Unfamiliar or Defamiliarization: The Uncanny Valley in Interactive Artwork Installations

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Abstract: *This paper proposes a new approach to analyzing interactive artwork based on the uncanny valley theory. The uncanny valley theory is currently used in robotic technology and computer graphics for making digital humans. Recently, interactive artwork installations similar to robotic or digital human devices have been developed using various digital technologies. Humans feel that not only a robot's appearance but also its performance is uncanny. This study performed a new type of interactive artwork analysis based on the uncanny valley theory. Audience members experienced two conflicting uncanny emotions when participating in the interactive artwork installation: "unfamiliar" in participating or "defamiliarization" in aesthetics or being contradictory. Audience members can have a novel experience by participating in interactive artwork and overcoming the uncanny valley. Through the new approach to the uncanny valley in interactive artwork, audience members will experience artistic value and expand their experiences by interacting with new technologies and content for human lifestyles.*

1. Introduction

1.1 Background and Motivation

Interactive artwork installations that move and directly induce human action using digital interactive technologies have been developed. Such aesthetics involve not only appreciation and interpretation, but also participation and activities through which the audience can experience the creation of content [1]. These conversions about interactions emphasize the development of installations with robotic features, including automated reactions and artificial intelligence (AI) [2]. Interactive artwork installations have been continuously developed using digital technologies; however, audience interaction with these installations has not increased in proportion to their development. Audiences follow the rules set by the artist and participate in already decisive situation within the interactive artwork; the participants make only non-subjective choices. Audiences not only experience the uncanny valley in reflecting on their own image but also in their reactions to interactive artwork. This non-participation is influenced by the artwork's content, and the subjects of the artwork have changed.

This is different from the concept of the uncanny valley among audiences of previous new media artworks because the audience interacts with the installation. Rather than just watching or listening, audience members participate in the installation directly and changed the content through their own activities based on the audience's or artist's desires. Such participation enhances the audience's uncanny emotions. Therefore, from this viewpoint, interactive artwork installations can create an uncanny valley for participants.

As robots begin to resemble humans, interactive artwork installations go from resembling robots to humans in similar experiences. Audiences may experience emotions similar to the uncanny valley when participating in interactive artwork installations, just like they do with robots. Robots perform various movements and activities to fulfil abilities similar to those of humans; androids possess a physical presence that simulated characters lack yet can be more perfectly controlled than any human actor to isolate the factor under study [3].

From the perspective of the humanities, an artwork's values and content qualities are downgraded by the audience's hesitation and lack of active participation. The development of robot technologies includes not only robot devices for human support but also a rethinking of the values of human identity for life issues. New digital media art has proposed new value using technologies in the domain of the humanities.

For example, Paik Nam Jun expanded the applications of television to form a new form of media and not just an entertainment source [4]. In this concept, robot technologies assume the role of a new media form and not just as a function. This new role expands the performance of the basic roles of robots. After the development of Paik's video artwork, television and screen objects expanded into new forms of media art through digital technology. Another example of such artwork is a series of mirrors installed by Daniel Rozin, which dealt with new media technologies. The mirror installation, which was made using digital technologies, was represented by the audience's images and activities, and the audience received new value to reflect on their self-identification through media mirrors [5]. These experiences generate artistic value and influence human lifestyles from the perspective of human content.

Robots have developed in two ways through the development of digital technologies: resembling human figures or performing various roles on behalf of humans, thereby imitating human reactions and operations. Robots have played Go and performed as actresses in movies, while an AI system has written a novel. In addition, various aspects of robots besides their physical dimensions have evolved, including their actions, emotions, psychology, and cognition. Robots based on AI should be declared as having the same rights as humans through self-evolution. Robot development has evolved based on recent technologies including the Internet of Things, wearable devices, smart homes, and affective computing. Interactions between humans and robots have been developed, such as human communication through AI or Big Data. Robots have participated in artwork, in the role of humans, and have performed various roles as actors, performers, objects, settings, and a robot itself.

Humans can experience the uncanny valley not only through humanoid robots but also through interactive artwork installations. This emotion is an ordinary experience of human participation. However, the audience can experience strong emotions by interacting with the installation and content. This study elaborates on the uncanny valley theories concerning the complex aspects of robot appearance and performance. In particular, interactive artwork installations evoke audience participation through audience activities in terms of the moving type in the uncanny valley theory and expand the value of human content.

1.2 Study Aims

Audience members hesitate to engage with interactive artwork that create uncanny valley emotions. Is the uncanny valley in interactive artwork a new grotesque form of aesthetics or is it the overcoming of such aesthetics? To date, the uncanny valley has been considered an unfamiliar emotion by audiences, and researchers and designers have proposed approaches to overcome it. However, new aesthetics provide new value for human life from the viewpoints of aesthetics and the humanities.

Participants have expressed ambivalent emotions toward a variety of interactive artwork installations. While they are interested in new media artwork materials through which they can engage with an artist's creativity, they also experience uncanny emotions in response to new media artworks because of their unfamiliar appearances and reactions. These ambivalent features have been used to analyze the concept of the uncanny valley in digital technologies. Audiences change their emotions in response to digital technologies through the uncanny valley, which has caused new aesthetics to be implemented in new media artwork. However, the participants hesitated to participate in interactive artwork installations, as audiences do not control the installation and content, and they aggressively produce meaningful artwork aesthetics. Hence, radical approaches are needed to address the problem of hesitation to participate in the artwork and for audience members to find artistic value within interactive installations.

2. Literature Review

2.1 Basic Research for Uncanny Valley

Mori proposed the "uncanny valley," which was the first theory related to humans and robot technology [6]. The concept of the "uncanny valley" was based on the generation of humanoid robots, human characters in computer graphic animations, and virtual digital characters.

Tronstad starts his discussion by referring to a previous essay on the "uncanny" written by Ernst Jentsch, in which Jentsch connects the uncanny to intellectual uncertainty, particularly to "doubts whether an apparently animate being is really alive, or conversely whether a lifeless object might not in fact be animate in psychology from Freud [7]." Although Freud agrees that such experiences may arouse feelings of uncanniness, he denies that intellectual uncertainty is the primary factor behind the uncanny. According to him, the recurrence of something repressed is required for a situation to be experienced as uncanny; without such, it can merely be frightening [7].

Uncanny valley theories can be applied to create various digital characters that affect animations or virtual reality. Digital human characters have been used in animation and virtual personas through visualization [8]. These characters have been used in various fields, including movies, exhibitions, animations, and cyber industries, to express the human desire for self-identity, change self-images, and support characters. Digital characters have been developed not only through the visualization of whole-body figure or facial expressions but also by reflecting human actions [9].

2.2 Research for Digital Human applied by the Uncanny Valley

The uncanny valley has been used to create facial expressions for digital characters [10,11]. Facial expressions are important for emotional communication by robot technologies, and not only for natural facial expressions that are similar to those of humans [12,13]. Based on previous research, digital characters can be in one of two categories—representation of self-identity or creation of an avatar—by customizing a system in a cyber or virtual world. With the development of AI systems, virtual characters can think and act like humans.

Uncanny valley theories have been used to decrease unfamiliar emotions in response to characters made to resemble humans [14,15]. Such analysis has been applied to the visualization and activities of characters, as well as to their external features and facial expressions and the customization of new characters. Humans may not only experience unfamiliar emotions but also experience unfamiliar aesthetic values from grotesque and strange objects. However, Mori's uncanny valley theory does not consider these ambivalent aspects. Mori understood the uncanny valley as merely involving unfamiliar emotions in response to robot technology. However, artwork has gone beyond these unfamiliar emotions and sublimates these emotions into aesthetics through the strategy of defamiliarization.

2.3 Research for Unfamiliar and Defamiliarization

Defamiliarization is a technique that uses humans and poets, has a new approach to reach the truth, and the truth why, and what familiar and recognition were abandoned, and the unfamiliar and non-familiar tends [16].

The concept of defamiliarization through the uncanny valley in robotics technology focuses on the two categories. First, robots can perform various activities to communicate with humans or other devices, and not just industrial roles; therefore, researchers consider the uncanny valley through a robot's performance and not just its appearance. Second, uncanny emotions not only result in unfamiliar feelings that disturb humans, but also new feelings for finding creative factors. In industrial technology, humans interrupt uncanny emotions. However, the uncanny valley has become sublimated in the artwork genre and has positively influenced human emotions.

3. Case Study

3.1 Definition of Uncanny Valley

In the uncanny valley theory, humans feel familiar emotions through the likeness of robots to humans. However, beyond the likeness of a robot, humans experience an uncanny valley from it. Humans are unfamiliar with and fear figures resembling humans (Fig. 1) [6]. Recently, computer graphics and digital character fields have applied uncanny theories to make characters humanlike and enhance their intimacy with users [8,9].

However, the uncanny valley theory lacked evidence that use verified data and statistical analysis to support the argument.
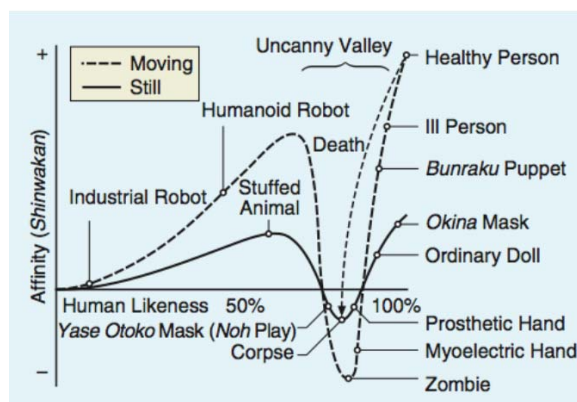
Figure 1. The presence of movement steepens the slopes of the uncanny valley [6]

3.2 Definition of Unfamiliar and Defamiliarization

Based on previous studies, this study defines the term "unfamiliar" as follows: Audiences can feel uncanny and strange emotions while participating in interactive art installations from the viewpoint of the uncanny valley. These emotions can influence audience members' participation in interactive art installations through hesitation, ambivalent emotions, and the problem of interactions. This experience causes an innately negative, stressful, or unpleasant interaction with the interactive artwork.

In addition, this study defines defamiliarization as follows: Audience members may have experienced creativity and participated in interactive art installations from the viewpoint of the uncanny valley. These emotions could positively influence audience members participating in interactive art installations and lofty sublimation of emotions by digital aesthetics in the strategy of disruptions of interactions, which would lead to new and disruptive ways of perceptions and interactions by audience members from the viewpoint of digital aesthetics.

3.3 Analysis Method

These robot figures resemble humanoids. Humanoids resemble humans, resulting in the uncanny valley. According to the graph shown in Fig. 1, the uncanny valley theory focuses on one factor of robots: whether they are still or moving. However, this theory does not consider the robot's role, but only robot figures that appear like human figures. In graph analysis and studies of the uncanny valley, the uncanny valley has three elements for human experience: appearance, activities, and multiple aspects.

3.3.1. Appearance Aspect

The factors of the uncanny valley in the characters and robot figures automatically resemble those of human facial expressions and physical body movements. The appearance aspect is related to the representation of figures or objects. Robot figures that resemble humans are humanoids; because humanoids are more similar to humans, they cause the uncanny valley. Humans experience an uncanny valley when reflecting on their own figure and reactions to their activities.

3.3.2. Activities Aspect

The factors of the uncanny valley in the thoughts and activities of characters and robots include automatic activities by human inference, deduction, and thought as well as automatic activities and operations that resemble human actions. Robots have evolved to perform various activities based on their thoughts. Humans can experience an uncanny valley in robot performance, similar to artificial intelligence, or the activities and operations of characters and robots. Artificial intelligence and its activities are connected by psychological actions through the audience's desires and can result in an outcome. Robot activities and performance may influence human life and serve as substitutes for human roles in various fields in the future.

3.3.3. Multiple Aspects

It is possible to mix the uncanny valley into figures and activities. More complex abilities and skills have been developed within robotic technologies, such as automatically imitating human facial expressions and activities through human inference, deduction, and thought, and automatically imitating physical body movements and activities as well as operations similar to human action. In addition, it is possible to mix the uncanny valley in appearance and activities. More complex abilities and skills have developed in human life. Humanoids that are similar to humans can cause the uncanny valley, and audiences have uncanny valleys that reflect their own figure and reactions through their own activities.

However, an uncanny valley exists in emotions related to the robot's appearance. Robots perform various functions including human tasks. A robot's performance is an important element of human dislike of robots in view of robots interrupting human life and not supporting humans. This implies that human desires can conflict with robot desires in ordinary life.

Robots do not simply duplicate human appearance but also human activity patterns.

Robot technology aims to replace human roles. Therefore, in uncanny valley theory, robot performance is important for human emotions. Currently, the uncanny valley theory not only includes emotions about a robot's appearance, but also the robots' performances in various roles. This new concept can be exhibited in interactive artwork installations, such as robotic devices in the development of robot technologies.

3.4 Analysis Method for Interactive Art based on Uncanny Valley

It is possible to apply the elements of the uncanny valley theory in robot objects to interactive artwork installations. An uncanny valley in an interactive artwork is defined as follows: audiences experience uncanny emotions when they participate in interactive artwork installations with humanlike reactions.

Humans experience uncanny valley emotions when automatic systems perform certain functions. Audiences experience uncanny emotions toward artworks with which they do not interact. They feel uncanny emotions in hyper-real or grotesque artworks. However, these artworks are not performed by audiences directly or cause harm through their choices. Interactive artwork differs from non-interactive artwork in terms of participation and appreciation. Participants can experience uncanny valley emotions in response to ordinary interactive artwork installations, as well as humanoid robots.

The uncanny valley in an interactive artwork has two aspects: installation and content. The complex effects of interactive artwork influence the audience's experience in depth, not only because of the installation's appearance and figures, but also because of the actions and the results of interaction. However, these are not the main issues caused by real representations and uncanny emotions; rather, these phenomena are the result of the artistic experience. Through the robot evolution process, the audience can experience an uncanny valley in humanoid figures with reactions resembling those of humans. Participating in an artwork is a multilevel experience involving thoughts and activities.

Robot research can be connected to research on interactive artwork installations in terms of reactions through human thought and the activity of technical installations or interfaces. Non-participation factors by audiences, such as the interactive artwork seeming strange and odd, as well as causing people to feel fear, can cause less completion of a work's contents through less participation. Participants can change their minds about participating in the interactive artwork. Through these elements, the interactive artwork embodies the fifth sense, and audience members experience emotions through these contents.

The uncanny valley in the interactive artwork shows ordinary objects and a screen after installation. The uncanny valley is enhanced by content that interacts with the installation. This process differs from ordinary functions and information services.

3.5 Analysis

According to the revised uncanny valley theory, the framework of the uncanny valley in an interactive artwork has the following elements:

3.5.1. Appearance Aspect in Interactive Artwork

The factors of the uncanny valley in characters and robot figures include interactive installations that automatically imitate human facial expressions and physical body movements. An example of artwork that exhibits the uncanny valley is the interactive artwork Please Smile (Fig. 2) by Nam Hye Yeon (2012). Please

Smile consists of five interactive robotic skeleton arms that change their gestures in response to participants' smiles [17].

Figure 2. Please Smile (2012) [17]

In the artwork, the participants experienced the uncanny valley in response to the automatic system for detecting human smiles. However, the connection between the audience's facial expressions and the robot hand's detection added defamiliarization to this artwork. This was because the audience had unfamiliar emotions involving automatic robot hand movements and a new concept of artwork value. This artwork overcomes the uncanny valley by making the mechanical robot hands look different from human hand. If this artwork concept involved prosthetic robot hands, or hands that almost looked like those of humans, the uncanny valley would diminish. The audience's uncanny experience expands the artistic value from the viewpoint of defamiliarization for connecting human emotion and robotic reactions.

Another example is the interactive artwork Portrait on the Fly (Fig. 3) by Laurent and Christa Sommerer (2015), which provides the audience with the uncanny valley. The artwork consists of a monitor displaying a combination of a few thousand flies. When audience members position themselves in front of the screen, the flies attempt to detect their facial features. This artwork creates values for humans; however, the audience experienced the uncanny valley when the flies' appearance represented their features [18].

Figure 3. Portrait on the Fly (2015) [18]

The uncanny valley in the artwork is overcome by using images of flies rather than real, living flies; the portrait made with flies was also abstract. The abstract portrait created through real-time representation changes with the audience's image reflection and creates a sense of humor. The audience's uncanny experience has artistic value from the viewpoint of defamiliarization for new human origins.

Therefore, researchers and artists should consider the uncanny valley in interactive artworks from the viewpoint of representation and go beyond the uncanny valley to enhance artistic value.

3.5.2 Activities Aspect in Interactive Artwork

The factors of the uncanny valley in the thoughts and activities of characters and robots include automatic activities from interactive installations involving human inference, deduction, and thought, as well as interactive installations that automatically perform activities and operations similar to human action.

One example is the interactive artwork Be Your Own Souvenir (Fig. 4) by blablabLAB (2011), which makes audiences hesitate because the artwork represents the audience's poses. In this work, the audience became both the producer and the consumer through a system that invites them to perform as human statues, with a free personal souvenir as a reward [19].

Figure 4. Be Your Own Souvenir (2011) [19]

The artwork proposes this concept by playfully encouraging the audience to strike enjoyable poses. Audience members become creators and models through their own poses and gestures. Audience members are represented by souvenirs created using a 3D printer. Participants created various poses for souvenirs. The audience experience an uncanny valley by becoming a souvenir in real time. The audience participated in this artwork by creating various poses, which meant that they desired to perform their own activities. However, this artwork overcame the uncanny valley because the installation represented blurred poses from participants rather than real audience figures in detail. This method of overcoming the uncanny valley is similar to that used in cartoons; for example, Disney characters are abstract and avoid the uncanny valley in animation. The realization of the audience's poses in hypertext-reality gives audiences more uncanny emotion. By applying uncanny valley theories, the value of aesthetics in interactive artwork installations can be expanded. The audience's uncanny experience explores artistic values from the viewpoint of defamiliarization with the new symbolic characters exhibited by others.

In another example, the interactive artwork Head (Fig. 5) by Ken Feingold (1999) provides the audience with an uncanny valley. Feingold's animatronic head converses with the audience in a quirky and humorous manner, but its appearance–as it blinks its eyes and moves its mouth–has a disturbing and uncanny look, resembling an animated corpse [20].

Figure 5. Head (1999) [20]

Feingold describes the head as having "moods" which can be triggered by certain words or phrases, much like people and these moods determine the nature and form of its responses. A total of 21 participants experience the uncanny valley from the artwork because of the realistic head. The head communicated with the audience using a speech system. The artistic value comes from the automatic speech system, and it is assumed that people felt an uncanny valley because the head seemed like a real head and spoke [21]. The audience's uncanny experience finds artistic value from the viewpoint of defamiliarization of new digital human beings.

Therefore, researchers and artists should consider the uncanny valley in interactive artworks from the viewpoint of activities and go beyond the uncanny valley to enhance artistic value.

3.5.3. Multiple Aspects of Interactive Artworks

It is possible to combine the uncanny valley into figures and activities. More complex abilities and skills have been developed within interactive artwork to automatically imitate human facial expressions and activities through human inference, deduction, and thought, and to automatically imitate physical body movements, activities, and operations that are similar to human action.

For example, interactive artwork Down with Wrestlers with Systems and Mental Non-Adapters! (Fig. 6) by Dmitry and Elena Kawarga (2013), exhibited the uncanny valley. A person must go on a running simulator to initiate a "social mechanism." On one hand, the participants feel like a god because the range of mechanisms depends on the participant's steps, but on the other hand, the participant is only one figure among many [22].

Figure 6. Down with Wrestlers with Systems and Mental Non-Adapters! (2013) [22]

In this artwork, the audience performs a symbolic task using a walking machine and feel uncanny emotions within a circle [22]. This artwork overcomes the uncanny valley by using symbolic devices for aesthetic value, such as small sculptures that symbolize human society. The audience continuously performs the artwork and participate in an unfamiliar situation. The audience's uncanny experience expands artistic value from the viewpoint of defamiliarization for social restructuring by directly reflecting on their figures and activities.

As another example, the interactive artwork "Amazing Art Installation Turns You into a Bird (Fig. 7), by Chris Milk: "The Treachery of Sanctuary" (2012)" also exhibits the uncanny valley.
This artwork was a giant triptych that took viewers through three stages of flight using Kinect controllers and infrared sensors. On the first screen, the audience could get virtual wings through their own actions; on the second screen, the participants could make birds on the screen fly through the sky using their arms; on the third screen, they fly toward the birds by moving their entire bodies [23].

Figure 7. Amazing Art Installation Turns You into a Bird [23]

In this artwork, the uncanny valley occurs when the audience is transformed into various kinds of birds on the screen. The participants feel an uncanny transformation into birds through their representation and by shaking their arms like the wings of a bird. The audience acted like birds on the screen. In this artwork, the audience has an uncanny valley while simultaneously reflecting on their own figures on the screen and their reactions to their own activities. These transformed birds represent the original human dream of flying in the sky. This artwork experience was new for the audience to dream of flying in the sky. Participants' interactions are only represented on the screens, but they are encouraged to perform various activities repeatedly. This artwork overcomes the uncanny valley by using silhouettes as images rather than representing real birds. These abstract images allow audiences to use their imagination. In addition, this artwork separates the screen into three parts so that the audience has three separate desires. The audience performs at three different levels within the artwork and acts on the shadow-style images. Using these methods, the interactive artwork can overcome and avoid uncanny emotions while showing unfamiliar situations. From the viewpoint of defamiliarization, audience members have a new experience beyond the limitations of reality in their figures and activities.

Therefore, researchers and artists should consider the uncanny valley in interactive artworks from the viewpoint of representation and activities and go beyond the uncanny valley to enhance their artworks' artistic values.

3.6 Results of Analysis

These uncanny valley issues extend beyond the appearance of robots. Audiences can experience uncanny valley emotions from interactive installations similar to those evoked by robotic devices. The uncanny valley in interactive artwork installations could interrupt the installation or its aesthetic value for participants through defamiliarization. Audiences can experience the uncanny valley in ordinary artwork, including hyperrealism, horror content, and uncanny new media artwork. The content does not operate directly on the audience, but only through appreciation and interpretation. Audiences only watch and feel the content. However, interactions with interactive installations are different from those with ordinary artwork because the audience chooses the situation, acts on, and reacts to the artwork. An audience can appreciate a canvas or object but does not operate on it. The participants either do not choose the content development or the results. Therefore, a new approach is required for audiences to operate and participate in artworks according to their desires. Interactive artwork installations can generate changeable content that differs from previous forms of noninteractive digital artwork. This strengthens the audiences' ability to create changeable content through their participation. In summary, audience members can have a new artistic experience in their figures, activities, and both aspects from the viewpoint of defamiliarization beyond the unfamiliar through the uncanny valley.

4. Conclusion

4.1 Summary

The uncanny valley in ordinary life has a significant effect on humans. This is because familiar objects can return to strange situations, which can cause the uncanny valley effect. In ordinary situations, the uncanny valley is more powerful than in unfamiliar situations. The features of interactive artwork installation and content include two aspects.

First, audience members experience the uncanny valley in the artwork and do not participate in the artwork because of new installations resembling humanoid robots, digital humans, and technical installations reflecting audience members' figures or activities. Many studies have proposed methods to overcome the uncanny valley problem. These methods are useful for interactive artwork, but aesthetics must be considered because artwork differs from functions and services.

Second, audience members experience the uncanny valley in the artwork and feel the new aesthetics of the artwork in view of new technologies. Aesthetics influence robot technologies and AI systems in terms of human–computer interaction, extended realities, and digital humans through interactive artwork installations.

Third, researchers and artists can create interactive artworks by considering two different aesthetics of the uncanny valley. Based on the results of the case studies, audience members may experience unfamiliar emotions when they participate in interactive art installations. These emotions can influence audience members'

participation in interactive art installations through uncomfortable and awkward emotions and the problem of interactions. Therefore, this experience would cause innate negative, frustrating, or uncomfortable interactions with interactive artwork. Otherwise, audience members could have experience the imaginative and in participating in the interactive art installations. These emotions could influence audience members participating in interactive art installations by positive and inspiring sublimation of emotions by interactive aesthetics in the strategy of active and lively interactions, which would lead to creative ways of perception and interaction by audience members from the viewpoint of digital aesthetics.

Finally, beyond the uncanny valley theory, interactive artworks directly propose new aesthetics for participants. This new approach to the uncanny valley in interactive artwork provides two forms of value for interactive artwork: enhanced participation by overcoming the uncanny valley and new media aesthetics for interactive artwork through defamiliarization. Audience members will experience artistic value through interactive art installations and expand their experiences by interacting with new technologies and content for human lifestyles.

4.2 Future Work

In the future, uncanny valley emotions evoked by artworks will decrease and audiences will interact with interactive artworks and create better content to generate aesthetic value. A new model will be developed as an evaluation tool to provide more empirical evidence to support its claims and analyses. Subsequently, I plan to evaluate the unfamiliarity or defamiliarization of audience participation in interactive artwork by directly influencing artistic values. It goes beyond the uncanny valley theory and directly proposes new aesthetics for the participants. Through these new approaches, the aesthetic and humanistic value of interactive installations can expand the realm of human life.

Conflicts of Interest: The authors declare no conflict of interest.

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