Computer Doodles Using Simulated Gravitational Fields

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1 Introduction

One way to study creativity is to build computer implementations that either model or support the creative process. Recent work by Cohen (1) and others has led to the development of computer programs that produce visual images from scratch. The work described here also involves the development of a computer program. However, rather than producing images from scratch, the program in question supports the image-making process in a human user.

The program attempts to support unsophisticated drawing or 'doodling' activity. It provides the user with the means of bringing together primitive, 2-dimensional shapes, under the influence of 'gravitational fields' so as to produce drawings exhibiting a variety of styles and structures. The program, called 'showscribble'[1] is far from being a realistic model of the creative process. However, it does provide some insight into the ways in which creative drawing processes might be implemented.

The fundamental assumption of the showscribble program is that a doodle is produced by applying a particular 'pen dynamics' to one or more basic shapes or patterns. To put this in contest, imagine drawing a face using zig-zagging pen movements. The result might be something like the image shown in Figure 1. This drawing was actually produced by the showscribble program. In this particular case it has traced out a basic 'face' shape (see Figure 2) using short-range pen movements based on an 'N' shape. In Figure 3 we see a drawing in

[1] The program runs under the Poplog environment and is in the public domain.

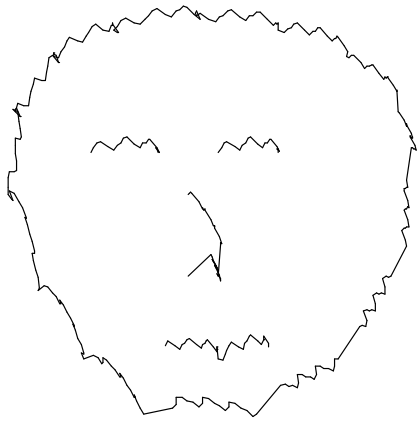

Figure 1:

which showscribble has combined a basic 'face' shape with a basic 'horse' shape using noisy pen-dynamics (i.e. a pen moving partially at random).

2 Primitive shapes

Drawings constructed by the showscribble program are based on primitive shapes. At present the program has a very basic repertoire of shapes. Some of these are shown in Figure 4. The shapes are represented internally as sequences of 2-d points. Thus the program is able to draw 'shakey' versions of the basic shapes simply by randomly permuting the points. A shakey face is shown in Figure 5.

3 Gravitational fields

To produce a doodle it is necessary to give the program a command specifying which primitive shapes should be used. In a simple case we might ask the program to produce a doodle based on a single primitive. In the data structures set up by the program, the points in the relevant primitives are treated like 'planets' with gravitational fields. To produce the doodle the program traces out the trajectory followed by a rocket that, having been launched from the first point, is swung through the relevant sequence of gravitational fields. When a single primitive is used, the trajectory passes through a single gravitational field at each stage. However, if multiple primitives are used, the trajectory is, at every stage, influenced by multiple gravitational fields. The final course therefore reflects the relative strength of the relevant fields.

The showscribble program, as currently configured, allows the gravitational fields of a particular set of points to be parameterized in a number of ways. It is

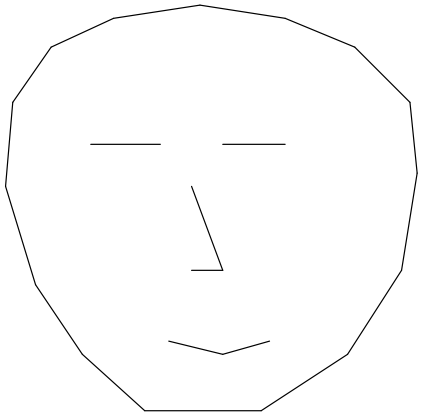

Figure 2:

possible to have conventional gravitational fields that intensify as the distance-off decreases. It is also possible to have 'soft-centred' gravitational fields that intensify as the distance-off increases. (Such fields are weakest in the centre of the gravitational field, hence the name.) The creative possibilities of these cases are yet to be explored. As yet all the experiments carried out have used homogenous fields. These exhibit no variation in intensity. However, even using homogenous fields, it is still possible to produce interesting 'gravitational' effects.

For example, we can vary the relative strengths of the gravitational fields associated with different primitives. A doodle produced by combining the 'house' primitive with a primitive 'bump' shape, using equal-strength gravitational fields is shown in Figure 6. A doodle produced from the same primitives in which the gravitational fields of the points in the 'bump' primitive are substantially weakened is shown in Figure 7. Note how much more of the structure of the house primitive shines through in this doodle.

4 Tracking primitives

In order to provide control over pen-dynamics, the program allows the user to make use of so-called 'tracking primitives'. Within the drawing process these play almost exactly the same role as ordinary primitives. However, whereas the points (planets) in an ordinary primitive remain static throughout the drawing process, the points in a tracking primitives are re-normalized in each cycle. In effect, the points in a tracking are re-projected around the current point (rocket position). This means that if the next point in a tracking primitive lies in a north-easterly direction, the attraction exerted will always be in this direction regardless of the current position of the trajectory.

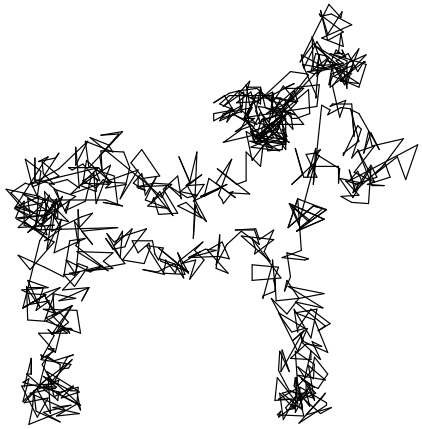

Figure 3:

It is possible to simulate quite interesting pen-dynamics by exploiting very simple shapes (e.g., a 'V' or 'N' shape) as tracking primitives. By introducing one of these shapes as a tracking primitive we obtain a particular class of small-scale pen-movements. A doodle based on the 'horse' primitive using the 'N' shape as a tracking primitive is shown in Figure 8.

5 Summary

The paper describes a program that facilitates the creative drawing process in a human user. The program allows the user to combine basic shapes together in ways that give control over global structure as well as short-range pen-dynamics. This process is not intended to be a model of the way in which people produce doodles. However, it does show one way such drawings might be created. Future developments will hopefully enable the program to produce a much richer range of images. Certainly there is a limit to what can be done using only houses, faces and horses.

References

[1] McCorduck, P. (1991). *Aaron's Code: Meta-Art, Artificial Intelligence, and the Work of Harold Cohen.* New York: W.H. Freeman and Company.

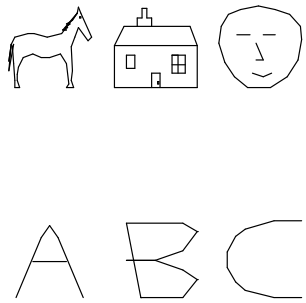

Figure 4:

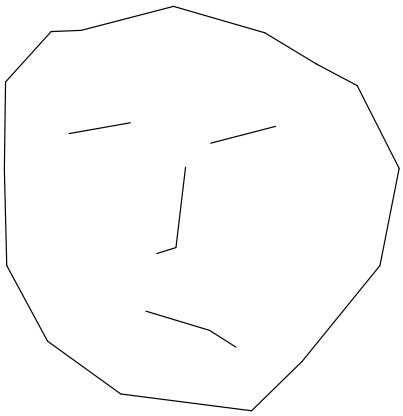

Figure 5:

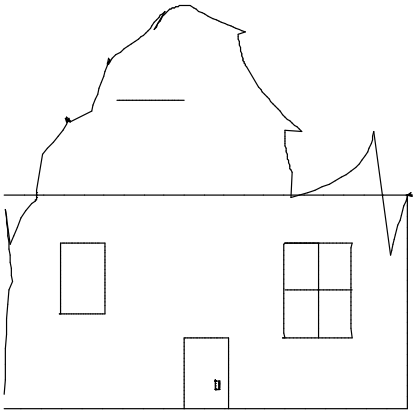

Figure 6:

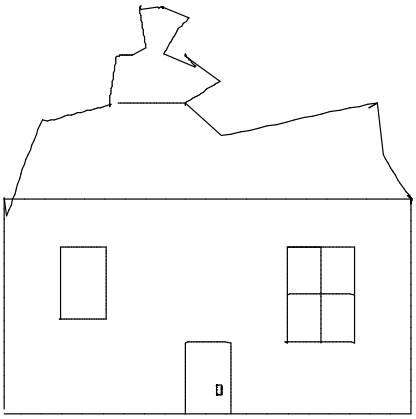

Figure 7:

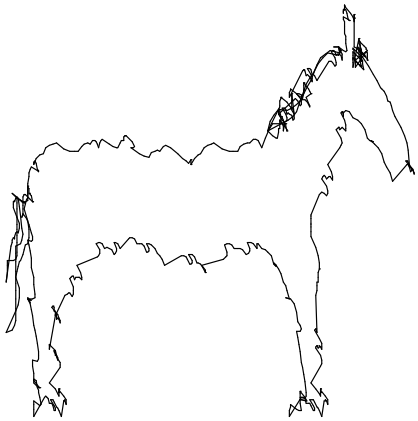

Figure 8: