

ENCODING SYRIAC LETTERS IN PARTITION THEORY USING EXTENDED VIGENERE CIPHER

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Оскільки тема діаграми *e*-абак з'явилася в 1978 році завдяки її застосуванню в теорії розбиттів, де це подання було однією з ідей криптографії, багато дослідників вивчають дану тему з чисто теоретичної точки зору без практичного застосування. Багато дослідників виявили до неї інтерес, почавши застосовувати суто математично, але, починаючи з останніх декількох років, вони шукали ідеї по цій темі. Дане дослідження присвячене шифру Віженера, який є одним з багатоалфавітних шифрів і був одним з найпопулярніших шифрів в минулому. Це обґрунтовано його простотою та стійкістю до частотного аналізу для повідомлень, закодованих за допомогою простих шифрів, таких як шифр Цезаря. Його застосування до букв сирійської мови, що є однією з найдавніших мов, зводиться виключно до читання релігійних гімнів, християнами в деяких регіонах світу, а також в якості мови торгівлі. У 2017 році він був ретельно вивчений за допомогою наведеної діаграми і зробив використання більш конфіденційним серед користувачів з точки зору пошуку відповідного погодження між буквами англійської та сирійської мов. Розвинено математично ідеї шифрування та розвинено шифр Віженера. У сирійській мові були використані спеціальні знаки і символи, що дозволяють вирішити проблему різниці в кількості букв між двома мовами, а також використовувати шифр між буквами сирійської мови

Ключові слова: теорія розбиттів, бета-числа, шифр Віженера, сирійські букви, англійські букви

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1. Introduction

Let r be a nonnegative integer, the sequence $\mu = (\mu_1, \mu_2, \dots, \mu_n)$ is said to be the composition of r if $|\mu| = \sum_{j=1}^n \mu_j = r$ where $\mu_1, \mu_2, \dots, \mu_n$ are non-negative integers, the composition is said to be a partition of r if it is $\mu_j \geq \mu_{j+1}$ for every $j \geq 1$ [1]. β -number for any partition μ to r is $\beta_i = \mu_i + b - i$ for all $1 \leq i \leq b$ where b is a positive integer greater or equal to the number of parts of μ , and the set $\{\beta_1, \beta_2, \dots, \beta_b\}$ is called a set β -number of the partition μ . In 1978, [2] provided a diagram called the e -Abacus, this is to represent any partition μ where each partition has its own diagram. The number of runner depends on the integer $e \geq 2$ as shown below:

runner -1	runner -2	...	runner - e
0	1	...	e-1
E	e+1	...	2e-1
2e	2e+1	...	3e-1
.
.

Fig. 1. e -Abacus diagram

Each number of β -numbers will be represented by a bead (•) in diagram (A), but if not, the value in the diagram is represented by a blank (-). For example, if $\mu = (5, 5, 3, 2, 1, 1)$ and $e = 3$, then the set of β -numbers would be $\{10, 9, 6, 4, 2, 1\}$ when $b = 6$ and the abacus diagram would be:

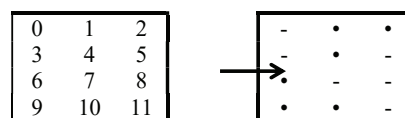


Fig. 2. 3-Abacus diagram

And if $\mu = (6, 3, 2, 2, 1)$ and $e = 4$, then the set of β -numbers would be $\{10, 6, 4, 3, 1\}$ when $b = 5$ and the abacus diagram would be:

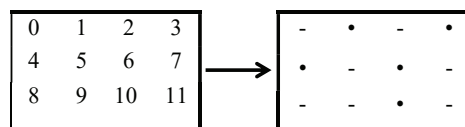


Fig. 3. 4-Abacus diagram

2. Literature review and problem statement

In the past years, there have been several studies trying to link between the letters of international languages and partition theory, especially the English letters. Sami and Mahmoodin [4] used the idea for coding Syriac letters using partition theory, as shown in the following Table 1. We tried to exploit an important aspect in some of the techniques mentioned in [5–8] references.

Table 1

The Partition for Each Syriac Letter

No.	Letter	Partition
1	Ⲁ	(43, 37, 31, 25, 19, 13)
2	Ⲃ	(30 ⁸ , 24 ⁴)
3	Ⲅ	(37 ² , 32, 31, 26, 25, 22 ² , 21 ⁴)
4	Ⲇ	(37, 32, 26, 20 ³ , 16, 15, 11 ³)
5	Ⲉ	(29, 27 ³ , 26, 24, 23, 22 ⁶)
6	Ⲋ	(30 ⁵ , 29, 24 ² , 19 ² , 14 ² , 9, 8 ⁵)
7	Ⲍ	(42, 37, 31, 25, 19, 13)
8	Ⲏ	(39 ³)
9	Ⲑ	(34 ² , 31, 30 ⁵ , 29, 28, 23 ² , 17)
10	Ⲓ	(40 ²)
11	Ⲕ	(32 ⁸ , 31, 26)
12	Ⲗ	(32 ⁷ , 31, 24, 17)
13	Ⲙ	(29 ⁸ , 28, 24 ² , 23, 16)
14	Ⲛ	(32 ⁸ , 26, 20)
15	Ⲝ	(28 ⁸ , 27, 26, 24 ² , 23, 20)
16	Ⲟ	(33 ⁷ , 32, 25)
17	Ⲡ	(30 ⁸ , 24 ² , 19 ²)
18	Ⲣ	(42 ³ , 38, 31, 26 ²)
91	ⲥ	(30 ⁸ , 29, 25 ³)
02	Ⲧ	(38, 32, 26 ³ , 22, 21, 17 ³ , 6)
21	ⲧ	(31 ⁷ , 30 ³ , 25)
22	Ⲩ	(35 ⁴ , 29, 23, 17)

3. The aim and objectives of the study

The aim of the study is to complement the ideas put forward in the Sami and Mahmood research, including which is there an additional way to make coding Syriac letters more secure.

To achieve this aim, the following objectives are accomplished:

- are there previously approved methods that can be adopted (as encryption) and can be applied to Syriac letters by using the coding techniques;
- is it possible to combine more than one coding at the same time.

4. Vigenere Cipher

It is one of the best known manual methods for multi-letter cipher, Vigenere uses the English letters arranged by a table named Vigenere table (Table 2). Consisting of 26 rows and 26 columns, this table is used for encryption and decryption. The first row consists of the English alphabet (26 letters) arranged in the order from letter (A) to (Z), which represents the letters that make up plain text. The first column from the left also consists of alphabetical letters arranged in the column; the letters represent an encryption key, each containing the row specified by the letter, and are the repetition of the alphabet that appeared from that letter. You can learn more about the history of the cipher and how to use it by [7–10].

Table 2

Vigenere Table

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

It can also be represented mathematically by using the following two equations:

$$C_i = (P_i + K_i) \text{ mod } 26,$$

$$p_i = (C_i - K_i) \text{ mod } 26,$$

where C represents the encrypted text, P represents the plain text and K represents the key.

Equation (1) for encrypted text and equation (2) for decryption. Used by sequencing each letter from 0 to 25.

5. Vigenere cipher with Syriac letters

Syriac is a Semitic language derived from Aramaic, which in the 6th century BC was the only spoken language in the Fertile Crescent until after the birth of Christ. Its new name acquired Syriac in the fourth century, coinciding with the spread of Christianity in the Levant. Syriac is the mother tongue of the Assyrian, Syriac, Chaldean communities in Iraq and Syria in specific. However, it is used not only by them but also by a number of Christian clergies in their books such as Arabs, Persians, Turks, Armenians, etc. The researchers [5, 6] indicate that there is a constant connection between the Syriac language and the Arabic language because of migration and trade and cultural exchange between the Levant and the Arabian Peninsula.

The Syriac language, like all other languages, has 22 letters and contains symbols as shown in Table 3.

Table 3

Syriac Letters and Symbols

Letters	ܐ	܂	܃	܄	܅	܆	܇	܈	܉	܊	܋	܌	܍	܎	܏	ܐ	ܑ	ܒ	ܓ	ܔ	ܕ	ܕ	ܕ
letters change depending on their location																							
symbols	!]	[«	»	-	.	,	:	/	()	(*	+	:	:	:	:	:	:	:	:	:

Before we start applying Vigenere cipher to Syriac letters, we know that any person, who knows the Syriac language and the sequence of its letters, is able to break the cipher. So in this research, the researchers decided to rearrange the letters according to the partition and beads of each letter that were found by Sami and Mahmood [4]. It is arranged by knowing the number of beads formed for each letter, then we start from the letter that has the lowest number, gradually to the last letter that has the most number of beads. If there is a repetition in the number of beads, we will look for the smaller μ_1 where it is placed in the first, and if it is found in some letters that the number of beads is equal and also the value of μ_1 , the researchers will resort to μ_2 and so... Table 4 below shows the Syriac letters, the number of beads and the partition of each letter arranged from smallest to largest (Table 4).

Now we will create a Vigenere table on Syriac letters, but it should be noted here that the table will carry the

same old characteristics of the Vigenere table but the difference will be here in the Syriac letters and also the arrangement of the Syriac letters as shown below (Table 5).

Table 4

The Number of Beads in Each Syriac Letters

	Syriac letters	Beads	Partition
1	ܐ	2	(40 ²)
2	܂	3	(39 ³)
3	܃	6	(42, 37, 31, 25, 19, 13)
4	܄	6	(43, 37, 31, 25, 19, 13)
5	܅	7	(35 ⁴ , 29, 23, 17)
6	܆	7	(42 ³ , 38, 31, 26 ²)
7	܇	9	(33 ⁷ , 32, 25)
8	܈	01	(32 ⁷ , 31, 24, 17)
9	܉	01	(32 ⁸ , 26, 20)
01	܊	01	(32 ⁸ , 31, 26)
11	܋	11	(31 ⁷ , 30 ³ , 25)
21	܌	11	(37, 32, 26, 20 ³ , 16, 15, 11 ³)
31	܍	11	(38, 32, 26 ³ , 22, 21, 17 ³ , 6)
41	܎	21	(30 ⁸ , 24 ² , 19 ²)
51	܏	21	(30 ⁸ , 24 ⁴)
61	ܐ	21	(30 ⁸ , 29, 25 ³)
71	ܑ	21	(37 ² , 32, 31, 26, 25, 22 ² , 21 ⁴)
81	ܒ	31	(29, 27 ³ , 26, 24, 23, 22 ⁶)
91	ܓ	31	(29 ⁸ , 28, 24 ² , 23, 16)
02	ܔ	31	(34 ² , 31, 30 ³ , 29, 28, 23 ² , 17)
12	ܕ	41	(28 ⁸ , 27, 26, 24 ² , 23, 20)
22	ܕ	81	(30 ⁵ , 29, 24 ² , 19 ² , 14 ² , 9, 8 ⁵)

It can also be calculated mathematically by the sequence of each letter in the new order, so the equation will be:

$$C_j = (P_j + K_j) \text{ mod } 22 \dots, \tag{1}$$

$$p_j = (C_j - K_j) \text{ mod } 22 \dots, \tag{2}$$

where is j sequence of the letter from 1 to 22, C represents the encrypted text, P represents the plain text, K represents the key.

For example, the message to be encrypted is ܐܘܪܝܢܐ, and the key word is ܡܢܝܢܐ, the encrypted text would be (Table 6).

The Vigenere table of Syriac letters can be used by intersecting plain text letters with a key letter, as shown below (Table 7).

To decrypt, we use equation (2), where we will use the encrypted text and the key to get the plain text, as shown below (Table 8).

And this method is very important for solving our problem.

Table 8

Rule Application Mechanism

Encrypted Text	ⲁ	ⲅ	ⲉ	ⲓ
C_j	ⲗ	ⲛ	ⲟⲓ	9
Key	Ⲛ	ⲛ	ⲛ	ⲉ
K_j	4	ⲓ	9	16
$p_j = (C_j - K_j) \bmod 22$	ⲉ	ⲟ	ⲓ	15
Plain Text	Ⲛ	ⲛ	ⲛ	ⲉ

6. Syriac and English in the Vigenere Cipher

In this part, we have a process to strengthen the cipher and make it more difficult to break, which is the process of linking the letters of the Syriac language and English

language, where the work is done by entering the plain text in Syriac and the key is in English and therefore the encrypted text will be in Syriac. The researchers found that the number of letters in the Syriac language is 22, which is less than the number of English letters. So we added letters that can change when they come in the middle and the end of the word and also added a number of symbols used in the Syriac language; the number became 52 letters and symbols. As for the letters in English, we will repeat them with an addition (‘) to denote a new letter. For example, the letter A, when repeated, becomes a new sequence A ‘. Syriac letters and symbols will be arranged in the same way we did in (3) depending on the number of beads and partition of each letter. In [4], only Syriac letters partition has been found, since we added new symbols, so we need to find partition for it, as shown below (Fig. 4).

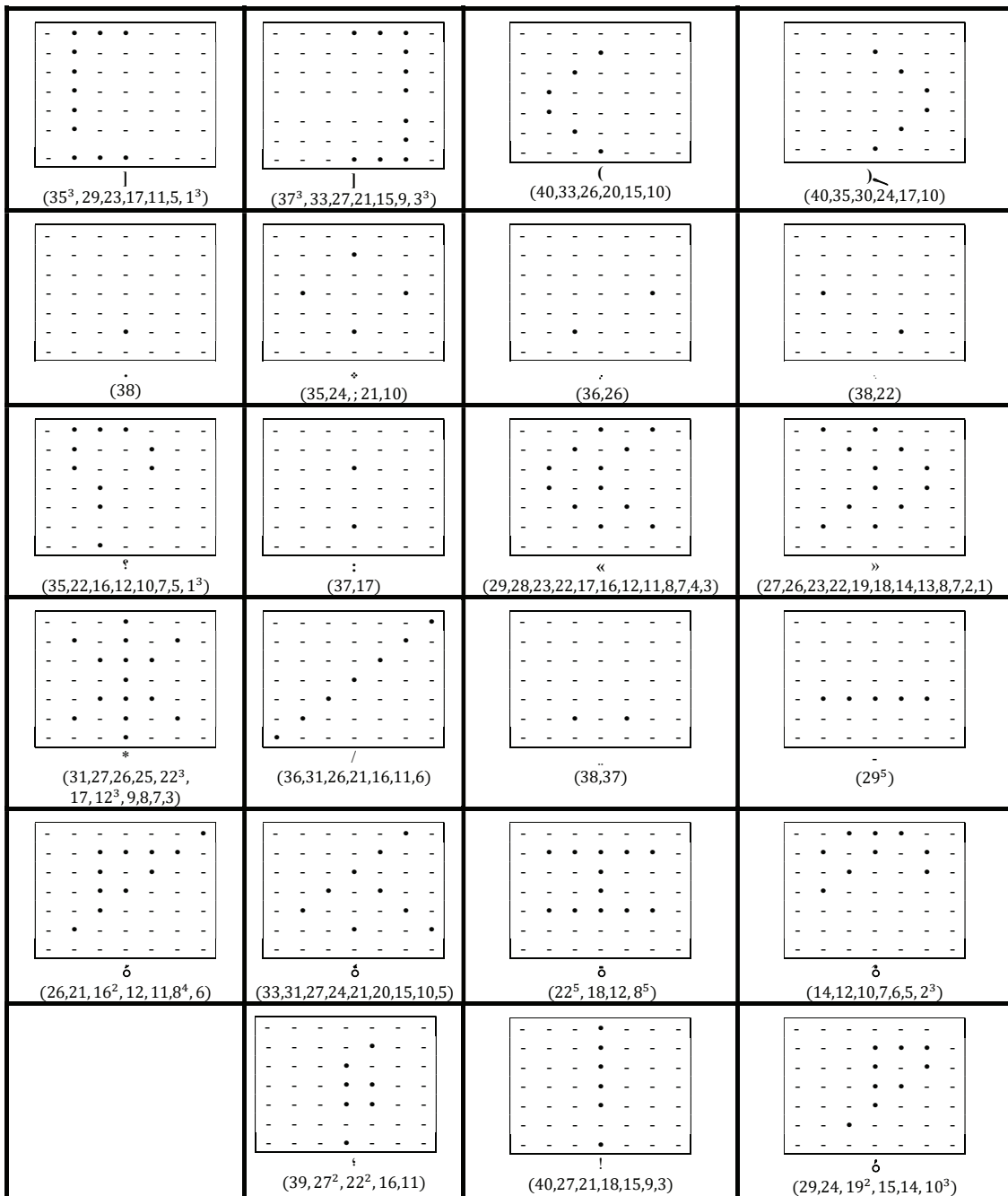


Fig. 4. Symbols of Syriac Partition

In Table 9, the new arrangement will be shown with beads and the partition of each letter.

Where (*Sy*) represents the symbols, (*Be*) the number of beads, μ the partition and (*Le*) represents the English letter (Table 9).

Vigenere table, because of the large number of letters, we have divided it, so became (Table 10).

It can be calculated using mathematical equations:

$$C_s = (P_s + K_s) \bmod 52 \dots, \tag{3}$$

$$p_s = (C_s - K_s) \bmod 52 \dots, \tag{4}$$

where *s* represents the sequence of letters from 1 to 52.

Table 9

Merging the Syriac and English Letters

No.	<i>Sy</i>	<i>Be</i>	μ	Le
1	2	3	4	5
1	.	1	(38)	A
2	:	2	(36, 26)	B
3	:	2	(37, 17)	C
4	.	2	(38, 22)	D
5	..	2	(38, 37)	E
6	,	2	(40 ²)	F
7	⋈	3	(39 ³)	G
8	⋈	4	(35, 24, 21, 10)	H
9	⋈	4	(39 ³ , 44)	I
10	/	4	(45, 38, 31, 24)	J
11	-	5	(29 ⁵)	K
12	!	6	(40, 27, 21, 18, 15, 9, 3)	L
13	(	6	(40, 33, 26, 20, 15, 10)	M
14	)	6	(40, 35, 30, 24, 17, 10)	N
15	,	6	(42, 37, 31, 25, 19, 13)	O
16	⋈	6	(43, 37, 31, 25, 19, 13)	P
17	⋈	7	(35 ⁴ , 29, 23, 17)	Q
18	/	7	(36, 31, 26, 21, 16, 11, 6)	R
19	:	7	(39, 27 ² , 22 ² , 16, 11)	S
20	⋈	7	(41, 34, 27, 24 ⁴)	T
21	⋈	7	(42 ³ , 38, 31, 26 ²)	U
22		8	(34, 33 ² , 29, 28, 23 ² , 17)	V
23	⋈	8	(34 ⁴ , 30, 29, 25, 24)	W
24	.	9	(14, 12, 10, 7, 6, 5, 2 ³)	X
25	.	9	(29, 24, 19 ² , 15, 14, 10 ³)	Y
26	.	9	(33, 31, 27, 24, 21, 20, 15, 10, 5)	Z
27	⋈	9	(33 ⁷ , 32, 25)	A'
28	⋈	01	(32 ⁴ , 28, 27, 23, 22, 18, 17)	B'
29	⋈	01	(32 ⁷ , 31, 24, 17)	C'
30	/	01	(32 ⁸ , 26, 20)	D'
31	⋈	01	(32 ⁸ , 31, 26)	E'
32	⋈	01	(35, 22, 16, 12, 10, 7, 5, 1 ³)	F'
33	⋈	01	(36, 33 ³ , 29, 28, 24 ³ , 17)	G'
34	.	11	(26, 21, 16 ² , 12, 11, 8 ⁴ , 6)	H'
35	⋈	11	(31 ⁷ , 30 ³ , 25)	I'
36	[	11	(35 ³ , 29, 23, 17, 11, 5, 1 ³)	J'

Continuation of Table 10

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
D'	5	5	5	.	[[[[[[[[[[[[[[[[[[[[[[[
E'	5	5	5	.	[[[[[[[[[[[[[[[[[[[[[[[
F'	5	5	5	.	[[[[[[[[[[[[[[[[[[[[[[[
G'	5	5	5	.	[[[[[[[[[[[[[[[[[[[[[[[
H'	5	5	5	.	[[[[[[[[[[[[[[[[[[[[[[[
I'	5	5	5	.	[[[[[[[[[[[[[[[[[[[[[[[
J'	5	5	5	.	[[[[[[[[[[[[[[[[[[[[[[[
K'	5	5	5	.	[[[[[[[[[[[[[[[[[[[[[[[
L'	5	5	5	.	[[[[[[[[[[[[[[[[[[[[[[[
M'	5	5	5	.	[[[[[[[[[[[[[[[[[[[[[[[
N'	5	5	5	.	[[[[[[[[[[[[[[[[[[[[[[[
O'	5	5	5	.	[[[[[[[[[[[[[[[[[[[[[[[
P'	5	5	5	.	[[[[[[[[[[[[[[[[[[[[[[[
Q'	5	5	5	.	[[[[[[[[[[[[[[[[[[[[[[[
R'	5	5	5	.	[[[[[[[[[[[[[[[[[[[[[[[
S'	5	5	5	.	[[[[[[[[[[[[[[[[[[[[[[[
T'	5	5	5	.	[[[[[[[[[[[[[[[[[[[[[[[
U'	5	5	5	.	[[[[[[[[[[[[[[[[[[[[[[[
V'	5	5	5	.	[[[[[[[[[[[[[[[[[[[[[[[
W'	5	5	5	.	[[[[[[[[[[[[[[[[[[[[[[[
X'	5	5	5	.	[[[[[[[[[[[[[[[[[[[[[[[
Y'	5	5	5	.	[[[[[[[[[[[[[[[[[[[[[[[
Z'	5	5	5	.	[[[[[[[[[[[[[[[[[[[[[[[
A	5	5	5	.	[[[[[[[[[[[[[[[[[[[[[[[
B	5	5	5	.	[[[[[[[[[[[[[[[[[[[[[[[
C	5	5	5	.	[[[[[[[[[[[[[[[[[[[[[[[
D	5	5	5	.	[[[[[[[[[[[[[[[[[[[[[[[
E	5	5	5	.	[[[[[[[[[[[[[[[[[[[[[[[
F	5	5	5	.	[[[[[[[[[[[[[[[[[[[[[[[
G	5	5	5	.	[[[[[[[[[[[[[[[[[[[[[[[
H	5	5	5	.	[[[[[[[[[[[[[[[[[[[[[[[
I	5	5	5	.	[[[[[[[[[[[[[[[[[[[[[[[
J	5	5	5	.	[[[[[[[[[[[[[[[[[[[[[[[
K	5	5	5	.	[[[[[[[[[[[[[[[[[[[[[[[
L	5	5	5	.	[[[[[[[[[[[[[[[[[[[[[[[
M	5	5	5	.	[[[[[[[[[[[[[[[[[[[[[[[
N	5	5	5	.	[[[[[[[[[[[[[[[[[[[[[[[
O	5	5	5	.	[[[[[[[[[[[[[[[[[[[[[[[
P	5	5	5	.	[[[[[[[[[[[[[[[[[[[[[[[
Q	5	5	5	.	[[[[[[[[[[[[[[[[[[[[[[[
R	5	5	5	.	[[[[[[[[[[[[[[[[[[[[[[[
S	5	5	5	.	[[[[[[[[[[[[[[[[[[[[[[[
T	5	5	5	.	[[[[[[[[[[[[[[[[[[[[[[[
U	5	5	5	.	[[[[[[[[[[[[[[[[[[[[[[[
V	5	5	5	.	[[[[[[[[[[[[[[[[[[[[[[[
W	5	5	5	.	[[[[[[[[[[[[[[[[[[[[[[[
X	5	5	5	.	[[[[[[[[[[[[[[[[[[[[[[[
Y	5	5	5	.	[[[[[[[[[[[[[[[[[[[[[[[
Z	5	5	5	.	[[[[[[[[[[[[[[[[[[[[[[[
A'	5	5	5	.	[[[[[[[[[[[[[[[[[[[[[[[
B'	5	5	5	.	[[[[[[[[[[[[[[[[[[[[[[[
C'	5	5	5	.	[[[[[[[[[[[[[[[[[[[[[[[
D'	5	5	5	.	[[[[[[[[[[[[[[[[[[[[[[[
E'	5	5	5	.	[[[[[[[[[[[[[[[[[[[[[[[

Continuation of Table 10

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
F'	⋄	⋄	/	-	!	()	-	⋄	⋄	/	:	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	
G'	⋄	/	-	!	()	-	⋄	⋄	/	:	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	
H'	/	-	!	()	-	⋄	⋄	/	:	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	
I'	-	!	()	-	⋄	⋄	/	:	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	
J'	!	()	-	⋄	⋄	/	:	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	
K'	()	-	⋄	⋄	/	:	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	
L')	-	⋄	⋄	/	:	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	
M'	-	⋄	⋄	/	:	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	
N'	⋄	⋄	/	:	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	
O'	⋄	/	:	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	
P'	/	:	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	
Q'	:	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	
R'	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	
S'	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	
T'	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	
U'	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	
V'	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	
W'	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	
X'	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	
Y'	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	
Z'	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	⋄	

For example, the message to be encrypted is ܠܘܕܘܟܘܢܘܬܘܢ , and the key word is GOOD LUCK, the encrypted text would be (Table 11).

Table 11

Rule Application Mechanism

Plain text	ܠ	ܘ	ܘ	ܕ	ܘ	ܕ	ܘ	ܕ	ܘ	ܕ	ܘ	ܕ	ܘ	ܕ	ܘ	ܕ	ܘ	ܕ	ܘ	ܕ	ܘ	ܕ	ܘ	ܕ	ܘ	ܕ
P_s	16	48	25	39	35	34	52	16	30	6	34	35														
Key	G	O	O'	D	L	U	C'	K	G	O	O'	D														
K_s	7	15	41	4	12	21	29	11	7	15	41	4														
$C_s = (P_s + K_s) \bmod 52$	23	11	41	43	47	3	29	27	37	21	23	39														
Encrypted text	ܘ	-	)	ܘ	ܘ	:	ܘ	ܘ	ܘ	ܘ	ܘ	ܘ	ܘ	ܘ	ܘ	ܘ	ܘ	ܘ	ܘ	ܘ	ܘ	ܘ	ܘ	ܘ	ܘ	ܘ

It is also possible to validate the solution through the Vigenere table by intersecting the plain text with the key.

To decrypt, we will use the second equation to find the plain text, as shown below (Table 12).

Table 12

Rule Application Mechanism

Encrypted text	ܘ	-	)	ܘ	ܘ	:	ܘ	ܘ	ܘ	ܘ	ܘ	ܘ	ܘ	ܘ	ܘ	ܘ	ܘ	ܘ	ܘ	ܘ	ܘ	ܘ	ܘ	ܘ	ܘ	ܘ
C_s	23	11	41	43	47	3	29	27	37	21	23	39														
Key	G	O	O'	D	L	U	C'	K	G	O	O'	D														
K_s	7	15	41	4	12	21	29	11	7	15	41	4														
$p_s = (C_s - K_s) \bmod 52$	16	48	25	39	35	34	52	16	30	6	34	35														
Encrypted text	ܠ	ܘ	ܘ	ܘ	ܘ	ܘ	ܘ	ܘ	ܘ	ܘ	ܘ	ܘ	ܘ	ܘ	ܘ	ܘ	ܘ	ܘ	ܘ	ܘ	ܘ	ܘ	ܘ	ܘ	ܘ	ܘ

5. Discussion of experimental results

Among the most important discussions that we came out with are:

The Syriac letters can play a pivotal role in the applications of types of encryption; especially as it is a language that is currently less used except in certain regions of the world and therefore it can be a lifeline for rescue.

It is quite useful that the choice of the Vigenere cipher was a good choice because it contains special conditions and flexibility, which made working on it completely useful.

It is quite natural that the experience of Syriac letters with other types with encoding operations will give us different results from those found here in this work, knowing that until the preparation of this research, we only tried two types of encoding and it was noticed that the results did not differ by a large percentage, so it was limited speak on Vigenere.

6. Conclusions

1. The ability to apply Vigenere Cipher not only to the English language letters (or similar ones) exclusively, but also possible with the letters of any language used, but it just needs to make a kind of common basis for the coding to be appropriate.

2. In the research, work was done (pairing) between the letters of the English language, which led to a significant development in the use of this technology significantly. The letters, signs and symbols used in the Syriac language were used as one unit, which made a great development, as it made difficult for non-speakers to reveal the mysteries of this topic.

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