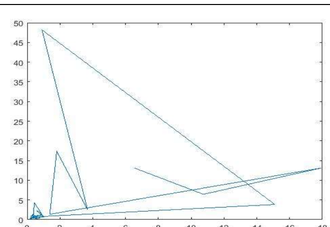
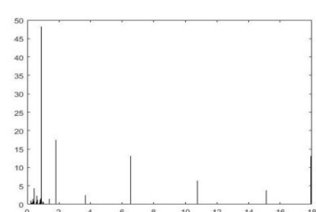
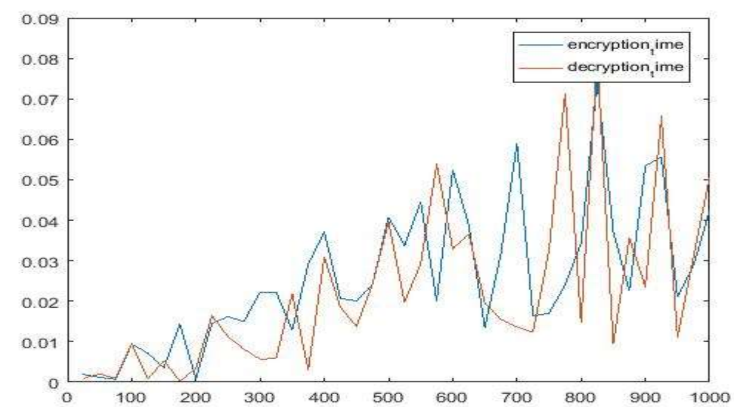
| | | |
|---|---|---|
| Decryption. Time & throughput between size of text on disk and decryption time |  |  |
| Decryption. Time & throughput between free size of text and decryption time |  |  |
| free size of text & encryption time |  |  |
| free size of text & decryption time |  |  |
| throughput between size of text on disk and encryption time & throughput between size of text on disk and decryption time |  |  |
| throughput between free size of text and encryption time & throughput between free size of text and decryption time |  |  |

| | |
|---|---|
| Number of text characters & Encryption. Time & Decryption. Time |  |



## 6. Conclusions

1- The algorithm is effective and can be applied to all texts regardless of language or text components, as it relies on numbers stored in the computer's memory.
2- There are no errors in the results, and no missing data was found. This is evident from the accuracy of the results obtained by implementing the algorithm on various texts in multiple languages.
3- Both the encryption and decryption times are minimal and almost negligible, which underscores the quality of the algorithm. It competes with currently used algorithms in research worldwide.

## 7. Discussion

Strengths

1- The results are error-free, demonstrating consistency between the original text before encryption and after decryption.
2- Both encryption and decryption times are minimal, rivaling other algorithms and representing superior performance.
3- The algorithm is applicable to all texts, languages, letters, and symbols.
4- Unlike previous classic methods that convert the original text into garbled text, the encrypted text in this algorithm is a numerical vector, representing a novel approach.

5- The encryption key is a four-component vector with specific conditions, but it allows for all real numbers, making it challenging for intruders to detect and crack the code.
6- While primarily designed for text encryption, the algorithm can be extended to encrypt images after further development.
7- The algorithm distinguishes between capital and lowercase letters in English.

Weaknesses

1- The algorithm encrypts a connected paragraph and does not encrypt two separate paragraphs unless done in separate phases.
2- Equations are not encrypted in their original form; they need to be converted into a Matlab program equation first.
3- The algorithm does not differentiate between bold, italic, and underlined text.

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