

Interaction Relationship between Symmetry and Arts in the Kingdom of Saudi Arabia

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Abstract

This study has introduced the Art in a new vision to increase the understanding of Saudi Art at the International level. The focus was on architecture patterns (in Al_Haram Al_Madini) and literature (poems, speeches). It is achieved through introducing the Art through the eyes of symmetry as new concept embedded in the art.

The aims of the study are:

1. to explore the characteristics of Saudi Art through symmetry,
2. to build a database of computer art,
3. to save the heritage art,
4. to develop art utilizing sophisticated scientific concepts with the use of latest technology.

The methodology focuses on two aspects; that are architecture patterns and literature relevant to poems and speeches. In the case of architecture patterns, the examining method has closely looked at the different types of symmetry like Rosette, Frieze, and Crystallographic symmetry Art. As for speeches and poems, the focused was on the general symmetrical concepts.

Keywords: Computer Art, Symmetry, Architecture Patterns, Rosette, Frieze, Crystallographic, Poems, Speeches.

1. Introduction

Muslims and Arab before Islam have known different kind of art since a long time ago, architecture is one of these art. The work of mosaic, painting the wall and internal decoration are found in different kind of such architecture art.

In the Arabian Peninsula, their art relied on materials like clay and stone colored, lead, fatty substances of plant, gypsum, precious wood, white marble, granite, sheets of gold, silver, precious stones, age of Ivory and other more of building icon materials, Mosque of Al_Madina can be considered the prototype building in the Arabian Peninsula beside Makka Mosque. It is one of the most prominent of these models, and also one of the most beautiful buildings of the Islamic world, even in terms of magnificence, decoration, and design. The Mosque is an engineering giant within the city of Madina Manwara,

Figure 1 shows a prototype of the form of the Madina Mosque at the time of Muhammad (peace be upon him) 622CE. The original mosque was an open-air building (covered by palm fronds) with a raised platform for the reading of the Quran. It was a rectangular enclosure of 30 m × 35 m (98 ft × 115 ft) at a height of 2 m (6 ft 7 in) wall which was built with palm trunks and mud walls. It was accessed through three doors: Bab Rahmah (Door of Mercy) to the south, Bab Jibril (Door of Gabriel) to the west and Bab al-Nisa' (Door of the Women) to the east.

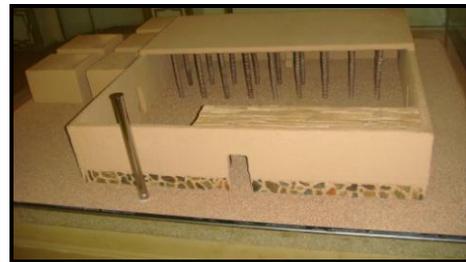


Fig (1) Madina first built by Prophet Muhammad (peace be upon him) and his companions

Figure 2 shows the Prophet's Mosque during the Ottoman Era taken from the web address [29].



Fig (2) The Grand Mosque in the era of the Ottoman Empire

The Founder of Saudi Arabia the King Abdul Aziz Al_Saud (Rahamh Allah) has controlled Makkah, and established the modern kingdom of Saudi Arabia. He has accepted guardianship of the holy sites as a prime responsibility of the kingdom.

Figure 3 is picture of the mosque at present taken from the web address [30].



Fig (3) the grand Mosque in the current Al Saud era

Figure 4 illustrations of suggested extension work in the future taken from the web address [31].



Fig (4) The grand Mosque with future extension plan

2. Background and the Investigation

How did the sophisticated Islamic geometrical patterns to be found on the whole and ground surfaces, on windows as frames, on doors dated from the beginning building Mosque of Al_Madina onwards evolve?.

Clearly, they did not evolve spontaneously. In addition, this investigation is looking at the symmetry in Saudi literatures [1, 28].

Previous work done by the author has used geometric and group-theoretic methods [15, 19, 22], tiling [18], colour & text [16, 17, 20, 21], biometrics and symmetry [23], tracking sepsis movement [24] to generate patterns, and interaction between Islamic Art, dialogue and peace [26]. Work by other researchers and scientists [2, 10] had carried out to produce images through the use of other methods. Over the past years the author has used computer graphics to study and analysis four hundred patterns on two dimensions plan. It found that $p3m1$, pmg , pg , and pgg are very rare patterns types and in many cases not attractive to the eye or to look at. $P6m$, $p4m$, $c2m$, $p2m$, $pm\ p6$ and $p4$ are very common pattern type.

There are many studies on Islamic patterns exist on Al_Hambra (Spain), Egypt and Turkey. These studies are

mainly looking at two dimension patterns. There is no such study on the Al_Haram. One frequently asked question is whether all the 17 wallpaper groups or 7 Frieze groups and point group can be found in Al_Madina Mosque? As for literature, the study explored symmetry in their contents.

This work will make a large contribution towards classifying Saudi Arabia Arts in Madina in addition to literature classification. Based on the founding, recommendation and advice will be given to the company in case of architectural patterns that look after the internal architecture product in the Al_Haram, burn in mine the author's previous experience.

The Mosque is lavishly decorated with stone and wood carvings and tile patterns on most of the ceilings, walls, and floors. Islamic art does not use representations of living beings, but heavily uses geometric patterns, especially symmetric (repeating) patterns.

3. Basic Theoretical Concepts and Definitions

In nature, the notion of symmetry is often associated with harmony of forms and beauty, and its concept is widely applied in objects (such as patterns and literatures).

The task of this section is to explain an important concept that needed in developing the methodology in the next part, it is build to drive and establish efficient path for classification and generation of Islamic pattern in Madina Mosque and literature (poems, speeches). This information is focused to avoid any unnecessary and irrelevant details for simplifying reasons.

The definitions and concept are as follow:

Figure, Object: a shape on a plane, includes points, lines, polygons, polygon interiors, circles, disks, parabolas, ellipses, hyperbolas, ...etc. Formally, a figure is any set of points on a plane [2]. As for literatures, speeches and poems can be any sets of letters or words and their locations.

Pattern, design: artwork of figure [9].

Pattern: is an artistic or decorative design [5].

Symmetry Pattern: is symmetric if there are translations, rotations, reflections, or glide reflection when applied to the pattern leave the appearance of the pattern unchanged. [15, 19, 22, 25].

Crystallographic Pattern: is a pattern which covers the entire plane and can be produced by repeatedly applying transformations to a finite motif (and to the images of that motif) [3, 25].

Frieze Pattern: is an infinite strip with a repeating pattern, is called a Frieze pattern [4].

Rosette Pattern: is any pattern having a flowerlike form [8], for example **R0**, **D2**, ... etc. as explain below.

R0: Reflection Symmetry Pattern has only one reflection.

Dn: Reflection Symmetry Pattern if the pattern has n fold reflection and n fold rotation, for example, **D2** is Reflection Symmetry Pattern has 2 fold reflections and 2 fold rotations.

Cn: Rotational Symmetry Pattern has n fold rotation, for example, **C2** is Rotational Symmetry Pattern has 2 fold rotations.

Algorithms are developed in the following section used below notations:

T The symbol **T** denotes a **Cell template tile** in which a cell is to be placed. **Cell** is the set of **Frames (Cell elements)**, The concept **Frame** present the position part in the Cell template tile. It is one entity in the set of entities presenting the continue bath movement of the line, It is constructed of one point "coordinate (x,y)". It is assumed that the template cell has no symmetries.

T_b^a In general, the subscripted symbol **T** is used to denote a tile generated by mirroring **T** in the line **ab**.

T_s^c The symbol **T** is used to denote the tile generated by rotating **T** about the point **C** through degrees **s**.

T_{ab} The symbol is used to denote the tile generated by movement with the distance **ab** followed by a mirror in the line joining the points **a** and **b**. In some cases of using **2ab** or **3ab**, the movement distance will be twice or three time of the distance between **a** and **b**.

U Construct of **Unit tile U** by gluing to **T** the Transformed versions of **T** as shown in the algorithms. A notation **P2,U** or **Pg,U** are used to present the unit tile that used to copied to produce the P2 or Pg pattern types.

+ The symbol **+** has used to denote the action of gluing two tiles together.

4. Methodology

The methodology has divided into two approaches or stages, which called Literature and Architecture Patterns. These approaches are described using flowchart as in Figure (5) below.

4.1 Literature Approach

It shows the method to classify poems and speeches. Literature, unlike architecture patterns, mathematics and many of the sciences, is an inherently subjective pursuit. One cannot alter the laws of physics or the principles of calculus at all, yet the meaning of a literary work can be

changed simply through a matter of interpretation, literature have given the artist and speaker greater freedom to play around with structure and content.

The classification method of symmetry in writing is as follows:

1. The last sounds that two or more words make sound the same or very similar.
2. The placement of symmetry in poetry is most often at the end of line, especially when the lines have a similar meter, or number of stressed or unstressed syllables.
3. Similar sounds can occur in the beginning or middle of words, symmetry requires both the end vowel and consonant combinations to sound alike.
4. Sequence of words repeated throughout the literature in systematic way, and such repetitions are classified. The enjoyment is come from identifying the recurrence of a complex structure, from recognizing how it has been translated throughout the literature.
5. In certain cases, overall structure of literature can have the pattern of "beginning," "middle," and "end.", the middle can serve as a focal point where events take place and the beginning reflect or plot points towards the end of the literature.

Above classifications are hard to spot for non-speakers of the language, it is hoped that we can decode the structural systematic of various classifications. This is done in the analysis of the structure of Saudi poems whereby words are replicated in such a unique manner that it makes profound sense. For paper cut, it will illustrate how they use different forms of symmetry-rotational, reflection, and repetition.

4.2 Architecture Patterns Approach

The Approach shows the methodology to classify Architecture patterns collected from Al_Haram Al_Shrif in Madina, the outcome of the approach is grouping these patterns. There are analysis diagrams for Crystallographic and Frieze patterns classification in various books and websites [14, 15, 16]. Therefore, there is no need to include them in this paper.

This approach is summarized in the below flowchart, see Figure 5. The diagram clearly stated the first question should ask whether the pattern is two dimensional patterns or not? If it is, the reader should refer to the classification

method to find the type of Crystallography pattern. If the pattern is not one of Crystallographic patterns, that means, it is not symmetry. If the result of the pattern examination is not in two dimensions, the following question should be asked, is the pattern in one dimension? If the answer yes to this question, the reader should refer to the classification method of Frieze pattern to find the type of it. If the pattern is not one of Frieze patterns type, that means, it is not symmetry. If the result of the pattern examination is not in one dimension, then the checking will be against Rosette patterns. There are two groups of Rosette patterns, these are depended on symmetry (reflection and rotation) of the pattern. If the pattern examination is not in one dimension, the following question should be asked, does the pattern has reflection? The pattern is R0 type if it has only one reflection, and it is Dn type if it has n-fold reflection and n-fold rotation. If the pattern has no reflection, the following question should be asked, does the pattern has rotation? Cn is the type of pattern if it has n-fold rotation and the pattern is not symmetry if it has no rotation.

The following information will explained the basic and main algorithms used in the approach, it is only for Crystallography patterns, although Frieze and Rosette patterns algorithms are part of Crystallography algorithms. There are mainly five different type of tiles categorized by their inner angles and their sides, these are; 1) parallelogram, 2) triangle, 3) rectangle, 4) square and 5) rhombus. Below, list of algorithms give the heart of the interactive computer graphics algorithms for the construction of each of the seventeen types of two-dimensional repeat patterns. The reader will find different algorithm published in references [11, 12, 14].

1. $P1,U = T$, where T is parallelogram.
2. $P2,U = T + T_{o180}$, where T is triangle.
3. $Pm,U = T + T_{ce}$, where T is rectangle.
4. $Pg,U = T + T_{hd}$, where T is rectangle.
5. $Pmm,U = T + T_{ce} + T_{ge} + T_{e180}$, where T is rectangle.
6. $Pmg,U = T + T_{ce} + T_{2hd} + T_{3hd}$, where T is rectangle.
7. $Pgg,U = T + T_{hd} + T_{e180} + T_{bf}$, where T is rectangle.
8. $Cm,U = T + T_{ab}$, where T is triangle.
9. $Cmm,U = T + T_{ab} + T_{cb} + T_{b180}$, where T is triangle.
10. $P4,U = T + T_{o90} + T_{o180} + T_{o270}$, where T is square.
11. $P4mg,U = T1 + T1c90 + T1c180 + T1c270$, where $T1 = T + T_{cb}$ and T is square.
12. $P4m,U = T1 + T1b90 + T1b180 + T1b270$, where $T1 = T + T_{ab}$ and T square.
13. $P3,U = T + T_{o120} + T_{o240}$, where T is rhombus.

14. $P3m1,U = T1 + T1b120 + T_{b240}$, where $T1 = T + T_{ab}$ and T is rhombus
15. $P31m,U = T1 + T1c120 + T1c240$, where $T1 = T + T_{ab}$ and T is triangle.
16. $P6,U = T1 + T1ab$, where $T1 = T + T_{c120} + T_{c240}$ and T is triangle.
17. $P6m,U = T2 + T2ab$, where $T2 = T1 + T1c120$, & $T1 = T + T_{ab}$ and T is triangle.

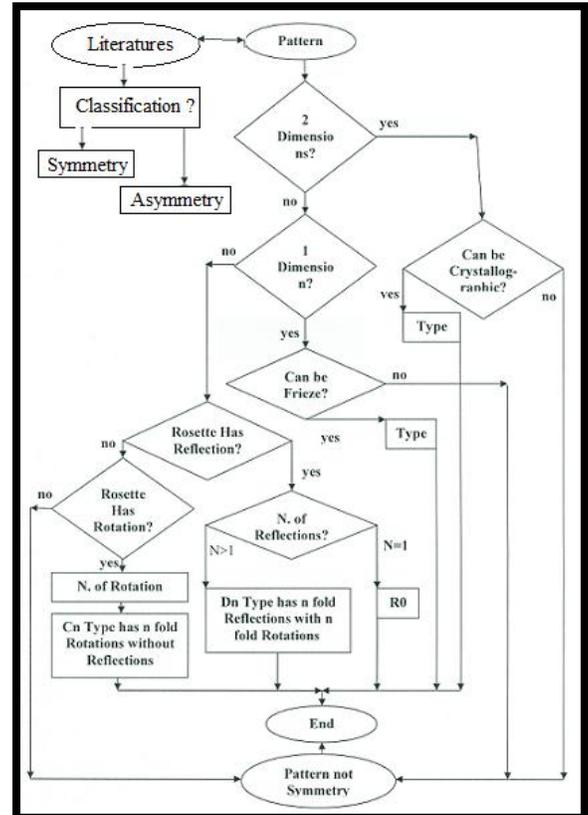


Fig.5. Flowchart explanation of approaches

5. Result of Images Analysis

This section shows selection photos out of 550 that have taken by the author for the purpose of proofing without doubt the issues and discovery by the research. Since, It is defiantly will avoid the arguments and questions by the scholars that has happened on Al_Hamra case [6, 7, 8, 12, 13, 32].

Frieze patterns or border patterns are commonly found in designing and decorating of Al_Madina Mosque. Iron, stone, mosaic, marble, and color painting are main material used in creating border Art. One example for each Frieze types are given below for selected of patterns. It is proof that there are all the Frieze patterns exist in Al_Madina Mosque.



Fig (6) P111 Decorative trims on ceramic work



Fig (7) Pm11 Decorative trims on a building



Fig (8) P1m1 Decorative trim on ceramic work



Fig (9) Pmm2 Decorative trim on iron work



Fig (10) Pma2 Decorative trim on marble work



Fig (11) P112 Decorative trim on iron window



Fig (12) P1a1 Decorative trim on building

Some type of Crystallography patterns or wallpaper patterns have found in the mosque. Below examples are selected pattern for each type of wallpaper that exist in Al_Madina Mosque. P1a1, Pgg, Pg, p31m, p2, p4g, p3, p3m1 and p6 are missing pattern type.



Fig (13) P4m decoration trim of iron work

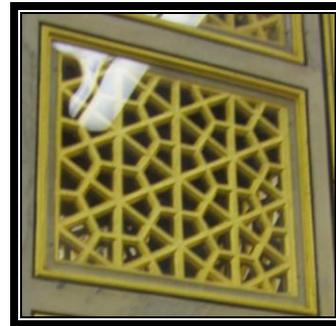


Fig (14) P6m decoration trim of marble work



Fig (15) Pmm2 decoration trim of iron work

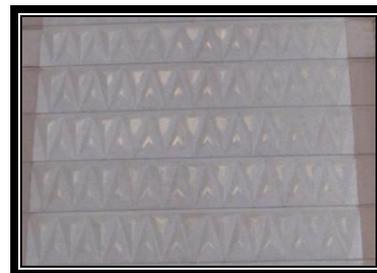


Fig (16) Pmg decoration trims of marble work

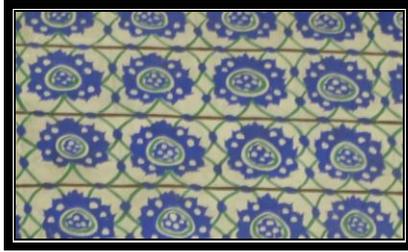


Fig (17) Pm decoration trim of ceramic work



Fig (18) Cm decoration trim of marble work

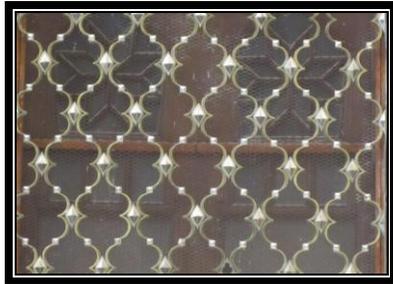


Fig (19) Cmm decorations trim of iron window

In order to complete the pictures of the pattern study about Al_Madina Mosque, Katem Suleman tile is the most frequently pattern occurring in Islamic culture, and indeed, the study found that it is the most common patterns in Al_Madina mosque. Figure (20) shows different variations on the theme of Katem Suleman that made of various materials. Such tile can be spotted in different parts of the Mosque. There are hundreds of these around the place. Also, it can be spotted as basic shape for Frieze and wallpaper patterns.

6. Discussion

In this section, the discussion has two subsections. First one is dealing with architecture patterns, and the second one is talking about symmetry in literature.

6.1 Architecture Patterns Discussion

The 550 photos have duplicated, it means that one pattern can be found in more than one photo. But, in the case of

counting, pattern is unique for each number. In another word, cannot one pattern count more than one time.



Fig (20) Different variations of Katem Suleman tile

As result of the study, it has examined the pattern against, Rosette, Frieze, and crystallography patterns. Table 1 show the distributions of Rosette Patterns were encountered in the Mosque, Diagram 1 shows graphically the analysis result of the table 1.

Table 1: The analysis Result of Rosette Patterns

Rosette Pattern Type	R0	D8	D4	D5	D6	D16
Frequency	36	24	05	01	04	4
Rosette Pattern Type	D12	D12	D10	C6	C16	
Frequency	3	2	1	1	1	

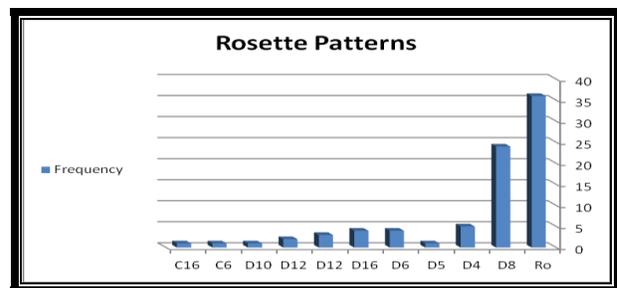


Diagram (1) Histogram view for Rosette Patterns Distribution

Table 2 below gives the number of Frieze patterns that has encountered in the designing. Diagram 2 as diagram 1, shows graphically the analysis result of the table 2.

Table 2: The analysis Result of Frieze Patterns

Frieze Pattern Type	Pm11	Pmm2	P111	P1m1	P1g1	P112	Pmg1
Frequency	66	33	25	10	4	3	2

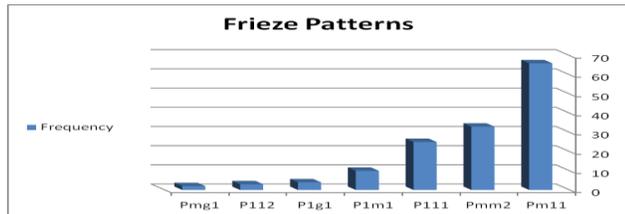


Diagram (2) Histogram view for Frieze Patterns Distribution

Table 3 shows there are few Crystallography patterns and Diagram 3 shows graphically the analysis result of the table 2.

Table 3: The analysis Result of Crystallography Patterns

Crystallography Patterns	Cmm	Pm	P4m	P6m	Pmm	Pmg	Cm	P4	Pg	P31m
Frequency	9	8	6	5	3	2	1	1	0	0
Crystallography Patterns	Pgg	P2	P4g	P3	P3m1	P6	P1			
Frequency	0	0	0	0	0	0	0			

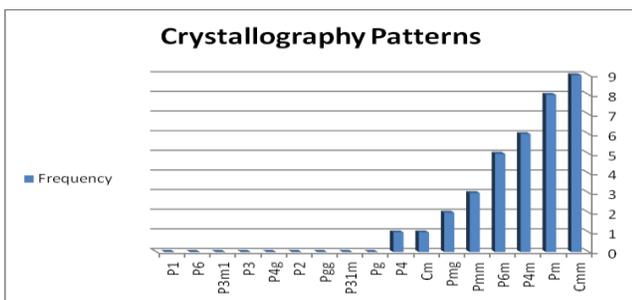


Diagram (3) Histogram view for Crystallography Patterns Distribution

Please note that P111 patterns in case of Frieze and crystallography patterns, it can be produced through any other patterns type by coloring or add motif to destroy the symmetry.

6.2 Literature Discussion

Symmetry has an important role in Saudi Arabia literature. Especially poems and speeches have strong tendency to include symmetrical elements for the following reasons:

1. Tying and keeping the lines and structures of poems and speeches together.
2. Giving poems and speeches a sort of pleasing to read and listen to.
3. Turning the poems and speeches into sound more appealing.
4. Making them easier to remember and recite because the human mind registers such clusters easily and with pleasure.
5. Adding more meaning and feeling and effect to their content.
6. Helping to create an image to the content.

Below, there are two examples to show the analysis of using symmetry within speeches and poems for classification purpose.

Example 1 [28]: The following speech by HRH king Abdulla Ben Abd Al_Azez (Allah protected him) for the third years meeting in the fifth periodic on 25th of September, 2011 with the Shura Council.

بسم الله الرحمن الرحيم
 والصلاة والسلام على رسول الله وعلى آله وصحبه أجمعين .
 أيها الإخوة الكرام :

السلام عليكم ورحمة الله وبركاته:
 يسعدني أن ألتقي بكم في افتتاح أعمال السنة الثالثة من الدورة الخامسة لمجلس الشورى ، سائلاً الحق تعالى أن يوفقكم في أعمالكم .
 أيها الأخوة والأخوات شعب المملكة العربية السعودية:
 إن كفاح والد الجميع الملك عبدالعزيز مع أجدادكم - يرحمهم الله - أثمر وحدة القلوب ، والأرض ، والمصير الواحد ، واليوم يفرض علينا هذا القدر أن نصون هذا الميراث ، وأن لا نفق عنده بل نزيد عليه تطويراً يتفق مع قيمنا الإسلامية والأخلاقية .

نعم .. هي الأمانة والمسؤولية تجاه ديننا ، ومصالحة وطننا ، وإنسانه ، وأن لا نتوقف عند عقبات العصر ، بل نشد من عزائنا ، صبراً ، وعملاً ، وقبل ذلك توكلنا على الله - جل جلاله - لمواجهتها .

إن التحديث المتوازن ، والمتفق مع قيمنا الإسلامية ، التي تصان فيها الحقوق ، مطلب هام ، في عصر لا مكان فيه للمتخاذلين ، والمترددين .
 يعلم الجميع بأن للمرأة المسلمة في تاريخنا الإسلامي ، مواقف لا يمكن تهملها ، منها صواب الرأي ، والمشورة ، منذ عهد النبوة ، دليل ذلك مشورة أم المؤمنين أم سلمة يوم الحديبية ، والشواهد كثيرة مروراً بعهد الصحابة ، والتابعين ، إلى يومنا هذا .

ولأننا نرفض تهمة دور المرأة في المجتمع السعودي ، في كل مجال عمل ، وفق الضوابط الشرعية ، وبعد التشاور مع كثير من علمائنا في هيئة كبار العلماء ، وآخرين من خارجها ، والذين استحسنا هذا التوجه ، وأيدوه ، فقد قررنا التالي:

أولاً : مشاركة المرأة في مجلس الشورى عضواً اعتباراً من الدورة القادمة وفق الضوابط الشرعية.

ثانياً : اعتباراً من الدورة القادمة يحق للمرأة أن ترشح نفسها لعضوية المجالس البلدية ، ولها الحق كذلك في المشاركة في ترشيح المرشحين بضوابط الشرع الحنيف.

من حفاكم علينا - أيها الإخوة والأخوات - أن نسعى لتحقيق كل أمر فيه عزتكم وكرامتكم ومصالحكم .. ومن حقا علينا الرأي والمشورة ، وفق ضوابط

الشرع ، وثوابت الدين ، ومن يخرج على تلك الضوابط فهو مكابر ، وعليه
أن يتحمل مسؤولية تلك التصرفات .
هذا وأسأل الله لنا جميعاً العون والعزة والتمكين .
والسلام عليكم ورحمة الله وبركاته.

The symmetrical analysis of the speech is as follow:

1. The speech has symmetrical structure because readers can see clearly the structure of "beginning", "middle", and "end". The middle can serve as a focal point where events take place, this is common structure of Saudi Arabia speeches. Also, the beginning reflects or plot towards the end.
2. The shift or placement of specific word or similar sound throughout the speech. In this speech, the word (Brothers "أيها الإخوة") has been repeated three times in systematic way before starting new event. This is common word and the reader can found it in the king's speech in "Arabic leader meeting in Algeria on 28/03/2001". It has repeated four times. And two times in the king's speech in "Arabic leader meeting in Egypt on 21/10/2000", and four times in the "24th meeting of Arabic leader on 03/04/2013". There is similar sound of this words such as("His Excellency president, ladies and gentlemen, Distinguished heads of delegates", "فخامة الرئيس السادة والسيدات رؤساء اعضاء الوفود الكرام", "اصحاب السمو والمعالي", "Highnesses and Excellencies", "أيها الحضور", "Presences", "السيد الرئيس", "Master President"), for more of such words, information and speeches see [28].
3. The reader can see the logical placement and shifting of the speech's paragraph.

Example 2 [1]: The following is few lines of two poems by the well known poet Prince Khaled Al-Faisal as a model for poetry.

The first is:

الى قصيدة العمر أم بندر
لك يا عنود الصيّد حرفي ومعناي
عمري قصيدة حب قدّمته لك
معك اشرفتُ شمس المحبّة بدنيابي
صورة قصيدي لمحّة من خيالك

The symmetrical analysis of the poem is as follow:

1. The poem lines assembling of two halves, each has five words as a strict rule of the number.
2. First half of the first line is sound similar structure of the first half of the second line.
3. The syllables of the word at the end of the first half in all lines are all similar, and at the end of the lines.
4. The first line can be read in reverse order and becomes another poem such as:

لك قدّمته حب قصيدة عمري
ومعناي حرفي الصيّد يا عنود لك

The second is:

أغير الطاروق
أغير الطاروق والقاف وأبدع
واولّع قلوب تحس بولعنا
واسير في بستان الاشعاع واقطع
وردة قصيدٍ مثلها ما زرنا

The symmetrical analysis of the poem is as follow:

1. The poem lines assembling of two halves, each has four words as a strict rule of the number.
2. First half of the first line is sound similar structure of the first half of the second line.
3. The syllables of the word at the end of the first half in all lines are all similar, and at the end of the lines.

7. Conclusion and Recommendation

This research has set out to show the different type of patterns currently exist in Al_Madina Mosque and to reveal the symmetry that has found in Saudi literature (poem and letters). It has hoped the outcome of this work achieved its aims to make some contribution to proof that, of course that is privilege of the reader to decide, the greatest satisfaction will come if the study is able to fulfill its purpose to encourage innovation to regeneration of patterns through the use of different means. Computer graphics combined with modern mathematics and technology offer all sorts of new and exciting possibilities.

The result of the research show that the Frieze patterns types are all exist and represent the highest number of architecture patterns. In case of Crystallographic Pattern, there are various types not found in the decoration for example, P1a1, Pgg, P31m, P2, P4g, P3, P3m1 and P6. Katem Suleman is the most common patterns in Al_Madani Mosque which made of various materials.

In the case of literature, the study shows symmetrical analysis of various literatures wrote by well known writer, the research shows that the symmetry concept has found in outline structure and its contents.

My recommendation is to look at the missing type of patterns and try to create these patterns in the Al_Madina Mosque.

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