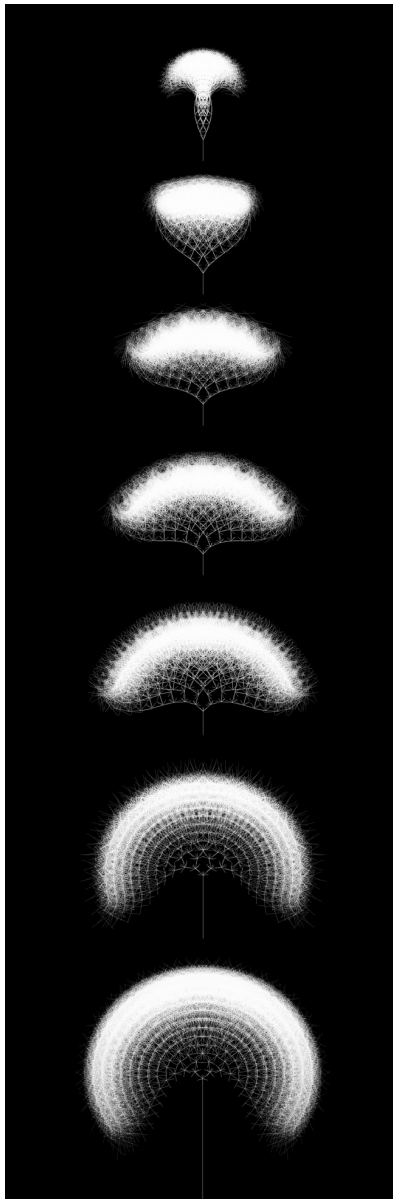

**Figure 1: Hybrid Dandelion utilizes generative design methods for mimic biological forms and growth behaviors.**

# Hybrid Dandelion: Visual Aesthetics of Performance Through Bionic Mechanism with Data from Biometric Facial Recognition

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**ABSTRACT**

Hybrid Dandelion is an interactive real-time animation art installation, used bionic mechanisms of algorithmic design to study generative rules for mimic biological form. It provides an approach to combine the algorithmic data structures from distributed computing, fractal tree, and L-system for investigate growth dandelion-like morphology. This work creates an interaction scenario with using facial recognition to scan audience's biometrics as means decoding your genetic data, and then inserting (the trait) into the dandelion model for modifying its indeed generative rules as like metaphor hybrid genetically modified task. It allows the audience to experience their unique data-driven artificial life form - dandelion as embodied and possessed through their facial features, heartbeat signal, and emotion expression in artistic expression.

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*CHI'19 Extended Abstracts, May 4-9, 2019, Glasgow, Scotland, UK.*
© 2019 Copyright is held by the author/owner(s).
ACM ISBN 978-1-4503-5971-9/19/05.
DOI: https://doi.org/10.1145/3290607.3313289

**AUTHOR KEYWORDS**
Data Visualization; Algorithms; Biologically-inspired Computing; Interactive Art; Bionic Design

**ACM CLASSIFICATION KEYWORDS**
Applied Computing: ARTS AND HUMANITIES

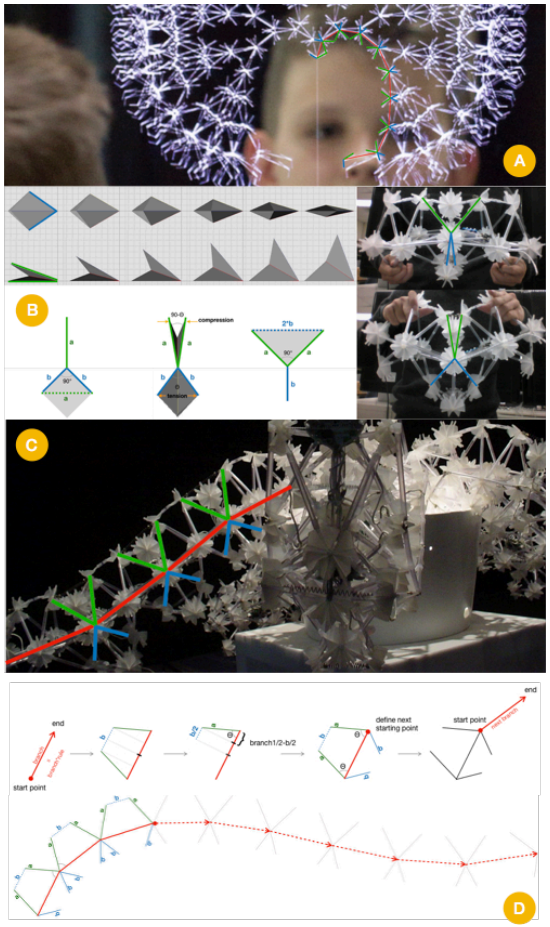


**Figure 2: The fractal-like branching structures on Dandelion model is designed based on MSOrgm's 2D Simulation by studies its mechanical movement on folding assemblies by SMA actuator.**

## INTRODUCTION

We utilize coding to explore the visual aesthetics in Hybrid Dandelion artwork, it uses bionic mechanisms of algorithmic design to study generative rules for mimic biological form and its growing behaviors, for investigate novel artificial-life forms.

Inspiring from contemporary architect using CAD/CAM with parametric and algorithmic tools study forms, make shape interact with adaptive behaviors during the design processes as nature system did [1][2], shaping complexity and skeleton-like structural system with combines properties from physical, mechanical and biomorphic [3], performing the transformable features as kinetic sculpture with demonstrate adaptive transport functions in space [4]. This field of biomorphic architecture also build creature by geometrical properties and rules to perform alternative patterns of shape in real world [5].

In this work, we combine the algorithmic data structures from distributed computing, fractal tree, and L-system with its rules and features, developing growing morphologies to mimic nature-like patterns, and developing the reactive mechanism from people's contact. It brings new communication to make people experience and see their personal biometrics information visualized in a real-time data-driven graphics. With the used of biologically-inspired computing, it draws powerful visual graphics by lines, embodiment of heartbeat signals, facial landmark, and emotional expression within dramatic dandelion dendriforms in time-based animation.

## BACKGROUND

The interactive art shows an application to aware audience's contact as input, triggering kinds of visualization [6] and physicalization [7], designing data-driven mechanisms for translate audience's data, making transfiguration as an interactive storytelling scenario, unlock a new artistic language. As Digiti Sonus [8] scan audience fingerprints' patterns into 3D modeling, generating sonic effect allows the audience to experience their self-biometric patterns.

Artificial life art field also discover the synthetic study of living systems. It used digitalized tools to investigate forms and behaviors from the nature, developing complex computing system and algorithm for simulate living organism(s) and its behaviors, and translate it into art form. As Luminescent Tentacles [9] used distributed processes simulate the behaviors of wiggling tentacle of the sea anemone, and making physical control system to act large number of actuators for performing life-like expression. More and more biologically-inspired computing [10] [11] model such as L-system, cellular automata, and reaction–diffusion systems, drawing inspiration for designer in using innovative process for "generate" designs. As Nervous System Studio [12] used generative design methods study patterns found in nature to create unique and affordable art and design object.

## DANDELION MODEL

### Recursive Growth Form Made from MSOrgm's 2D Simulation

Based on my previous interactive kinetic sculpture MSOrgm [13], which build kinetic nature-like growth form composed by shape-memory alloy (SMA) actuator within in foldable truss structure.

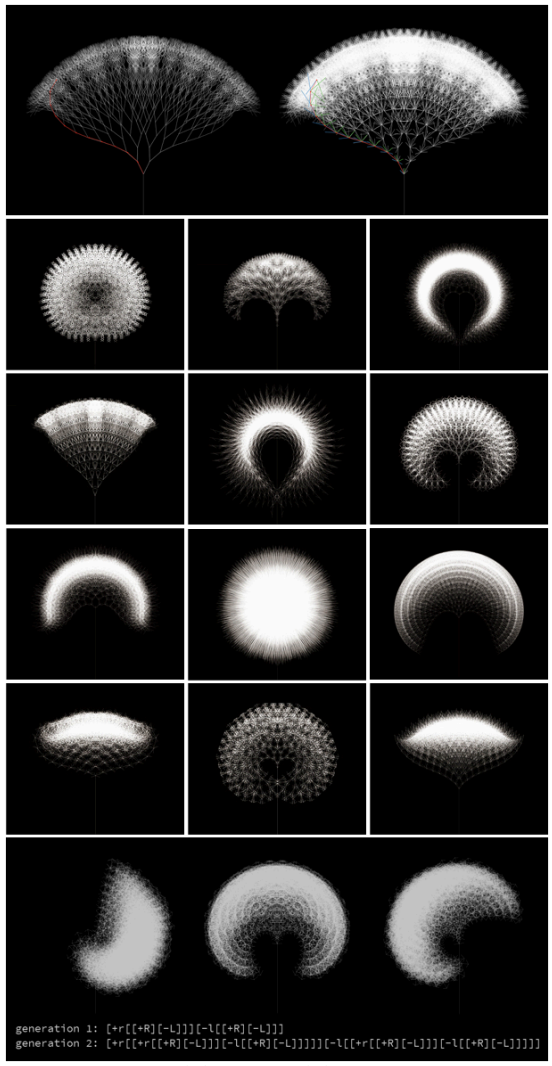


**Figure 3: Dandelion model uses L-System, a rewriting grammar-based system to generate replicated patterns by recursive generation rules. By adjusting parameters and multi-faceted production rules, nature-like morphologies can be evolutional generated.**

The dendriform-tree and fractal-like branching structures on Dandelion model, is made extending by original MSOrgm's 2D simulation model - MSOrgmVP, build for studying recursive mechanism in forms growing, and inherit its transformable feature into repeated geometrical rules when recursion generated in MSOrgm's leaf. With this model assist, I could draw the ideal natural growth forms with generated folding assemblies and manufacture detail for construction.

### Leaf's Behaviors Generated by Distributed Processes Framework

By found inspiration from the sensitive plant of Mimosa pudica or Drosera (Sundews), its tentacle and leaf movement response to mechanical stimuli. Elaborate and impressive touch responses of plants capture the imagination as such behaviors are act unexpected and adaptivity. The MSOrgmVP leaf also designed as distributed processes setting in similar one-dimensional Cellular Automata framework. Each joint between interconnected branch can see as a grid with motor cell, each cell's state triggering bending behavior on branches. Each cell can see as an interactive motor cell, when input stimulus on one of it on leaf, that generate successive bending behaviors at all.

### Using L-System to Generate Fractal Tree Structure in Time-based Animation

The main dandelion model uses L-System, a grammar-based system, for using MSOrgmVP's recursive and distributed processes mechanism from unique leaf into fractal tree structure, and it use "Turtle Geometry" to draw millions of lines in display replicated patterns as dandelion morphology. By input stimulus signals on leaf and parameters of generative rules, it can output replicative and adoptive fractal geometry, a high level visual impactive diagram in time-based animation. With the use of complex parameters and multi-faceted production rules, many nature-like behaviors as growing, blossoming and other evolutional transformation can be generated.

## EXHIBITION DESIGN

### Artist Statement

In this artwork, I treat dandelion model as a virtual artificial life creature, brings a concept to rethink of upcoming future, that scientist could use genetic engineering to create hybrid life form through decode one organism's genetics data and then pass down its trait with others organism's DNA. And according to recent scientists have more knowledge on reading the relations of how genes effecting facial features, therefore, this work "Hybrid Dandelion" create an interaction scenario with using facial recognition to scan audience's biometrics as means decoding your genetic data, and then inserting (the trait) into the dandelion model for modifying its indeed generative rules as like metaphor hybrid genetically modified task. With the synchro mechanism by real-time data grasping, analysis on camera, and then transmit key parameters to Dandelion model, "Hybrid Dandelion" allows the audience to experience their unique dandelion patterns as embodied and possessed through their facial features, heartbeat signal, and emotion expression.

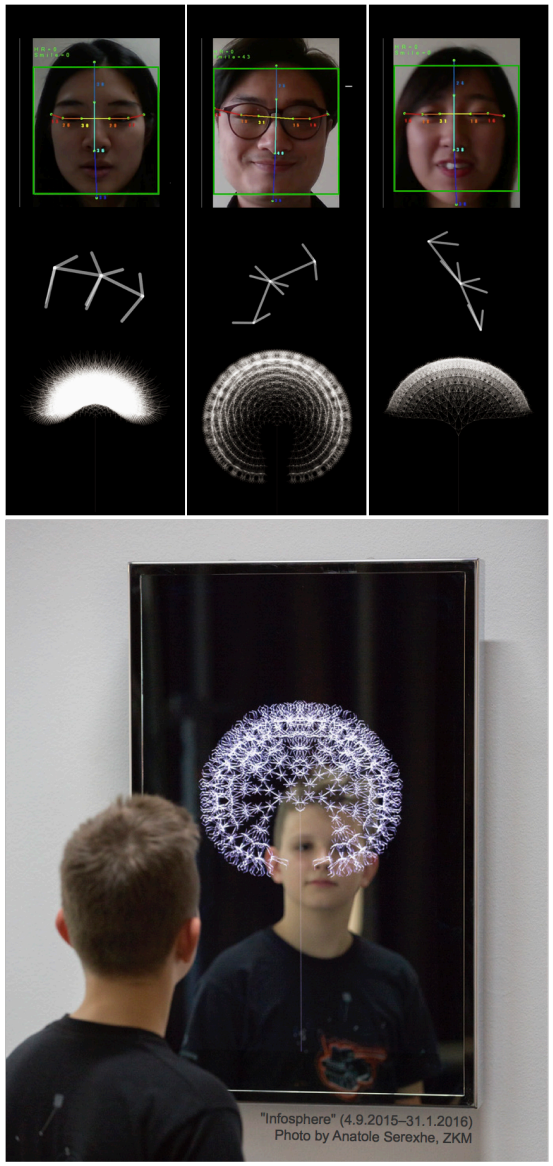


**Figure 4: Hybrid Dandelion allows the audience to experience their unique dandelion patterns generated by their personal facial features.**

### Data Grasp, Analysis, and Applied in Dandelion Model

The synchro mechanism develops facial information application processes, grasp data from Intel® RealSenseTM Depth Camera which can analyze the facial expression and the embedded physiological characteristics seining by the biometrics. The facial data are used as nourishment parameters to trigger the complicated fractal-based dandelion growing. These physiological characteristics are used to analyze the key scale features according to the Chinese face readying standards, which says that "a perfectly proportioned face measuring no more or less than three times the forehead in length, and five times the eye in width." We use Intel RealSense SDK to determine the ratios of face height into three segments, and width into five segments. These facial proportions are used to adjust the parameters of core dendriform's geometry with recursive rules within dandelion model.

## CONCLUSION

We present a real-time data-driven graphics with applied of biometric facial information making dynamical and flexible visualization by bionic dandelion-like form, shows a dramatic algorithmic aesthetics made by generative design and distributed processes framework. The potential of the dandelion model is not limited to what we have presented, we hope that the bionic mechanism can be used to conduct shape-changing with some functional issues according to user's physical properties and psychoanalytic by analysis by facial recognition, which abilities can be contribute to Organic User Interface (OUI) in future. Through this dandelion shape can be construction physically as our previous kinetic artwork MSOrgm (constructed by folding assemblies with actuator), It can be designed as adaptive Tangible User Interface (TUI) with algorithmic artistic expression.

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