EVOLVING 3D ARTFORMS

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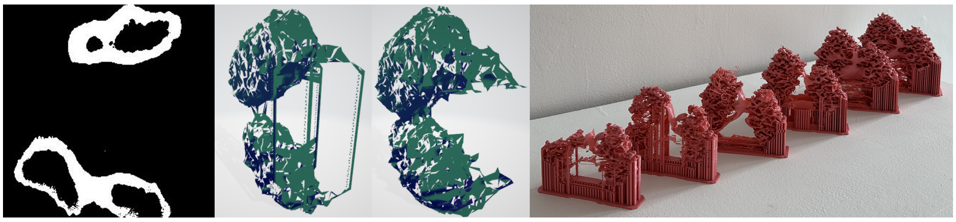

(a) Start Image [1] (b) Gen 17 (c) Gen 24 (d) 3D Printed GoL Evolution

Figure 1: Life cycle from image, to 3D generation visualization, to a 3D physical evolution.

Eryn Foster is an interdisciplinary artist based in Halifax, Nova Scotia. Her artwork, created using a hybrid ink drawing and contact printing process, has a strong resemblance to images of microscopic single-celled organisms [1]. Posing the question: How could these 2D organisms be instantiated in the real world? To this end, the project "A proposition of Organisms" used genetic programming to evolve 2D art into 3D forms. However, the result lacked a connection to the starting image [2].

To address this challenge, we repurposed Conway's Game of Life (GoL) as a generative process to evolve 2D images into 3D organisms. GoL is a zero-player game set on an infinite two-dimensional rectangular grid [3]. Each cell is initialized to be alive or dead at the beginning of the game. Each generation thereafter, a common set of rules stipulating the necessary conditions for birth and death is used to change the state of each cell. The rules of birth and death could look like this: if a cell is alive, it will remain alive if it has 4 or 5 live neighbours. If it has more or fewer than this amount, the cell will die in the next generation. If the cell is dead, then it springs to life only in the case that it has 4 live neighbors. Depending on the rules, many unique patterns might emerge from this *cellular automaton* algorithm.

Starting from 2D images, our goal is to generate 3D organisms that creatively and freely evolve with the simple purpose of living. These new 3D organisms should maintain characteristics of the original image and also produce novel attributes in the 3rd dimension. To achieve this, code was built to convert an image into the initial conditions for the GoL, and to accept user parameters including a rule base, a 3D *area* size, and the number of generations to evolve.

Our experiments show that the initial image and the severity of the rules were the determining factors of a successful evolution. If the original 2D organism were clustered with live cells and governed by strict rules for birth and death, it would die after 10 generations. However, if it favored birth, the organism would overpopulate and lose its shape [4]. The same was observed for starting images with insufficient live-cell density. The best staring images were those that had clumps of live cells, but also randomness in which the live cells were not too close to each other [5]. This is paired with a rule that does not require a lot of live cells for survival and rebirth, as seen with: B2S23 (Born 2, Survival 2 3). This means that for a cell to survive to the next generation, it must have 2 or 3 live neighboring cells; if it is dead, it is reborn in the next generation if it has 2 live neighboring cells. This allows the organism to grow while maintaining its characteristic form, thereby facilitating successful evolution, Figure 1.

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