

## Implementation Of 3D Virtual Poetry Image By Using Bezier Cubic Splines And Open GL Primitives

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### Abstract

This paper presents suggested algorithm to draw or generate a 3D virtual poetry image from Arabic poetry text. Bezier curves had been used to generate this image depending on some computed values named *appearance rates* which is defined and evaluated from the poetry text. Those defined values have a great effect on poetry image generating where those values represent the control points which they are used in Bezier cubic function. Bezier cubic and triangle primitive had been used to implement the poetry image. Many poetry segments written by different poets had been taken as samples to test the suggested algorithm.

**Keywords:** 3D virtual poetry image, poetry, Bezier Cubic Splines.

### تمثيل صورة شعرية تخيلية ثلاثية الابعاد باستخدام شرائح مكعب بزايير واوليات الاوين جي ال

#### الخلاصة

هذه البحث يقدم خوارزمية مقترحة لرسم او توليد صورة شعرية ثلاثية الابعاد من النص الشعري العربي. تم استخدام منحنيات بزايير في توليد تلك الصورة بالاعتماد على بعض القيم المحسوبة والتي سميت بنسب الظهور للحرف والتي عرفت وحسبت من النص الشعري. لهذه القيم المعرفة تأثير كبير في توليد الصورة الشعرية حيث ان هذه القيم تمثل نقاط السيطرة في معادلة مكعب بزايير. تم استخدام مكعب بزايير والمثلث لتمثيل الصورة الشعرية. تم الاخذ العديد من القطع الشعرية المكتوبة من شعراء مختلفين كعينات لاختبار الخوارزمية المقترحة.

### Introduction

The poetry text describes the poet experience in this life, passion (happiness, sadness), and viewpoints. All of those feelings can met on the same point and create the abstraction and this makes the poetry. So if the oil painting can be compiled in words i.e. the viewer can translate the lines and colors into

Words and those Words can construct a story which talks about that oil paint. This thing Can be done but in reverse way, this means that the poetry can be converted into image and this image can describe the feelings in that poetry virtually. Of course this process can be mplemented in some way. Many papers and review article

talking about the poetry, poet and the poetry experience [1, 2, 3]. The linguists such as Mitchell [4] wrote about the poetic image definitions. Ezra Pound and others [5] examined the rise in prominence of the image by tracing its use through the work of three modern poets. Paula A. Patterson [6] examined in her PHD thesis the relationship between architectural phenomenal and Meanings that animate them by taking up the genealogy of meaning.

Huiqing [7] defined in his paper eight types of obscure poetic images, he analyzed the eight types of the obscurity of the poetic images in Yeats' works, the essay wishes to help found a constructive way to read and interpret the poems.

Poetry experience means something which the poet met it in his life (live its circumstances) may be in past or in present or may be in future. This experience motivates the poet to write his text. The poet describes his feelings via writing the poetry and those feelings may be hidden behind the words (indirect sentence contains many other meanings rather than what does it mean). The research focuses on revealing the nature of poetic image from a cognitive perspective and aims at building an original typology of images in Arabic poetry at the future. It highlights cognitive mechanisms that lead to the emergence of novel poetic images which cause a

possible breakthrough in the conceptualization of the world.

In this paper the poetry text is implemented as 3D virtual image during a suggested algorithm. This implementation is considered very important in poetry analysis applications and extracting the *poet print* corresponding to his poetry texts.

In the suggested algorithm, the 3D virtual images of some poetry texts for three poets are created Corresponding to the poet experience. Badr Shaker AL\_Sayab is an Iraqi poet, Nazic AL\_Mala'eka is an Iraqi poet too, and Mahmood Darweesh is a Palestinian poet. Each one of them has a special manner in writing the poetry text corresponding to the circumstances he live. The sufferance, happiness and sadness feelings could be found in the poetry texts of them, alienation, loneliness, passion, nationalism (glorification of homelands) and talking about the environment in which they grew up. All of those contradictious feelings are evident in their writings. Those feelings are implemented and drawn as a 3D virtual image (which reflects those feelings) by using our suggested algorithm.

#### **Bezier Cubic Splines**

Bezier Cubic Splines are an excellent and preferred method to draw the smooth continuous curves often found in typography, CAD/CAM, and graphics in general. Among their many advantages is a very sparse data set allowing a mere eight values (or four x, y points) to completely define a full and carefully

controlled and device independent curve. Figure (1) shows a cubic spline shown in its graph space [9, 10]. Here is a cubic spline appears in its equation space:

$$r(u)=(1-u)^3r_0+3u(1-u)^2r_1+3u^2(1-u)r_2+u^3r_3 \dots\dots (1)$$

Where  $r_0$ ,  $r_1$ ,  $r_2$ , and  $r_3$  are the control points,  $u$  (for time) always goes from zero at initial point to a one at the final point.

**The 3D virtual poetry image creation**

In this research, 3D virtual poetry image is created depending on important computed values. Those values are evaluated by using defined rate which is called *the letter occurrence rate*; this value is computed depending on defined criteria. Three types of this rate are calculated for each letter. The computed values (the three occurrence rates for each letter) play an important role in plotting Bezier curves and generate OpenGL triangles and as result create 3D virtual poetry image. More details are explained in the next sections.

**The Arabic Letters form and Their Representations**

Many samples of poetry text for many poets had been used to implement the corresponding image for each sample. Firstly, the sample of chosen text must be implemented as numerical values, where each Arabic letter must take a unique numerical value. The letters in Arabic language are different from letters in English language where there is a primary letter such as  $\text{أ}$  and this letter may be appeared in the

middle of the word and is written :  $\text{أ}$  also may be appeared in the end of word then it is written:  $\text{أ}$  such as  $\text{الله}$ . This case is occurred in almost Arabic letters. Table (1) contains all Arabic letters with their writing shape. Table (2) shows the numerical values which will be given to the Arabic letters.

After giving each letter its corresponding numerical value, three values for each letter must be evaluated, where the first value is the absolute appearance of letter in the whole poetry text. Each Arabic letter will take its appearance rate in the given text. The second value of the letter is the rate of the letter appearance together with the next letter in the same word in the text. Finally, the third value which the letter must be taken is the rate of appearance of that letter with the previous letter and this evaluated for the whole text (every word in the text). For example: The following poetry text is for Badr Shaker AL Sayab poet [1]:

عصافير ام صببية تمرح  
أم الماء في صخرة ينضح  
وقبرة تصدح ولكن على خربة بالية

To compute the three values for each Arabic letter in the poetry segment above, the first letter must be taken ( $\text{ع}$ ) and the *rate* of its appearance in the whole text must be evaluated. Its rate is the summation of appearance letter ( $\text{ع}$ ) in the text (sum means the number of repeating the letter in the text) dividing on (total number of letters-1) which text it contains. The second rate is called the *post appearance* which represents the

number of repeating a given letter (recently read) with the next letter (neighbor letter) dividing on (total number of letters-1) which text contains. The third rate is same as the second but here the value is computer from the recent letter with the previous letter. Sum of repeating is divided on the total summation of letters-1 to give *pre appearance*.

**The 3Dvirtual poetry image creation by using Bezier Cubic Spline and OpenGL Primitive (Triangle)**

Bezier curve needs points called control points to plot and control the curve, in the suggested algorithm, the three computed appearance rate values: absolute appearance, post appearance, and pre appearance are considered three control points which can be used in Bezier curve function. A Bernstein Polynomial of order 3 is exactly what we need to relate Bezier control points to cubic spline coefficients.

The fourth point is a point which is chosen carefully to make the generated curves tide together and to avoid random generation which can cause generated curve to be out of the determined 3D coordinates. One end of each generated curve should be connected with the other end of curve, i.e. all generated curve should be met together in the same point (start point or end point). The formula for a degree three Bezier curve is [10]:

$$Q(u)=B_0(u)p_0+B_1(u)p_1+B_2(u)p_2+B_3(u)p_3 \dots\dots\dots (2)$$

Where the four functions  $B_i(u)$  called blending functions, are scalar-valued.

The blending functions  $B_i(u)$  are clearly degree polynomials. Indeed, when their definitions are expanded they are equal to;

$$B_0(u)=(1-u)^3, B_2(u)=3u^2(1-u) \dots (3)$$

$$B_1(u)=3u(1-u)^2, B_3(u)=u^3$$

Here, the three defined control points can be represent the sense point in the poetry segment, or may be describe the poetry experience of the poet. These defined points of appearance rate control the shape of generated curve. one curve is generated for each letter in the given text. And all of those curves represent the image or drawing of the poetry.

One of the OpenGL primitives (Triangle) [10] had been also used in the suggested algorithm to implement and generate the poetry image. The triangle had been chosen for important future considerations, one of those considerations is a triangle mesh generating.

**The suggested algorithm of 3D virtual poetry image creation**

**INPUT:** The poetry text as text file.

**OUTPUT:** The 3D virtual poetry image. The image is generated by using Bezier Cubic Splines and Open GL primitives (triangles).

**Step 1:** Give each letter in alphabetic a unique number.

**Step 2:** Convert the poetry text to text file contains integer values. Each number in the file represents one letter.

**Step 3:** Find the total number of letters.

**Step 4:** Give a flag to each letter value in the file. The initial value for all flags is zero.

**Step 5:** Read each number in file and find its corresponding repeating (how many times it occurs).

**Step 6:** Compute the corresponding *absolute appearance rate* of each letter value in the text file.

**Step 7:** Compute the *post appearance rate* of each letter value in the text file.

**Step 8:** Compute the *previous appearance rate* of each letter value in the text file.

**Step 9:** Drawings: draw triangle and curve for each letter in the poetry text.

**Step 9.1:** Give the appearance rates values of each letter its number in text with some arrangement to the vertices of the triangle

*// Draw the appearance rates triangle for each letter by calling drawing procedure of triangle*

**Step 9.2:** Draw Bezier curve depending on defined absolute appearance values of each letter in the poetry text.

*// To draw three connected curves for each letter, the first curve is computed depending on absolute appearance of letter, the second curve is computed depending on pre appearance of that letter, and the third curve is computed depending on the post appearance of that letter.*

**Step 10:** total number of letters = total number of letters - 1

If **total number of letters** is greater than zero then go to 9.1 to read the next letter in the text. Else go to End.

**Step 11:** End

#### **Algorithm Implementation**

The algorithm is implemented by using VC++ with OpenGL Graphical

interface. The algorithm is executed by reading the text file of poetry text, and then the letters in that file must be converted to its corresponding numerical values. Then those values should be processed. The drawing of 3D poetry image is drawn by using OpenGL graphical interface taking into account the projection of the 3D generated scene and its lighting location.

#### **Results**

Many texts of poetry for many Arabic poets had been taken as experimental examples such as poetry segments for Badr Shaker ALSayab, Nazic AL-Mala'eka, and MohmoodDarweesh had been taken as input to the suggested algorithm.

#### **Conclusion and future work**

From the experimental results, 3D image can be generated from any text, but to draw an image contains music or harmony details implicitly, this matter requires a poetry text contains what is called *music of poetry*. The Arabic poetry has a wonderful music between their words implicitly, and the reader can feel this music when he reads a poetry text carefully. Many OpenGL primitives can be used in the suggested algorithm to generate a poetry image or poetry print and as a result this generated image can describe the feelings of poet or what is called a *poet experience* i.e. what he was feeling when he began to write this poetry. Many 3D images for the same poet can be generated by our suggested algorithm and then those images can be used to create the *poet print* using a specific criteria (this for

future work). Triangle is one of the important OpenGL primitives since it is widely used in mesh generation algorithms, and triangle is used in our suggested algorithm for that purpose but as a future work. Also B-Spline curves can be used to generate the potty paint but some important points must be taken into account such as how the knots of B-Spline should be chosen and other considerations.

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**Table (1) The Arabic letters and there possibility of appearance in the word.**

Arabic letter	As a start letter	As a Middle letter	As an End letter
ء	-	ء	ء
ا	ا	ا	ا
ب	ب	--ب--	--ب/ب
ت	ت	--ت--	--ت/ة/ة
ث	ث	--ث--	--ث/ث
ج	ج	--ج--	--ج/ج
ح	ح	--ح--	--ح/ح
خ	خ	--خ--	--خ/خ
د	د	--د--	--د/د
ذ	ذ	--ذ--	--ذ/ذ
ر	ر	--ر--	--ر/ر
ز	ز	--ز--	--ز/ز
س	س	--س--	--س/س
ش	ش	--ش--	--ش/ش
ص	ص	--ص--	--ص/ص
ض	ض	--ض--	--ض/ض
ط	ط	--ط--	--ط/ط
ظ	ظ	--ظ--	--ظ/ظ
ع	ع	--ع--	--ع/ع
غ	غ	--غ--	--غ/غ
ف	ف	--ف--	--ف/ف
ق	ق	--ق--	--ق/ق
ك	ك	--ك--	--ك/ك
ل	ل	--ل--	--ل/ل
م	م	--م--	--م/م
ن	ن	--ن--	--ن/ن
ه	ه	--ه--	ه/ه
و	و	--و--	--و/و
ي	ي	--ي--	--ي/ي

**Note: middle letter is the letter which is may be written between two adjacent letters (--).**

Table (2) The Arabic letters with corresponding numerical values.

The letter	ء	ا	ب	ت	ث	ج	ح	خ	د	ذ	ر	ز	
Its numerical value	1	2	3	4	5	6	7	8	9	10	11	12	
The letter	س	ش	ص	ض	ط	ظ	ع	غ	ف	ق	ك	ل	
Its numerical value	13	14	15	16	17	18	19	20	21	22	23	24	
The letter	م	ن	ه	و	ي	ذ	و	ى	ة	أ	إ	آ	ئ
Its numerical value	25	26	27	28	29	30	31	32	33	34	35	36	37

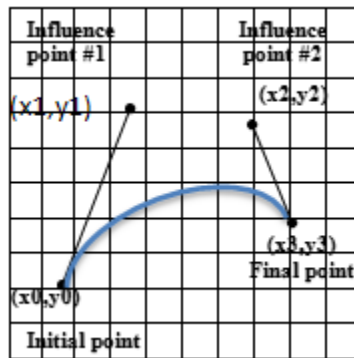


Figure (1) Cubic Spline in its graphic space.

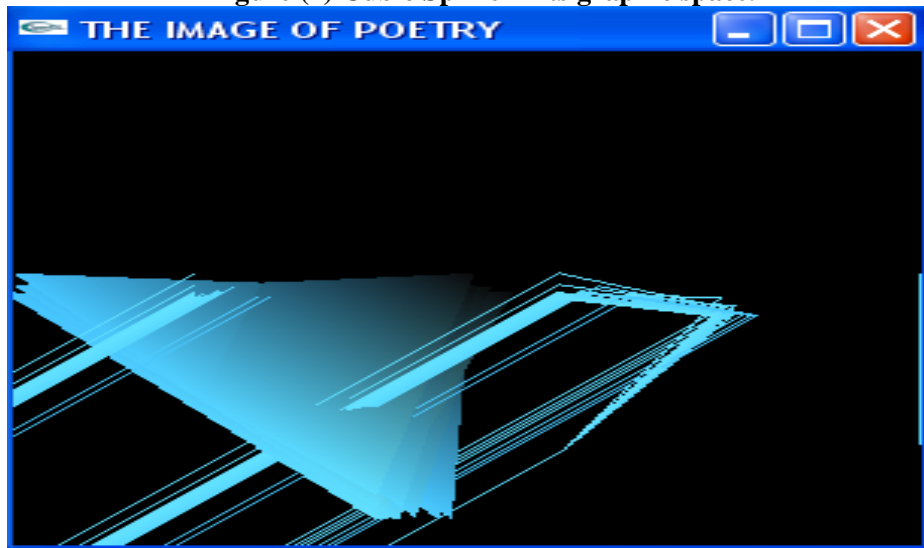


Figure (2) 3 D virtual poetry image of the segment below for the poet Badr Shaker ALSayab.No. of generated curves is 522, No. of generated triangles is 173. The following poetry segment is taken from [1]:



سلام على العالم الارحب  
على الحقل والدار والمكتب  
على معمل للدمى والنسيج  
على العش والطائر الازغب  
على التوت وبستان فيها الاريح  
على زهره في وساد العروس  
على حبيبة في انتظار الأ ب  
على شاعر تستحم الشמוש  
بعينه بصغي الى جندب



Figure (3) 3D virtual poetry image of the segment below for the poet Badr Shaker AL Sayab. The number of generated curves is: 273, the number of generated triangles is: 90. The following poetry segment is taken from [1]:

عصافيرام صبية تمرح  
أم الماء في صخرة ينضح  
وقبرة تصدح ولكن على خربة بالية  
عصافير بل صبية تمرح واعمارها في يد الطاغية



Figure (4) 3D virtual poetry image of the poetry segment below for the poet Nazic AL Mala'eka. The number of generated curves is: 483, the number of generated triangles is: 160. The poetry segment is taken from [2]:

اماه .. وحشرجة ودموع وسواد  
وانبجس الدم واختلج الجسم المطعون  
والشعر المتموج عشعش فيه الطين  
أماه .. ولم يسمعها الا الجلاب  
وغدا سيجي الفجر وتصحو الاوراد  
والعشرون تنادي والامل المفتون  
فتجيب الموجه والازهار

رحلت عنا.. غسلا للعار

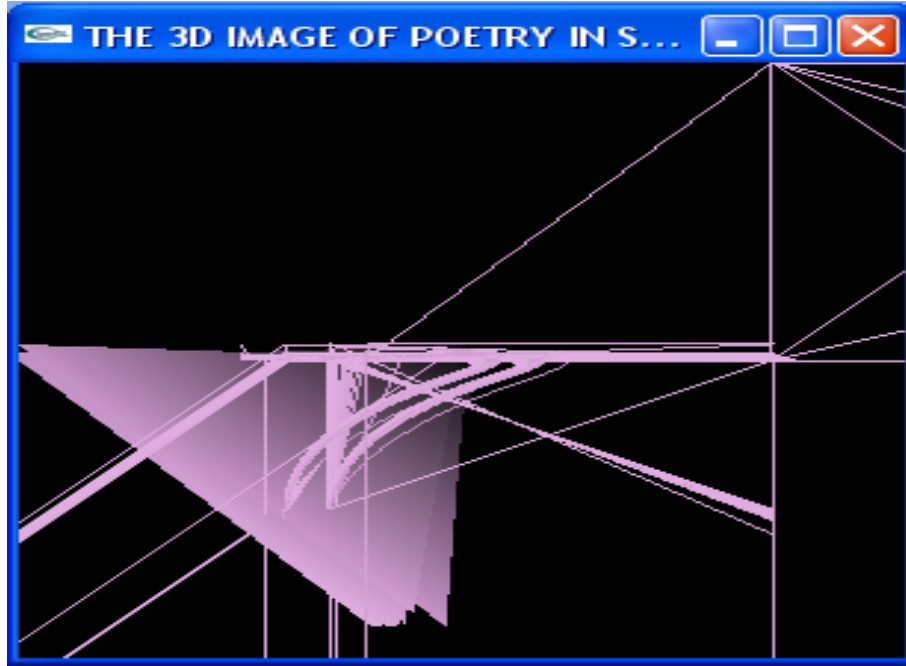


Figure (5) 3D virtual poetry image of poetry segment below for the poet Mahmood Darweesh. The number of generated curves is: 768, the number of generated triangles is: 255. The poetry segment is the following [3]:

م  
وكان ذات يو  
أشأم مايمكن ان يكون ذات يوم  
شرذمة من الصلال  
تسربت تحت خباء الليل  
الى عشاش  
ابوابها مشرعة

لكل طارق غريب  
وسورها ازاهر وظل  
وفي جنان طالما مربها

تفجرت على السلام زوبعة

هدت عشاش سربنا الوديع  
وهشمت حديقة  
ولااعدت عار  
ولم تندس روعة الحياة  
وسربنا الوديع

اناخرفي تتركني  
قدرتي تخونني

.. دوحها في ملتقى الدروب

.. ماجدنت  
"روما الاسودالقديم

"سدوم

ويلاه ..  
ويلاه .. ان  
وفكرتي  
من ركبها تضيع

اله