

Expressive Fabrication

Encoding Generative and Genetic Techniques into Digital Fabrication

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ABSTRACT

How can we design “uniqueness” with digital fabrication? We introduce objectDNA, an approach that alters and evolves design when users link object traits with external variables leading to chance and unique artifacts. We posit that interactions which utilize a generative model can lead to new design dimensions such as those where objects can grow, die, mutate, and reproduce. Using a camera sensor, we show how color can be mapped from outside scenes onto objects as an example of site-specific design.

INTRODUCTION

Digital fabrication has been explored as a technology to reinstate craft and uniqueness to objects [6], however software interfaces limit the amount of control a user has for influencing the design of an object. These interfaces are often constrained to parameter-tweaking and example-rifting. Historically, evolution as algorithm has been explored as a design strategy for creating unique and chance work [4], and more recently work has begun to recategory the role of the maker as the ‘artist creator’ and the ‘artist gardener’ [5]. We propose a more fluid, expressive method of making which uses sensor data and chance events to produce unique, printable forms and behaviors.

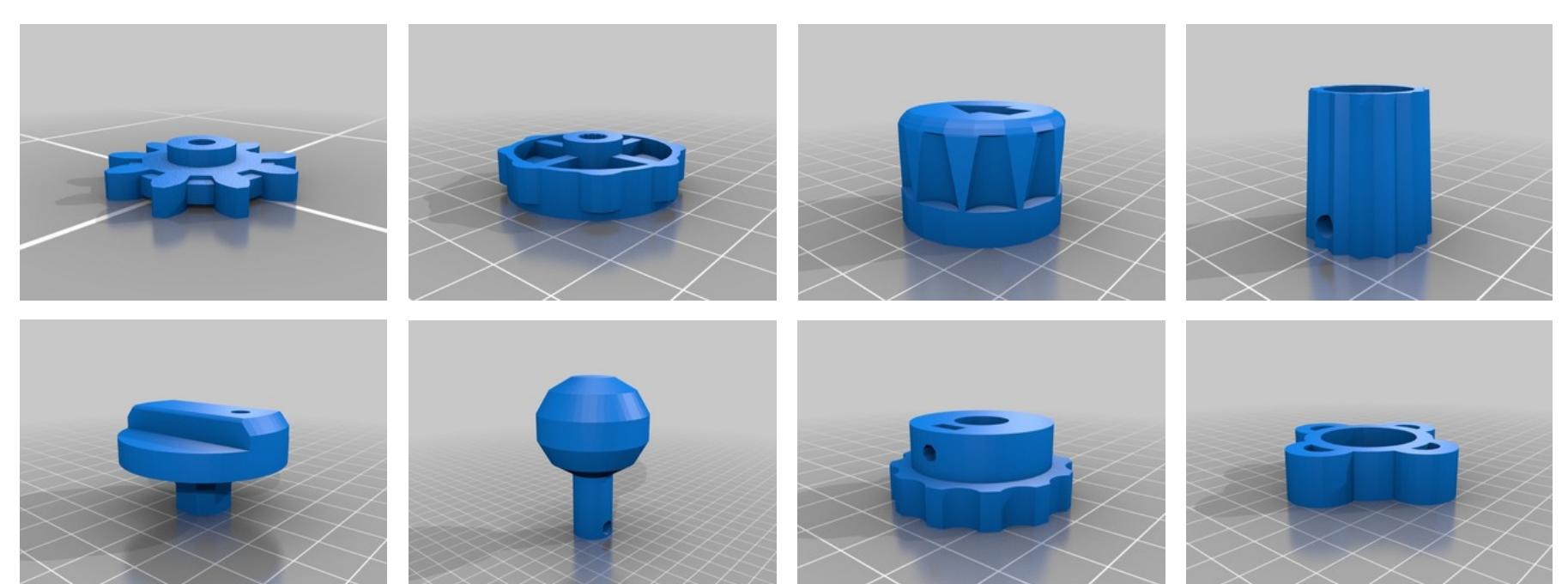


FIGURE 1: THINGVERSE SEARCH RESULTS FOR ‘KNOB’. THESE KNOB DESIGNS FOLLOW THE SPOKE AND WHEEL MODEL, BUT DOES THIS CAPTURE THE EXPRESSIVE AND CREATIVE POTENTIAL?

How can we design “uniqueness” with digital fabrication?

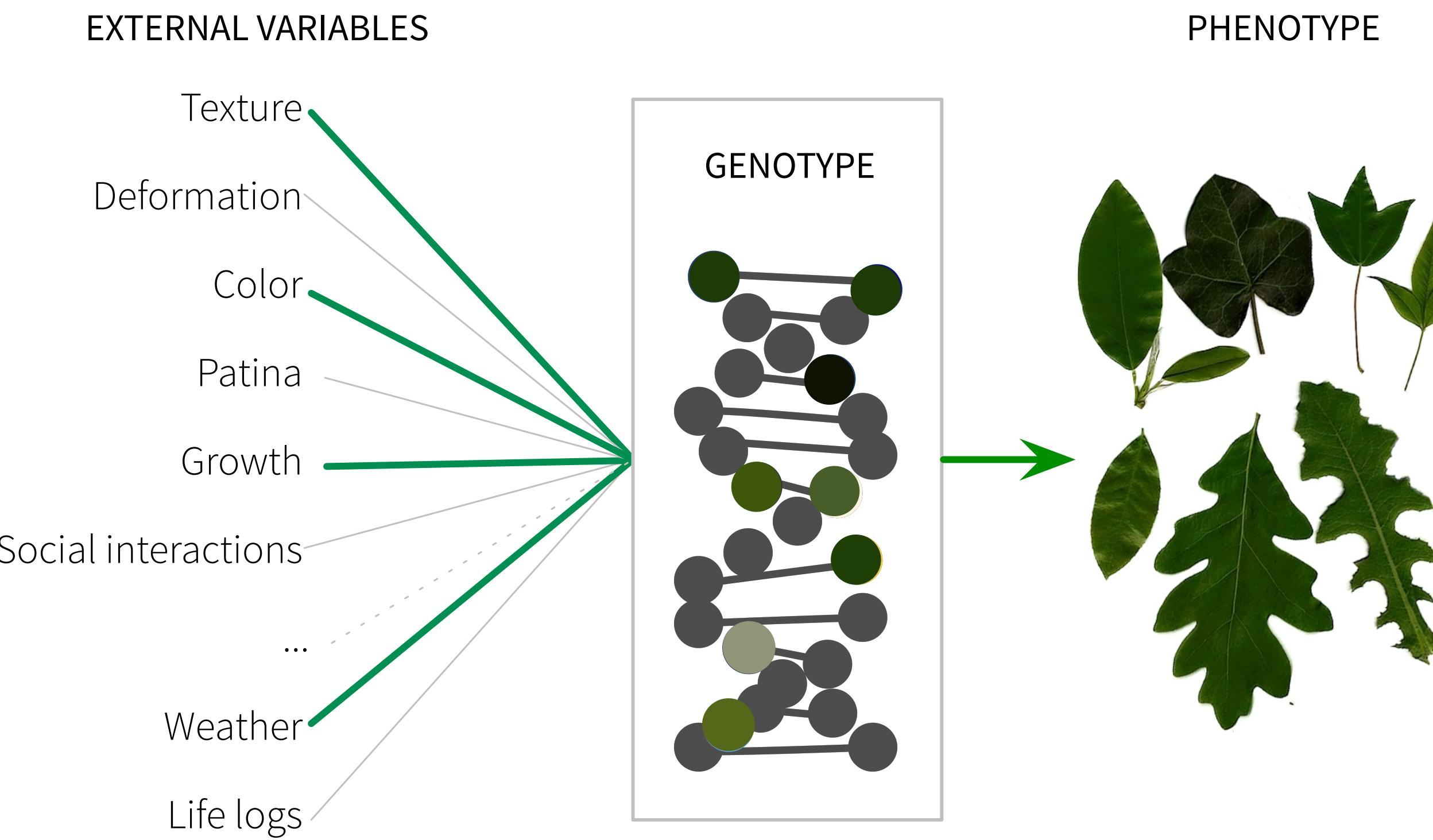


FIGURE 2: A CONCEPTUAL SKETCH OF HOW EXTERNAL VARIABLES CAN BE APPLIED TO AN ENCODED OBJECT (objectDNA) AND USED TO EXPRESS A FAMILY OF DESIGNS. THIS PROJECT DEMONSTRATES THE COLOR INTERACTION.

objectDNA

Viewing DNA as a generative algorithm, we can characterize interactions useful for makers : *reproduction* - merging two similar entities into a hybrid third, *mutation* - introducing chance variables via agents, and *genotype/phenotypes* - embedding traits through dominant/recessive hierarchies. Our project incorporates the environment as a mutative agent that influences the color of digital objects made for fabrication.

SYSTEM ARCHITECTURE

Our system uses *Grasshopper*, a graphical generative algorithm editor for *Rhino*, the interactivity plug-in *Firefly*, and custom *Rhino C# SDK* components [4,5]. Interaction flow is depicted in Figure 3 : a) connect to a live camera feed, b) on user event, run k-means color segmentation on the incoming image frame, c) process a list of colors and map them to constructive solid geometries, d) encode the geometries and colors into a feature vector, e) render the geometries on a display, and f) store generative encodings in a database for analysis. Since color quality is affected by lighting conditions, we map colors to their closest *PANTONE* equivalents.

MUTATION PROTOTYPE

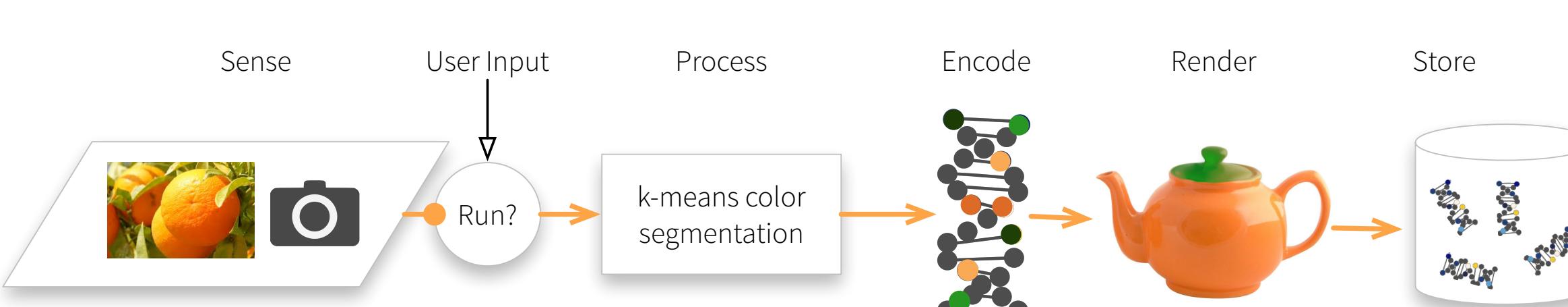


FIGURE 3: INTERACTION FLOW FOR A COLOR MUTATION OF THE UTAH TEAPOT MODEL.



FIGURE 4: A DIGITAL TEAPOT ALTERED WITH A DEGRADING SHELL COMPOSED OF MATERIALS MAPPED FROM THE ENVIRONMENT.

DISCUSSION

Is object change good or bad? Objects are identified differently when they are able to change becoming more lifelike and subject to the variables and forces that act upon them. While our digital fabrication technique materializes unique digital objects, we cannot claim they are equal or superior to analog-originated work, nor can we say the same for the making process; For instance, important to uniqueness is the identity of the creator [1], but where does creative agency lie - when does changing a design make you its creator? Our project suggests that traditional notions of authenticity and uniqueness shifts for digitally created artifacts. We will continue our work on object uniqueness by exploring how sensors, personal data, and temporal variables (Figure 2) can alter our relationships with objects and the making process.

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