

Modified text excerpts from Behavioral Kinetic Sculpture

Casey Reas (2001)

Elements of a Behavioral Kinetic Object

A behavioral kinetic object is a dynamic system, meaning it changes with time. This system is composed of a source of energy, inputs, outputs, and a control architecture which converts the information from the inputs into information which stimulates the outputs. These elements sum to form the complete object, but other elements may be added to provide mass or form.

Input

The interface between the object and the world is its sensors which convert physical stimuli into electrical signals. For example, a sound wave moving through the air may vibrate a tiny diaphragm within a microphone and this vibration modulates an electrical signal which accurately reflects the sound in the environment. This analog electrical signal must then be sampled into a digital signal so that it is valuable to the control system. This process is known as an analog to digital conversion or ADC. There are many different sensing mechanisms that may be employed for creating an aware object including light detection, motion detection, sonar, a video camera, touch sensors, gyroscopes, etc.

Output

The output of a behavioral kinetic object allows it to communicate and to achieve its goals. For example, through moving its motors in a purposeful and synchronized manner a object may project the emotion of anger or may attract the attention of a passerby if it needs attention. A object may use actuators such as standard motors, servos, solenoids, or hydraulics to create movement.

Control

The control system for a behavioral kinetic object is a set of rules that creates behavior through mapping the input and the output. To achieve this task it must store the information about the current state of the environment and possibly information about the previous state of the environment. W. Ross Ashby explains how the body of an organism may be defined as variable information:

All bodily movements can be specified by co-ordinates. All joint movements can be specified by angles. Muscle tensions can be specified by their pull in dynes. Muscle movements can be specified by co-ordinates based on the bony structure or on some fixed external point, and can therefore be recorded numerically. A gland can be specified in its activity by its rate of secretion. Pulse-rate, blood-pressure, temperature, rate of blood-flow, tension of smooth muscle, and a host of other variables can be similarly recorded [Ashby p. 30].

The amount of information that is stored in variables may vary from minimal to extremely complex and likewise, the control system may facilitate behavior that ranges from the relative simplicity of an insect to the complexity of a mammal. The control system for an object is typically written in Assembler or Ccode and implemented on microcontrollers. An advanced object has an adaptable set of controller rules so that it may change its behavior to better adapt to its environment.

Behavioral Model of Interaction

The principle idea behind a behavioral model of interaction is to develop a method of interaction that is more similar to engaging with plants, insects, animals, and people than engaging with stones, books, furniture, and buildings. The goal of creating an object with behavior is not to mimic biological organisms, but to utilize their characteristics to develop a visceral engagement with three-dimensional form. Qualities of a behavioral mode of interaction include perception of control, responsiveness, unpredictability, engagement with the body, and nuance of communication. These qualities may be manipulated by the creator of a behavioral kinetic object to either facilitate communication or to challenge expectations.

Perception of control

A child's experience of playing with a stuffed animal is much different than playing with a real animal. When a child interacts with a cloth animal, she/he is in total control of the situation, but interacting with a real animal requires mutual interest. To engage in a positive interaction the human must be aware of the animal's emotions through physical cues and the child must provide appropriate feedback so that the animal knows how to respond. In this scenario, there is continuous information being passed back and forth between the animal and human. The human is not in control of the animal and the animal is not in control of the human, but there is reciprocal communication. The perception of control in a behavioral interaction may range from strong control to total lack of control, but there must be information communicated between both parties for a behavioral interaction to exist.

Responsiveness

The need for a response to every action is necessary to maintain communication. If speaking with another person, for example, we notice the changes in his/her facial expression in response to what we say. We know that eye contact implies engagement, the nod of the head is a confirmation, and wandering eyes may mean a lack of attention. In speaking on the phone we often give feedback through verbal confirmations and tone of voice. If there is no response or feedback in a given situation, the people interacting are not able to construct a mental model of the state of the other person and communication becomes confused and impossible.

Unpredictability

The idea of unpredictability is related to control but differs in expectation. If we are able to predict every response, interaction is boring. In growing a plant, for example, we should see a positive correlation between watering it and growth, but if a plant grew exactly one millimeter every week and sprouted a new bud on exactly the first day of every month, we would not have the joy of seeing a new and unexpected flowering or new growth. A balance must be met, though, between the disinterest of unchanging reactions and pure chaos. If the plant grows a different amount each week regardless of the care it receives, there would be no noticeable correlation between the caregiver and the organism and the connection would be lost. Although random systems may provide appealing results, they do not allow humans to speculate the future of the system and therefore do not engage the imagination like a behavioral system.

Engagement with the body

Our natural modes of communication and behavior engage the entire body. We communicate through our movement, speak with our hands, and understand the world in relation to our physical presence. Total engagement of our body requires a physical kinetic presence. Through creating physical behavior in the medium of sculpture we are able to engage on a visceral level not possible in flat representation.

Nuance of communication

The amount of information we convey to other people while communicating with them is theoretically infinite, but filtered through our senses to make it manageable for our brains. In contrast, the information we convey to our machines through a mouse and keyboard is extremely small and quantized. A behavioral interaction would ideally provide a channel for communication where minute details of human communication could be detected and affect the system.