

Digital Kinetic Art: A Bridge Across the Uncanny Valley of Robotic Art

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Abstract—This article explores robotic art in the context of history from ancient Greek to tele-robotic art. Beyond the robot technologies, we might find the characteristics of robotic art and kinetic art; what differentiates them from precedent art forms. New forms of kinetic art, which are controlled by digital algorithms, can be entitled as ‘digital kinetic art.’ Digital kinetic art could be a middle term to cover various art works from kinetic art toward robotics. It can also be a bridge crossing over the uncanny valley of robots.

I. INTRODUCTION

From the Greek myth of Pygmalion's sculpture named *Galatea* to the telematic robot *Telegarden* by Ken Goldberg, many artists dreamed and tried to build sculptures with movement, and to embed intelligence in machines. As a genre of art, robotic art was founded under the influence of kinetic art[3], while the first robot was developed in the mid-20th century[1]. In that point of view there raises an underlying question, how the robotic art is differentiated from previous art. Eduardo Kac tried to clarify the term robotic art with the statement of Robotic Art in 1997[2]. He argued robotic art is different from anthropomorphic sculpture or internet based programs, and he tried to settle robotic art in a new territory.[2] Nevertheless, there remains an unexplained aspect, a blurred area between robotic art and its related art forms, e.g. interactive installations with machines, robotic sculptures, physical computing art, interactive instruments, and kinetic interfaces in mechanical parts of digital art. They are lying in the unexplored territory between robotic art and kinetic art. This exploration focuses on the overlapped boundaries around them and proposes a middle term, “digital kinetic art” with comparable examples. This paper is intended as an investigation of the diachronic context from automaton to kinetic and robotic art.

II. PHYSICAL MOVEMENT IN ART

A. Automaton

Historically, the concept of a robot is derived from Greek sculpture, which is represented by the myth of Pygmalion and Hephaestus, who were believed to create the living sculptures, i.e. automata.[1][3] From the ancient Greek to the early Renaissance, the term of art was not distinct from engineering[4]. However, except the mechanical inventions of Leonardo da Vinci and some of the Renaissance artists, most

classical artists were obsessed about the eternal beauty with central perspective[6]. The realized form of automata came from mechanists and inventors outside the field of art. In the 18th century, experimental machines were unveiled, for example, Jacques de Vaucanson created animal machines in which a mechanical duck digests corn, replicated later by cybernetic artists.[5] At the same period, Wolfgang von Kempelen constructed an interactive game machine in Germany.[4] In 1769 Kempelen created an android pseudo-automation that simulated mechanical intelligence known as the *Chess Turk* or *Chess Automaton*. [5] Even if these machines were beloved by enlightened monarchs and curious spectators, the mechanical objects were far from coexisting with artists until the Futurists in the 1910s.

B. Kinetic Art

At the beginning of 20th century, the Futurists began their experiments in reproducing the movement of bodies. Their strategy was a representation of dynamic contents on the static picture with the overlapped transition of motion.[7] Such as the illustrated illusion of movement from the Futurists, it jumped into physical movements by Marcel Duchamp, Laszlo Moholy-Nagy, and Alexander Calder. They considered realizing the change of motion by the environment or electromechanical actuators[6]. Thus, their early kinetic sculptures presented new aesthetic value of the physical motion. In an effort to avoid the repetition of rotational movements e.g. Duchamp's *Rotary Glass Plates* (1920), and in order to realize the eternal change of motion, Calder focused on the movement by environment instead of electro-magnetic mechanisms.

In the 1950s, Jean Tinguely developed artistic machines as a form of kinetic art after those precedents. Tinguely transformed the concentric rotation of motors into a series of movement. According to Pontus Hulten, Tinguely succeeded to build anti-machines or meta-machines which symbolize the character of everlasting change without any kind of exact computations.[7] Tinguely presented a metamorphosis of mechanical systems into artistic machinery. His kinetic art works showed not only the artistic machinery, but also the anthropomorphic machine, which can be found in the *Métamatic* series in 1959. These machines generated automatic drawings differently every time through the irregularity of unbalanced rotations. After Calder's passive movement, for example, Theo Jansen realized many species of animal-like structures only with thin pipes, which were light enough to crawl by wind. On the other hand, sensing technologies and computer controls have permeated into kinetic art for the purpose of interaction with spectators. The

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machine that reacts to spectators or surrounding environments has been called cybernetic art since the 1960s.[12]

III. ROBOTIC ART AND DIGITAL KINETIC ART

A. Robotic Art

Robotic Art was also introduced as a kind of cybernetic art from the exhibition of *Cybernetic Serendipity* in 1968[12]. Kac explained the first attempt at the development of robotic art that kinetic art reintroduced the machine to the artistic dispute and influenced the development of robotic art.[3] Continuously, he suggested three different types of robotic art: Nam June Paik and Shuya Abe's *Robot K-456* (1964), Tom Shannon's *Squat* (1966), and Edward Ihnatowicz's *The Senster* (1969-70)[3]. From these three different examples, robotic art could be interpreted with three characteristics: free mobility, organic hybrid, behavioral autonomy, and also in three different forms: anthropomorphic humanoid, artificial life, articulated joint structure. Further, Kac mentioned that a robot displays behavior which can be mimetic, synthetic, or a combination of both[2]. In spite of Kac's ambitious argument with the territory of robotic art[2], overlapped characteristics still remain between robotic art and digitalized kinetic art.

B. Digital Kinetic Art

After Tinguely, kinetic artists have built reacting machines by accepting new materials like computers, motors, sensors, circuits, lightings, and even nature itself. This technological expanding of kinetic art substantially influenced a new form of architectural sculpture. For example, the Berlin based creative studio ART+COM realized *Kinetic Sculpture* (2008) through the process of artistic creativities based on the algorithmic control technique. The installation *Kinetic Sculpture* demonstrates a physical morphogenesis of the transition between the collectivity and the individuality with elegant motion.[9] This abstract illusion of machines reminds us about the experiments of early kinetic art from Duchamp and Moholy-Nagy. In comparison with them, the main dissimilarity is the employment of digital technology, which enables the sophisticated motion.

Beyond the abstract illusion of mechanical movement, Louis-Philippe Demers and Bill Vorn have developed various machines for performance stages. They discovered the overlapped boundaries between artistic machines and anthropomorphic robots. The technological transitions to digital control allowed a hybrid of kinetic art and robotic art. Consequently, Demers designated their works with varying terms: machine, kinetic art, and robot.[10] Gretchen Skogerson explained one of their creatures by also use the neutral word, 'machine': "Demers and Vorn create a machine environment where the machines, because of their behaviors, address issues of empathy and anthropomorphism." [11] Despite the appearances as like kinds of primitive species, most of their machines are controlled with computer programs. The process of digital algorithms allowed the emotional behavior into machines as like robots. Humans have the ability to imagine the anthropomorphic existence from a machine[11].

For one more example nearby robotic art, Kenneth Rinaldo also exhibited an interactive installation e.g. *Autopoiesis* (2000) consists of fifteen robotic arm-like extensions which are built of twig branches, each equipped with a series of infrared sensors that can determine the position and movement of spectators.[12] In contrast, *Telegarden* (1995) by Ken Goldberg and *bios[bible]* (2007) by robotlab of ZKM both of which hired industrial robot-arms – from Adept Technology and KUKA – directly in order to represent robotic behaviors. In the blurred boundary, there is another missing territory of the interactive apparatus, which can play with human. It is also relevant to the haptic device of robots, educational robots, and kinetic interfaces of design works[6]. They are designed by human behaviors, but also by the consideration of mechanical functions i.e. interactions.

C. A Bridge Across the Uncanny Valley of Robotic Art

It might be suggested that the characteristics of digital kinetic art are: interactive, random accessible, algorithmic controllable and programmable machines in the form of kinetic art. However, these characteristics are generally overlapped with robotic art in regard to the digitalized behavior. The distinct difference is that they are not robot-kind which determined by Kac neither the literary context nor industrial robots[3]. All things considered for the works from Tinguely to Demers, the artistic design of machinery could be a strategy not only inventing new behaviors of machines, but also crossing over the uncanny valley of robots. Masahiro Mori suggested the design methodology which keeps in safe familiarity by a non-humanlike design, avoiding the uncanny valley of robot's appearances.[13]

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