# Beauty from the Computer: Virtual Floral Designs

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**Abstract**. *We present the program which helps the user to create virtual flowers. No graphical designing skills are necessary to create 3D flowers, based on basic inflorescences found in nature. The creation of a virtual flower consists of choosing desired type of division of the stem and desired type of structure of the blossom. The final outlook of the new flower is defined by a number of parameters that apply to the chosen structure.*

*Program is written in MEL so it takes advantage of powerful visualization capabilities of 3D graphical designing tool Maya.*

*The paper begins with the presentation of natural types of inflorescence, which are later applied to the design process of the new flower. We present the shaping of the flower by the user's point of view.*

**Keywords.** Inflorescence types, Maya, MEL-Maya Embedded Language, Floral design, Virtual flowers.

## 1. Introduction

Perhaps there is no one who, at least once in his lifetime, has not noticed and been impressed by the *unity* and *order* when looking closely at a flower. This order can be seen in *proportions* which appear again and again.

For example, let us take a daisy. The "florets that make up the pattern in its centre grow at the meeting points of two sets of spirals, which move in opposite directions, one clockwise, the other counterclockwise" [1] These spirals are logarithmic and also equiangular, since the angle they describe with the radii remains always the same. The sections of these spirals are in the proportion of *golden section*.

There are numerous other examples, like seed pattern of the sunflower, pentagonal star pattern of apples and pears when cut through their girth, etc. Patterns and therefore *harmony* may be found not only in plants but also in animals and, at last, in human and in its work [1,3].

The order and proportions, described above, may be well modelled by a computer, which lead us to the thought that the same patterns from the nature could be used for *new creations* also.

We try to show an example of this on the world of plants.

## 2. Floral designs

### 2.1 Natural inflorescence types

Floral diversities can be categorized into two major inflorescence types: indeterminate and determinate [4,5]. In the former, the first flowers to open are in the base, whereas in the latter, the first flower to open is at the top or middle. The types of indeterminate inflorescences are spike, raceme, corymb, umbels, capitulum and thyrse, where compound versions of raceme, corymb and umbel also exist; simple umbel involves further round and flat version of inflorescence (see Figure 1, above).

On the other side, determinate inflorescences consist of dichasium, scorpoid cyme, helicoid cyme and cincinnus; again, compound versions of dichasium and cyme exist (Figure 1, below).

### 2.2 Virtual floral designs

Our floral designs are programmed in Maya, which is a programming tool for 3D graphics. Maya has extremely broad field of applications: from scientific animations to film effects, cartoons, computer games; it is especially known for the special effects from films like Lord of the Rings, Titanic, Star Wars, The Matrix, to name just a few.

Floral designs are programmed in MEL (Maya Embedded Language). MEL is the interpreter language in which most of Maya menus and windows as well as user interfaces are realized.

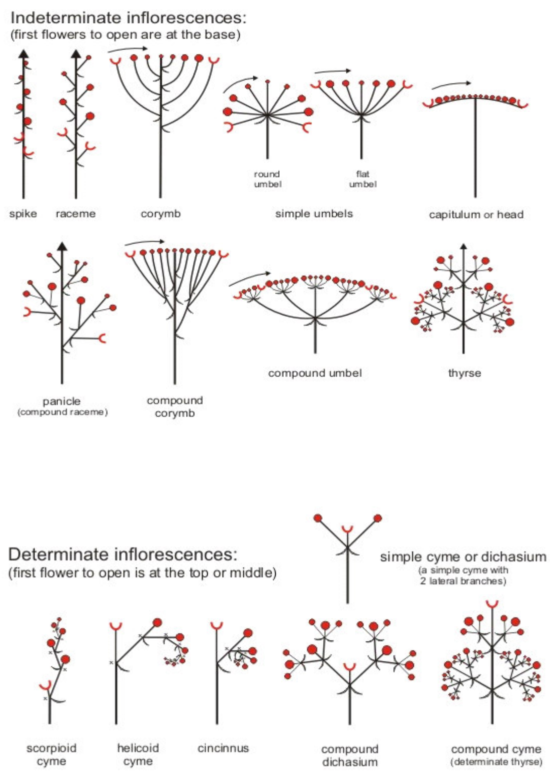



**Figure 1. Two classes of natural inflorescence types.**

## 2.3 MEL

MEL is a simplified C++-like language, in which user defined data structures, objects, classes, methods and pointers are left out, yet general programming control structures such as loops, branches, functions are remained; on the other side, character data structures, global and local variables, expressions, conditions, switches, etc., are preserved [2]. Additionally, MEL incorporates hundreds of commands to work with strings, mathematical functions, I/O data files, etc.

MEL is the interpreter language, whose commands are written, one after another, in an ASCII file to, for instance, compose a complex film scene.

Just to get the impression about MEL, we give the following example (Figure 2) in which a simple blossom is drawn: it is constructed by a sphere, flattened along *y*-axis and a filled circle, deformed into approximate petal shape and duplicated 7 times around the centre of the blossom (for the sake of simplicity the texture of the blossom is neglected).

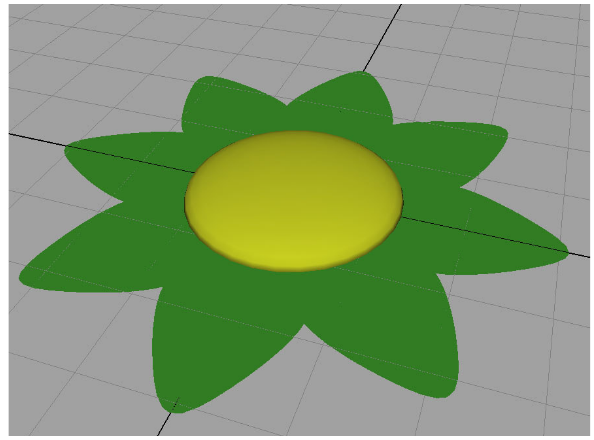


**Figure 2. A simple blossom.**

Corresponding MEL program:

```
circle -c 0 0 0 -nr 0 1 0 -sw 360
-r 0.05 -d 3 -ut 0 -tol 0.01 -s 8
-ch 1;
rename petal;
scale -r 16 16 16;
select -r petal.cv[2:4];
move -r -0.5 0 0;
select -r petal.cv[2]
petal.cv[4];
scale -r -p -1cm 0cm 0cm 1 1
0.45;
select -r petal;
move -r 0.806601 0 0
petal.scalePivot
petal.rotatePivot;
move -r -1.798793 0 0;
planarSrf -ch 1 -d 3 -ko 0 -tol
0.01 -rn 0 -po 0 »petal«;
rename filledPetal;
delete petal;
duplicate -rr; rotate -r 0 45 0;
for ($i=1; $i<7; ++$i) duplicate
-rr -st; select filledPetal2
filledPetal3 filledPetal4
filledPetal5 filledPetal6
filledPetal7 filledPetal8;
```

```
sphere -p 0 0 0 -ax 0 1 0 -ssw 0
-esw 360 -r 1 -d 3 -ut 0 -tol
0.01 -s 8
-nsp 4 -ch 1;
scale -r 1 0.233333 1 ;
scale -r 1.281439 1.281439
1.281439 ;
```

We may observe that the program is relatively involved, considering the simplicity of the drawing. However, the blossom was created by *programming*, not *drawing,* what offers us the possibility to program new flowers instead of designing them. We shall discuss the difference between these two approaches later.

## 3. Presentation of the program

Not all of the inflorescences discussed earlier are applied in our program, yet some others are added.

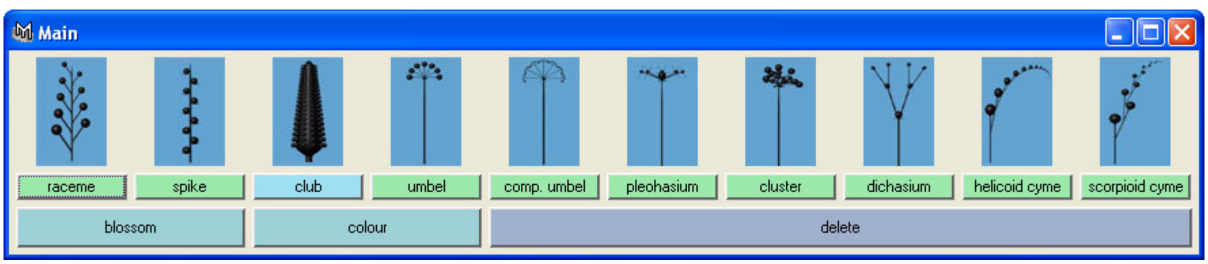
In the following, we shall describe the procedure to create new flowers from the user's point of view.

### 3.1 Description of the user interface

The program starts with the basic window, in which ten basic inflorescences (Figure 3, above) are offered, together with the possibilities to select the shape and the colour of the blossom of a new flower (Figure 3, below). The design procedure could be accomplished in one or in two steps:

-In *one step procedure* the user simply selects the type of the inflorescence and the shape and the colour. The selection of the inflorescence involves, of course, determination of various parameters relating to it.

-In *two step procedure* the first selection of the inflorescence applies to the branches, while the second applies to the stem. In this way, the inflorescence of the branches is applied at the places where pedicles originate from the stem, in accordance with the "major" inflorescence (of the stem). A kind of "recursion" is created in this way. Since there is no prohibition on which types of inflorescences may be mixed, this design procedure may lead to quite "fantastic" designs, certainly not to be seen nature.



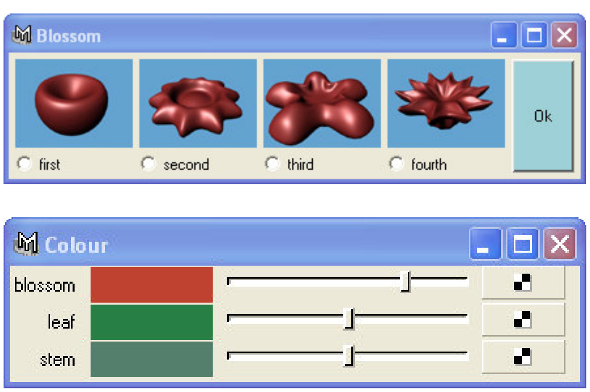




**Figure 3. Ten inflorescences (above), selection of blossoms (middle), selection of colour (below).**

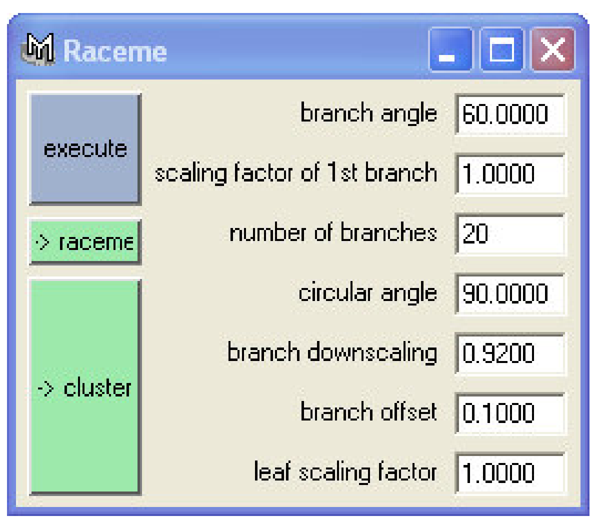



**Figure 4. Selection of inflorescence (raceme).**

### 3.2 Examples of the design procedure

We shall illustrate the above design procedures with the following examples.
If we choose "raceme" type for one step, we are forced to define 7 parameters (as seen on Figure 4), determining this type of inflorescence. The resulting flower would look like the one in Figure 5.
If we proceed with yet another step, these 7 parameters, just defined, hold for the branches, and we have to define 7 parameters more - in the case we select type "raceme" again, this time to define the stem. The resultant flower would be considerably more complex (Figure 6).
We may observe the recursive structure of the flower: at the places where the flower from Figure 5 has pedicles this flower has small "flowers" like the one from Figure 5.
Would we use "cluster" type of inflorescence in the second step instead of "raceme", the program would produce flower on Figure 7.

### 3.3 More examples

The triple of flowers illustrated on Figure 5 to Figure 7 could be varied by using other types of inflorescences. On Figure 8 we may observe some of them: spike, spike-raceme, spike-cluster; umbel, umbel-raceme, umbel-umbel; dichasium, dichasium-raceme, dichasium-cluster; helicoid cyme, helicoid cyme-raceme, helicoid cyme-cluster.

## 4. Conclusions

We presented the program which constructs virtual floral designs, using the inflorescence types from nature. The main advantage of the program is the simplicity of the design of new flowers: instead of drawing them with a kind of 3D graphical designing tool, which involves a lot of experience, we offer a program which requires only definition of parameters relating to the specific inflorescence type.

**Figure 5. Raceme type of the one step design.**

**Figure 6. Raceme-raceme type of two step design.**

**Figure 7. Raceme-cluster type of two step design.**

Unlike the nature, the program allows any combination of two inflorescence types. Recursive designs, up to the level two are possible, although the preliminary experiments show that flower designs even at level three are possible (with respect to the computing capability of the present average personal computers). The program exploits two powerful features of Maya: it is written in its interpreter language MEL, which made the concept possible in the first place, and it makes good use of Maya's powerful visualization.
The program could be extended in many aspects in the future: the concept of randomness may be introduced into designs, the variety of leaves' shapes and arrangements could be considered, more realistic blossoms should be programmed, not to mention the complete incorporation of all the natural types of inflorescences, etc.

**Acknowledgement**

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## 5. References

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[5] Northern Ontario Plant Database, `http://www.nothernontarioflora.ca`

**Figure 8. Various one and two step designs.**