A Theoretical Model for the Design of Aesthetic Interaction

Hsiu Ching Laura Hsieh(✉) and Nine Chun Cheng

Department of Creative Design, National Yunlin University of Science and Technology, 123 Section 3, University Road, Douliou 64002, Yunlin, Taiwan
laurarun@gmail.com

Abstract. This study attempts to acquire creative concepts in the field of "new media art interactive creation" from the research on "arts as experience aesthetics", "practical aesthetics", the hypothesis of "somaesthetics", the usability of "human-computer interaction", and the users' experiences to the integration of the design and aesthetic interaction principles required for the experiences of aesthetic interaction so as to make up the past shortcomings. The study aims 1. to shape a theoretical model for the design of aesthetic interaction and 2. to analyze and explain pleasant experiences enhanced by aesthetic interaction with interactive products. The current situations, thorough relevant theories and research are first discussed to further formulate the theoretical model for the design of aesthetic interaction, and then the attributes of aesthetic interaction are analyzed with interactive products. The research outcomes could provide the design of interaction with a point of view different from the past cognition theory and present the originality and the aesthetic interaction in interdisciplinary research.

Keywords: Aesthetic interaction · Somaesthetics · Human-computer interaction

1 Introduction

Different from the past visual field of high technology, cognition theory, and usability emulation, the recent development trend of "human-computer interaction" attempts to pursue the experiences and value of human nature from the derivation from aesthetic field of view and the discussion of interaction. In regard to human expectation of aesthetics, different levels of needs in life are in agreement with Maslow's theory, where aesthetic experiences are necessary in human life to satisfy higher spiritual needs. Unfortunately, past discussion of aesthetics for human-computer interaction stays on appearance aesthetics of user interface. The deeper and latest aesthetic interaction needs to be further explored (Hashim, Noor, Adnan) [7]. Aesthetics has long been applied to art creation and aesthetics to reflect beauty and pleasure; the aesthetics in such art creation presents the relationship between personal mastery and works from the creation of poetry to the murals in chapels. Based on such inference, Tractinsky et al. [21] proposed a new field of view that user interface could also present aesthetics, induce pleasant design of interaction, and assist users in perceiving the experiences in the use of such interactive interface. The early design of "human-computer interaction" used to be compromised between aesthetics and functions, where aesthetics was not emphasized as much as functions. Bardzell [3] indicated that research on aesthetic interaction was

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shallow and stressed merely on the decoration of visual elements in the interactive interface and emphasized the needs for deeper discussion. Responding to the above users' "inner aesthetic needs", Löwgren [12] emphasized that aesthetics interaction was not simply good and pleasant, but observed and concerned about higher levels, which stressed on the energy and expression of system interface.

It is necessary to comprehend the field of "human-computer interaction" to further satisfy the higher psychological needs of global users from the emphasis of the appearance of interactive interface to "it looks beautiful" and "wonderful use experiences". For this reason, designers and researchers of interaction should realize that the design of interaction is not simply the visual creation but also plays a higher level role of a user being induced the aesthetic experiences when interacting with the interface (system). Such aesthetic experiences (perception) is a mutual interaction (communication) between the system and the user and does not simply rely on the appearance aesthetics of the interface, but requires a designer designing an "experience" for people's perception. This research aims 1. to shape a theoretical model for the design of aesthetic interaction and 2. to analyze and explain pleasant experiences enhanced by aesthetic interaction with interactive products. The current situations, thorough relevant theories and research are first discussed to further shape the theoretical model for the design of aesthetic interaction, and then the characteristics of aesthetic interaction are analyzed with interactive products.

2 The Correlation Between New Media Interactive Art and Human-Computer Interaction

2.1 New Media Interactive Art and Human Computer Interaction

Manovich [14] mentioned that new media interactive art was the confluence of computer history and media technology. Murphie and Potts [18] mentioned that new media art initiated in the mid-19th century when Babbage, a British mathematician, invented an analyzer, the predecessor of computers, and Daguerre invented photography. The appearance of microprocessors in the mid-20th century reduced the production cost of computers and founded the popularization. The production of Macintosh computers later on had computers become personal products. Not until the late 20th century, when various software and hardware efficacy was advanced by leaps and bounds, were computers broadly applied to professional image and sound processing. New media art integrates and digitalizes dynamic images, drawings, modeling, sound, space, and texts. According to Manovich's research [14], new media art presents five features. (1). Numerical representation, all media could become programmable. All works created by computers, despite of the imagery complexity, are the explanation and interpretation of digital information with 0 and 1. (2). Modularity. For instance, A webpage is composed of several independent text, image, video, and program files. (3). Automation. In the production process of new media art, automation is first applied and then programming languages. The work content can even be automated by following the logic procedure, time, input, viewers' physical dynamics to present the changes of works. (4). Variability. New media art is the data and information with diverse forms where the same element

could generate distinct appearances through different programming or application. (5). Cultural transcoding. Two levels are discussed for new media art. One is the culture level, which concerns whether the application of media could deliver the creator's deep experiences, observation, and criticism of the society and the culture, i.e. the decoding and messaging of cultural connotation. The other involves in computers, including the above numerical representation, modularity, automation, and variability.

Human-computer interaction is an interdisciplinary subject, the combination of computer science and cognitive engineering. Human-computer interaction involves in the application of language processing, artificial intelligence, multimedia, human factor engineering, linguistics, and sociology. The human-computer interaction model conforming to "simple, easy, friendly, and pleasant" becomes the primary rule to design a user interface. The constant update of human-computer interaction models, the voice recognition and synthesis, the recognition of handwriting and gestures, and virtual reality are the channels for human-computer interaction. The application broadly covers traditional computers, PDA, ATM, and mobile phones.

Interaction qualities are the key in new media art, which relies on the roles of computer interaction. It is similar to the role of interaction in human-computer interaction. Baljko and Tenhaaf [2] indicated that interactive media art presented an interface, through which the users interacted with art work systems; the operation and participation processes depended on digital operation in which the participants operated the data in the interactive interface. Interactivity is a primary quality in new media art, and the interaction model and connotation are constantly deducing. Manovich [14], an important researcher on new media art, mentioned that it was the funniest and the most difficult part to define interactivity, and it was still under processing. It is considered in this study that the development and application of interaction qualities are the most challenging, inspirational, and necessarily discussed and developed issue for designers.

According to the experts of human-computer interaction, Mayer [15] and Morse [16], an interactive device was designed to invite the users investing in the development and changes of social experiences, and interactivity could encourage the users to participate in the exchange and communication of social experiences. The difference between interactive art creation and traditional art work is that the former guides the audience to join in a purposive, inclusive, and mediated process. The past art forms stressed on the creators as the authors that the audience were merely the passive readers and the authors as creators that the audience were the negative readers. Interactive art, on the other hand, gives the users the rights of author and participation so that the audience could participate in the interactive process and become a part of the art creation.

2.2 The Correlation Between New Media Interactive Art and Human-Computer-Interaction

Combining the interaction qualities of human-computer interaction with Dewey's aesthetic view of Art as Experience [5], Petersen et al. [20] proposed pragmatic aesthetic experiences and indicated that the correlation between new media art and human-computer interaction appeared on both emphasizing and stressing on the integration of aesthetics with daily interaction. Aesthetics was shaped in a part of daily life, and the

aesthetic feeling came from the relationship between users and interactive devices. Aesthetic interaction integrated two points of (1) aesthetic being pragmatic and (2) artifacts being properly used. Pragmatic aesthetics emphasized the purposive role of aesthetics in an interactive design system, and the aesthetic feeling appeared in the use process and would be the integration between the understanding of the interactive system and the use potential. According to Manovich' research, interactive products (such as smart phones and tablets) largely enter people's daily life and change the lifestyles due to the popularity of personal computers and the Internet so that the reception of information and the styles to exchange with people are greatly changed. It is inferred in this study that such a style reveals great influence on current designers, as creators also use interactive products, which would infiltrate in the thinking and living models, in the daily life; designers would extend more interesting and interactive performance styles through the application and cognition of human-computer interaction in the daily life; and, art creators are the observers and practitioners of life to naturally blend the interaction experiences in the daily life (the use of interactive products) and integrate them into the creation.

Nowadays, interactive products have become the important media for the exchange of production, consumption, and cultural data. For instance, various interactive product interfaces (such as ipod, ipad, and iphone) ubiquitously exist in people's daily life for browsing on the Internet, playing computer games, sending and receiving e-mails, and collecting information through the Internet. In new media art, an interface is the platform for the exchange of information, ideas, and concepts designed and arranged by the users and creators. In human-computer interaction, an interface is the media for presenting aesthetic feeling, inducing pleasure, and assisting the users in the operation. In fact, current artists or designers encounter the challenge to design an interface and experience design. Such experiences have to be able to induce effective responses and feedback of the participants in order to become effective interactive device design. Such a problem could be solved by the theories, technologies, methods, and procedures in human-computer interaction.

3 Discussing Human-Computer Interaction from the Aspect of Art as Experience

Dewey's Art as Experience [5] reveals that the existence of aesthetics is really perceived when a person experiences aesthetic experiences. Aesthetic feeling is an integrated perception covering the entire experiences, rather than a single part or detail of perception, and integrates the relationship between doing and undergoing. Each action and the successively induced results are associated. People could experience the aesthetic properties through doing and undergoing processes; that is, aesthetics is perceived by doing and undergoing. Petersen derived Pragmatic Aesthetic from Dewey's aesthetics theory but stressed on the mutual relationship between psychology and body; meanwhile, he claimed that the aesthetic feeling in aesthetic interaction was not on the art work but appeared on human-system and human-human interaction processes and the perceived experiences in the interaction. Irvin [9] also applied Dewey's aesthetics of Art as

Experience and further explained that people could perceive more satisfaction, elegance, pleasure, and abundance when pay the attention to daily life experiences (e.g. online purchase, searching data on the Internet, and sending and receiving e-mails).

Summing up the above researchers' statements, it is found that aesthetic interaction does not exist in art work but appears on the movement in the interaction and after the interaction between participants and art work. Some experiences are perceived in the process from doing to undergoing. Such experiences are experienced in the process and present aesthetic feeling. As a matter of fact, people could acquire aesthetic experiences from the daily life; the experiences in such daily behaviors (e.g. browsing the Internet, sending e-mails, using interactive products) could be satisfactory, pleasant, and abundant. Generally speaking, daily behaviors are involved in body rhythm (movement). In the experimental research, Moen and Sandsjö [17] indicated that the aesthetic physiological experiences were the feelings or inner images based on different body movement; such imagination was related to personal imagination or the expression in mind about beautiful rhythm (movement). Accordingly, it is inferred that daily life experiences, including the interaction between browsing the Internet and interfaces, e.g. online shopping or searching information on the Internet, could result in aesthetic experiences, as such interaction with interfaces contains the experiences in aesthetic through body rhythm. The correlation between body rhythm theory and interaction and the application are discussed in the following section.

4 Somaesthetics and Human-Computer Interaction

Laban's body rhythm principles [10] are broadly applied by researchers, educators, psychologists, physiologists, professional therapists, and dancers. The body rhythm principles reflect the inner emotion of people and the way they exist in the world. Referring to Leban's body rhythm principles, the effort elements made by a participant refer to Body, Time, Space, and Information, which could be used for analyzing and integrating the application of interaction design, allowing the interactive interface being easy to use, close, and user-friendly. Movement qualities are also permanently applied to the interaction design in human-computer interaction. Four movement qualities were studied by Bacigalupi [1], including Rhythm, Tempo, Sequence, and Direction. Rhythm referred to the tension between dynamics and statics; tempo referred to the rhythm space being fast or slow; sequence referred to the time sequence of an event and the following event; and, direction could be applied to interface design to induce the dynamic model in the interaction between the user and the creation. Loke et al. [13] applied Leban's body rhythm principles in the research on interactive media and proposed different methods and principles to apply body rhythm principles to interaction design and to create a new point of view for applying body rhythm principles to interaction design. Apparently, Leban's body rhythm principles are worth adopting and implementing in practical creation. Nevertheless, it is inefficient to simply analyze the effort elements and movement qualities of body rhythm principles. A medium, an interface for the

human-computer interaction system, is necessary for shaping human-computer interaction. In the following section, the interface design strategies and considerations for human-computer interaction are discussed.

5 Aesthetic Interaction and Human-Computer Interaction

Norman [19] proposed the aesthetic experiences in human-computer interaction, where the perception of interactive aesthetic experiences contained the sensory and visceral level, the behavioral level, and the thinking and reflective level. The sensory level was the lowest stage, in which the perception was connected with the sensory cognition of humans. The perception in the behavioral level was the perceived aesthetic feeling after the cognition based on operation and behaviors. The perception in the thinking level referred to the deep emotion; the perception at this stage was far beyond the instantly perceived aesthetic feeling and was the deep aesthetic experiences created by rational judgment. Hassenzahl [6] also found out the correlation between use and aesthetic feeling. Zhang and Li [22] claimed that effective and useful interface system efficacy could affect a user's overall perception of the creation. They defined that effective quality existed in people's experiences in using the system. Such research could help designers think of different degrees of effects and perception, when the audience or participants interacted with the work, in the design interaction. Besides, such research could also assist designers in understanding the close relationship between different levels of perception, work efficacy and aesthetic feeling.

6 Shaping a Model for the Design of Aesthetic Interaction

By analyzing Dewey's aesthetics of Art as Experience and Petersen' Pragmatic aesthetic, it is discovered in this study that aesthetic experiences not only present great correlation with inner perception, but the participation of body movement also deeply affects aesthetic experiences. In this case, Leban's Body Rhythm theory is also integrated. The aesthetic feeling perceived in the interaction covers the practicability of aesthetic feeling and the proper use of creation, and aesthetic experiences are acquired through the actual operation of body rhythm. By integrating the above theories, it is believed that aesthetic experiences would gradually emerge from the process of the participating audience using and operating the interactive interface to further shape an aesthetic interaction module. The composition of the aesthetic interaction module is explained from three stages. First, the major context considered before designing the aesthetic interaction is demonstrated from the use context, the user experiences, and the interactive artifact interface. Second, the dynamic dimensions of body movement, time, space, and information in the real operation of interaction through a participant's body rhythm are interpreted. Third, the movement qualities of rhythm, tempo, sequence, and direction in the interaction are explained. Finally, a theoretical aesthetic interaction model is organized (Fig. 1). Interface component includes:Text, Images, Icons, Layout, Navigation, Buttons. Interaction characteristics are shown in the following. (1) Orderliness (random-to-orderly):The level of orderliness of either artifacts' showing

information, or users' searching or manipulating information through an interactive products. (2) Accordance (independent-to-chained):The rank of connectivity among various information elements accessible through interactive artifacts or those artifacts themselves. (3) Continuity (detached-to-continuous):The level of continuity of users' controlling toward interface components. (4) Directness (indirect-to-direct):The level of directness of what is shown through an interactive products or its information components. (5) Proximity (specific-to-proximate):The level of juxtaposition of managing information. (6) Movement (inactive-to-dynamic):The level of movement dynamics for both participants' managing interface components and artifacts' showing information elements.

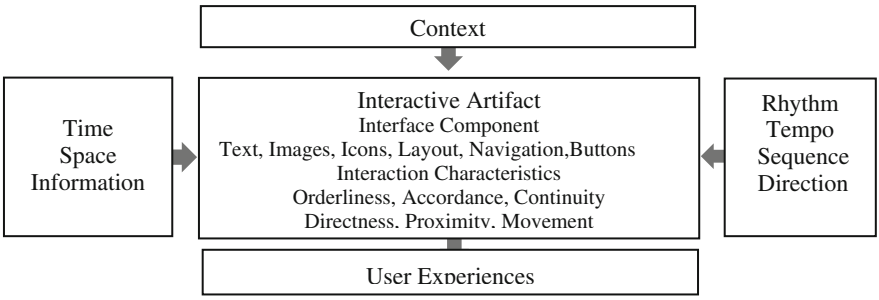

Fig. 1. A theoretical model for the design of aesthetic interaction

6.1 Three Considerations Before Aesthetic Interaction Design: Use Context, User Experiences, and Interactive Artifact Interface

Pragmatic Aesthetic is applied in this study because the viewpoint of Pragmatic Aesthetic would not attach to a single creator or a designer, but concerns about the interaction experiences between human and creation and the background context of interaction. The rationality of system experiences would be multi-dimensionally and completely considered in pragmatic aesthetic. In fact, a user and the existing environment are not independent, but would extend the consideration to the integration and the mutual relationship between the participant and the existing environment. In this case, integrating use situations and user experiences in this study to create aesthetic experiences is the process to invite people enthusiastically participating in and interacting with the creation interface, which could induce the perception, and allow the audience perceiving and understanding the meaning. Aesthetic interaction, related to inducing imagination, focuses on stimulating and encouraging people to present the autonomic thoughts and perception after the real-time interaction and having them operate and use the interactive artifact interface with individual methods. Consequently, a creator has to think of three dimensions of Use Context, User Experiences, and Interactive Artifact Interface when intending to design aesthetic interaction, so as to generate more efficient interaction and allow the audience or participants experiencing the cultural connotation and deep meaning behind an art creator's creation. The relations among use situations, participants, and interactive artifact interface are described as following.

6.2 Dynamic Dimensions of Aesthetic Interaction: Body, Time, Space, Information

By integrating Human-Computer Interaction theories and Body Rhythm principles, it is proposed in this study that four dynamic dimensions of body, time, space, and information in the interaction process are worth noticing when a creator produces the interaction design. Moen and Sandsjö [17], Human-Computer Interaction researchers, emphasized that the dynamic of interactivity appeared on a user operating the creation with body movement speed. Davis [4] and Petersen et al. [20] discussed the importance of time, which could affect a user experiencing aesthetics, in interaction, and then space. The space idea formed in interaction was different from the space formed by other creation. Physical space and virtual space were the basic differentiation. When a virtual element in interaction was placed in the concept of time, it became the movement and created the virtual space cognition. Information, which allows interactive products present the unique properties, is another core in interaction. Here, information refers to digital information which presents flexibility, abundance, and pervasiveness to have interactive products show the uniqueness. Research on Human-Computer Interaction reveals exhaustive and exquisite analyses; the above dynamic analysis of a user's body movement (body movement, time, space, information) is worth the reference for an art creator proceeding interactive creation (Fig. 1).

6.3 Movement Qualities of Aesthetic Interaction: Rhythm, Tempo, Sequence, Direction

Movement qualities contain four items of rhythm, tempo, sequence, and direction. The variation of rhythm often results from a rhythm to the next rhythm. Such a moving process is related to the tension between statics and dynamics. The interaction between continuity and variation creates activity and rest and even controls people's demands for balancing consistence and diversification. Tempo is often defined as the termination of rhythm or speed, meaning the proportional and sonorous interactivity and the play with faster speed. In visual art performance, fast tempo often associates with smaller, narrower, and thinner object shapes or possible a large force on an object. Slow tempo, on the other hand, associates with larger, wider, and fatter object shapes, which are regarded as easier, more powerless, and larger obstruction. Sequence explains that an event occurs following the sequence in the time axis. The visual performance of sequence is often used for displaying cause and effect and revealing the relationship between an event and the next event. The application of sequence to interactive media would present distinct appearances because of the sequence of an event. The application of sequence to interactive media could offer the audience (users) a reminder (direction), set the audience expectation, and support the information structure on the interface. Direction is related to the step in sequence. An object shows the sequence of an event by following the time axis and further presents with steps. The above-mentioned rhythm, tempo, sequence, and direction are applicable to shape efficient and perceived pleasant experiences of the viewers (users).

It is suggested in this study that the above rhythm, tempo, sequence, and direction could be applied to the design of visual interface in an interaction system in order to attract and stimulate the users in the interaction. The visual interface design refers to the presentation of an interface and the visual communication, covering images, texts, symbols, composition, roaming and buttons. The design of such interface elements aims to induce a user's interests, guide the user to touch the interface, and drive the dynamic to induce the exchange of user experiences. When a user presses the interactive interface button, some functions are presented, or more media effects (such as films, animation, and dynamic texts) are added. The entire experiences would present interactivity and could enhance the users' experiences in willingness expression and aesthetic interaction.

7 Conclusion

In short, the relationship among use background, user experiences, and interactive artifact interface is the major context in the aesthetic interaction design. A creator would consider the production of different interactive dynamics through the interactive dynamic dimensions (body movement, time, space, and information), allowing the participants operating the interaction system through body movement and achieving the possibilities of roaming, perceiving, and exchanging. Eventually, movement qualities (rhythm, tempo, sequence, and direction), which could control interaction, are used as the context for constructing the visual interface. It is anticipated that the theoretical aesthetic interaction design module derived in this study could help the human-computer interaction design present aesthetic characteristics and assist the participants in acquiring new vision and new opinions through the use of interactive products. The deductive module, aiming to comprehend and design aesthetic interaction, could be applied to the aesthetic interaction design in interactive interfaces and provide structural knowledge and mutual correlation ideas for comprehending aesthetic interaction. By discussing and integrating the multi-dimensional theories of user experiences, Rhythm Theory, Pragmatic Aesthetic, and Human-Computer Interaction, it is expected that the theoretical model would inspire the future research on aesthetic interaction design.

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