The Research and Implementation of Interactive Media Art Design System

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Abstract. Interactive media art is an important part of the new cultural industry, is a typical combination of art and technology, which combines visual, auditory, space design, light, electricity and other forms of effect to fresh vibrant feeling. Interactive media art is widely used in exhibition industry, interactive advertising, stage art and performance, interactive games and other fields. China's interactive media art has just entered a stage of rapid development, there is no ready-made universal interactive media design system, which is the bottleneck of the development and application of interactive media in china. This paper first carries out research on interactive media system involves hardware and software development technology, then explain the interactive media art and design of each subsystem and their design method and implementation process. In this system, we design and implement a set of visual programming model based on node, and develop a friendly interactive authoring environment, visual interactive subsystem and a powerful plug-in system. The main work is as follows: 1) in order to enhance the intuitive and interactivity of the system, this paper studies and implements a visualization programming model based on nodes includes: basic data structure definition, node implementation mechanisms, implementation mechanisms of the scenes and the efficiency analysis of programming model. The model defines the user to carry out the logic of visual programming. With visual programming model based on nodes as the guide, based on Qt library, this paper developed the interactive multimedia art and design system, including: interactive creation environment, plug-in architecture interactive visualization subsystem and system. Interactive create environment to achieve a variety of systems and users to interact with the interface, including the file interface, view control interface, the scene editing interface. The contents of the visual interactive subsystem include: the graphical rendering of the control, the management mechanism of the control and the execution model of the system. Control is a graphical representation of the node, but also a direct manipulation of the user when the object. The system adopts plug-in architecture, and all the function modules are integrated into the main frame of the system through the form of plug-in. 3) based on the main framework of the interactive multimedia art design system, this paper develops a powerful plug-in system. The plug-in system is divided into five categories according to the function: sound, image, video, graphics and mathematical processing. This system has good interactivity and high degree of openness, the art of using the system's existing function modules can be directly carried out visual programming to create interactive art application, so as to expand the function of the system plug-in professionals can develop personalized functions.

1. Introduction
Decades ago, when the first computer ENIAC was born in the University of Pennsylvania at the moment, people may not realize that the process followed by the entire human civilization this huge monster will affect the eyes. The later years, with computer technology as the core of the third industrial revolution
(the first industrial revolution, which began in 1760s, is characterized by the steam engine to replace the bio energy, to the primary level of machine production to replace the manual labor, social employment patterns change, and promote the development of the city, in turn the city's development also promoted the development of industrialization; the second industrial revolution -- began in the latter half of the nineteenth Century to 20 century, the electrical, steel, chemical "three technology" and the automotive, aircraft and radio communication "three great inventions", has greatly changed the appearance of the human society, the revolution the center in the United States and Germany[1], the second industrial revolution not only makes the industrialized countries economic development imbalances between industrialized countries and intensified, and the Non industrialized countries in the economic and social development level of the gap is growing; the third industrial revolution -- during the two World War and beyond, including nuclear power, electronic computer, the new technology revolution's three technology, the development of the electronic computer as the representative of the information technology, the automatic production non material trend of the industrial structure intensified. ) completely subvert the people's traditional social life and economic model. Especially the generation of the Internet, but also marks the arrival of the information age. At present, the cultural industry is gradually turning from the traditional newspapers, radio, television and other new forms of culture to the computer as the main media; the new media culture industry is rapidly becoming the world's most promising industry. Developed countries in the world's information industry, the new media culture industry has accounted for 15% of the GDP. The current art more and more scientific, more and more scientific and artistic [2], the close combination of technology and art, is becoming an important trend of [2] new culture industry development, China's famous scientist Tsien Hsueshen once said, "let the science and art of the marriage bar, it will create a miracle!". A combination of art and science to art form produced very big change, produce amazing results, is a huge force applied to promote the art of social and cultural life, such as the Beijing Olympic Games to promote scientific and technological Olympics Games, at the opening ceremony of a large number of science and technology application, produced a magnificent artistic effect. Interactive media art is a new practical power part, combined with the pure art and technology contribution; it is from a new field of science and technology application, combining visual, auditory, space design, light, electricity and other forms of effect and to give fresh feeling full of vitality. The interactive media art is not only a kind of new art form, is a kind of new foundation involved technology in various cultural industries, it has gradually affected many aspects of people's material and cultural life, is an important new direction for the development of cultural industries. Simple interactive technology in the museum exhibition and other places has already been applied, such as the touch sound device, etc. The interactive technology more and more appear in the museum exhibition center and other places in the United States [3], such as Washington news museum visitors can play editing newspapers, or through the virtual image experience as a journalist. Then you can also put their "guest" anchor or reporter photo or video download home. At present in all kinds of party performance, the application of multimedia interactive technology is not a lot, the basic is still limited to the actors on stage performances, the background screen play some of the preset video and screen. If the video content on the background screen changes with the actor's posture and position changes, will greatly increase the performance of the authenticity and immersion. At present in many concerts, leisure park, amusement park, theme park has all kinds of digital technical performances, this performance is more and more strong, use a lot of photoelectric interaction devices, these interactive technology increases the performance of fun, music video image on the screen with the actor and the orchestra played change, it is a very novel concert, can give more to enjoy the beauty of the audience [4]. Several typical forms of interactive art are shown in Figure 1 and 2 and 3.
Figure 1. Schematic diagram of interactive concert.

Figure 2. Schematic diagram of interactive stage play.

Figure 3. Sketch map of interactive scenes.

2. Interactive media and Processing software

2.1. Definition of interactive media
Baidu encyclopedia explains: "interactive media, multimedia, refers to a variety of media (text, images, animation, video, sound, music) of the collection." Wikipedia's explanation is: "through the media, connecting the media, it has the integration can interact with the viewer, and there is no lack of multimedia elements (image & Picture & Animation) covering. In short, interactive multimedia is through the input (via the number type interface message) to the output (multimedia components through
According to the relevant information, the author defines it as the information exchange system with feedback characteristic based on the digital information platform. In essence, the interactive media is a digital branch of the media, and it is a kind of media with special information dissemination function. In the study of interactive media, we will encounter some other similar terms, in order to avoid confusion [5], here to pick out the most common definition of two to explain and compare. Wikipedia explained: "refers to the use of computer (Computing and information processing) and network (transmission and exchange) and other new technology, produced by the form, content and type of traditional media change. The term new media can distinguish from the industrial, man-machine interface, art movement, and multimedia format to explain the different interpretations is due to the different fields of view (industry, science, art, and the starting point of the different media). New media is relative to the old media is concerned, is a constant change of concept, can be considered to be attached to the new technology on the means of information dissemination. According to Xiong Chengyu, Professor of Journalism and Communication College of Tsinghua University, the new media is "the appearance and influence of media form on the basis of computer information processing technology". The new media is a new type of information exchange system, which is different from the traditional media in the new media. Two is the "digital media" (Media Digital), Baidu encyclopedia explained: "in the human society, the form of information is a variety of forms of information; we call these forms of expression (Medium). A common important feature of information media in computer recording and dissemination is the smallest unit of information (bit) - '0' or '1'. Any information stored and transmitted in the computer can be broken down into a series of '0' or '1'. We call the information media, which is stored, processed and transmitted by the computer, which is the digital media. Almost all of our past familiar media are stored and transmitted in the form of simulation, but the digital media is stored, processed and transmitted by the computer in the form of bits [6]. It is quite difficult to implement the interactive performance in the simulation domain, but it is much easier in the digital domain. Therefore, computer interaction is a significant feature of the digital media." Through the above three concepts of the terminology described, we can find that the maximum range should be the "new media", no matter what age, the new media always refer to the time in front of the power of the media; followed by digital media, it is now the era of "new media"; the smallest is interactive the media, it is an important branch of digital interactive media". The scope of the interactive media is very extensive; this paper is focused on the art of interactive design. Productivity characteristics of each era will affect the characteristics of art; art for the development of technology has long been in the "support" and "resistance" contradiction. The productivity of the cooperative relationship between art and time has become one of the development of civilization witness, with interactive media as the representative of the strong technical features of art has more mission: to find out the effect of the heart and metaphor in the performance of their own at the same time, shorten the distance in the spiritual sense. Artists and designers in the process of creating a variety of media, technology, new materials, and many other ways to achieve the most suitable to find the best way to show the channel. When they are in the process of the use of interactive media, found hidden in the media inside the delightful special, these non-expected results and promote the art of face changing, and because mining media new possibilities such as sporadic [7], and the germination of new interactive mode of artistic creation and appreciation. The latest interactive display system, as shown in Figure 4 and 5.
2.2. Classification of interactive media

Usually, interactive media from the scale of application can be divided into large-scale display based interactive design and small end user interaction design for individual users. This article from the designer's point of view, according to the art of the interactive media work itself can be divided into the following four types: 1, installation art: art installation in the traditional sense, refers to the artist in the specific space and time environment, will be in our daily life consumption or consumption has been the material cultural entity, art of effective selection, utilization, transformation, combined to make a new interpretation of the display of individual or groups of rich spiritual and cultural implication of the art form. In short, the art of installation is the comprehensive display of "space + material + emotion". 2, Game Art: the game industry is an important driving force for the interactive media commercialization process, designers use the latest technology, feedback from the calculation of the collision [8], the physical system and the object coordinates to the game player input system, image and sound, full extension of the artistic appeal of the game. In addition, the production of technology, such as 3D engine, has also led to the development of computer related hardware to a certain extent. 3, network art: the main form of network art is mostly concentrated in the web design, interactive advertising and other fields. After Web2.0, the interaction of Internet art works has won the leading position in the field of digital media. 4, image art: video art is also called "digital editing of synthetic art", involving the creation of the film and television effects, animation design, is one of the most common forms of artistic expression. After entering the digital era, the image art has evolved from the simple visual display to the
interactive stage, and various types of art appeared, such as interactive movies. Interactive movies (Interactive Movie) is a concept of entertainment media industry, has been formed in the early ten years ago [9], the interactive technology is still under development, but also on various forms of media continues to influence. The basic meaning of the interactive film is that the participants can become the role of the film, the environment involved in the film, and continue to produce interaction. The essence of interactive movies is actually a really decided by the audience of the film, making this film (selected theme, screenplay, director and actor etc.) through online voting and other interactive way to determine, this is a kind of subversion to the traditional film production mode. Four typical interactive media schematic diagram is shown in Figure 7, 6, 8, 9.

![Figure 6. Schematic diagram of device art.](image6)

![Figure 7. Schematic diagram of game art.](image7)

![Figure 8. Sketch map of network art.](image8)
2.3. Brief introduction and analysis of Processing software

Processing software is from the Massachusetts Institute of Technology Media Lab (M.I.T. Media Laboratory) aesthetics and Computation Group (Aesthetics & Computation Group) Casey Reas and Ben Fry founded, is a specially designed for designers and artists has launched a programming language. Aesthetics and computation group by the famous computer artist John Maeda, founded in 1996, with its highly experimental and conceptual works, active in art and design fields, explore the computer operation characteristics and bring endless creativity. Reas Casey’s works mainly deal with the dynamic performance of the biological system, and the multimedia, induction device art, sculpture and digital printing, etc. Casey lectures in Europe, Asia and all over the United States, has served as Austria’s forest of the Arts Festival (Electronica in Linz Ars (multimedia art world’s largest annual event)) of the review. The research focus of Ben Fry is how to combine information visualization (Organic Information Visualization), and to create with the updating data, electronic system dynamic deformation or change in real time [10]. His doctoral thesis in the huge amount of information processing of human genetics reveals how visual decoding is successful, Ben with Genomic Cartography (gene cartography). Processing is a revolutionary forward-looking emerging computer language, the concept is introduced in the context of Electronic Arts programming language, and the concept of Electronic Arts introduced to the program designer. It is an extension of the Java language, and supports many existing Java language architecture, but in the grammar (Syntax) on a number of simple, and has a lot of intimate and humane design. Through it without too advanced programming technology can realize the dream like visual display and interactive media works. At the same time, it can also be combined with Arduino and other related hardware, design a complete interactive system; develop a perfect interactive product, strong expansion. As far as Processing itself is concerned, it is better to say that the design software is more appropriate than the programming language. The startup interface of Processing is shown in Figure 10.

![Figure 9. Sketch of image art.](image9)

![Figure 10. Processing Start Interface.](image10)
3. Interactive media design based on Processing

3.1. Operation of Processing software
All of the items that are open in Processing are called a Sketch project, each Sketch project has a directory with the same name as the Sketch project name, and a Sketch main program is generated in this directory. For example: if the project name is "Sketch_123", then the Sketch directory name is "Sketch_123", and the Sketch main program name is "Sketch_123.pde". If you use images, pictures, sound, font files in the Sketch project, you will be placed in the "data" directory under the Sketch directory. If you have access to other link libraries, you need to place the link library file in the Sketch directory under the "code" directory. When performing the export function, the system will be all the files data and code directory, remitted to a compressed file. Typically, Sketch project files will be placed in the Processing installation directory, if the Sketch project files in other directories you need to use the "File" menu in the "Preferences" setting. In addition, you can also have a number of program files in the same Sketch directory. You can place the original Processing file (with the file name is "Pde"), as well as the original Java file (with the file name is "Java"). To let Sketch program can be executed in the web page, the use of Export function, the system will convert the original Processing file to Java file format, and then compiled into Applet. At the same time, the system will also produce a number of related files, together with the Applet file, stored in the applet directory under the Sketch directory. The running interface of Processing is shown in Figure 11.

![Figure 11 Processing Operation Interface.](image)

3.2. Advanced Java model
This mode is a more flexible mode; you can edit the environment in the Processing directly to the complete Java programming language to write programs. In this mode, you can use the link library is no longer limited by the Processing provided by the library, but you can use all the Java language provided by the link library. Although in the Processing editing environment, and can be used directly to complete Java programming language to write the program, but the only way to export Applet in the
browser, if you want to use some of the resources and access the computer program function. Related words, because Applet in the browser limitations. Based on security considerations, the implementation of Applet program in the browser, is to prohibit access to the computer resources of the computer, otherwise it will become a hacker program. Therefore, need to convert Applet to Application [11], so you can skip the browser, individually directly on the machine on the computer program, it can fully use all functions, at the same time, can also show images in full screen mode. The interactive example is shown in Figure 12. The core code is as follows:

```java
void draw ()
{
    background (0);
    float pic1Pos = hs1.getPos ()-width/2;
    fill (255);
    image (pic1, width/2-pic1Width/2 + pic1Pos*11.56, 0);
    hs1.update (); hs1.display ();
}
```

![Interactive instance](image)

**Figure 12. Interactive instance.**

### 3.3. Hardware design

When Processing is used independently, it can be regarded as a visual multimedia design tool, which is mainly used in the field of graphic design and animation design. But Processing's ability to expand is not only that, through the relevant hardware support to complete the complex interactive media design system, Arduino is to achieve this kind of creative magic wand. Arduino is an open source code based on the I/O Simple interface version, with the use of similar Java, C language development environment. Users can quickly use the Arduino language and Flash or Processing and other software to make interactive works. Arduino can be used to develop electronic components, such as Switch, Sensors or other controllers, LED, stepper motor or other output devices. Arduino can also be used in an independent manner; the interface of the software communication can now support Flash, Processing, Max/MSPVVV or other interactive software. Arduino development IDE interface based on the principle of open source code, the same as Arduino, Processing software can be free to download and use, to develop a stunning interactive works. Based on the interactive media design of Processing, in order to allow users to get the best interactive experience in appreciating works, designers tend to through a variety of effective techniques to simulate the environment perception". This technology simulation is different from the previous simple visual processing (such as GUI, UI, etc.), but through the specific external hardware devices (such as sensors, projectors, etc.) to select the most suitable interaction. For Processing, the most common external connection device is the sensor, and Arduino is connected between the Processing and the sensor bridge. So far, Processing based interactive media
finally get rid of the "pure visual constraint" and can fully express the designer of a tiger with wings added, like a powerful and unconstrained style of creative concept [12]. Arduino schematic diagram shown in Figure 13.

Figure 13. Sketch map of Arduino development board.

4. The idea of interactive media creation based on Processing

4.1. Human characteristics of interactive media creation

With the advent of knowledge economy, the concept of "people-oriented" Liaooyuanzhishi spread in various fields, the core of this idea is the return of self-consciousness. As the media of information, the role of culture in the production and dissemination of culture is gradually diversified. User experience UE (Experience User) and user centric UC (User-Centered) concept is introduced, in a sense to lay the foundation of the humanities in the information age. Relevant information shows that the people-oriented design ideas from the people of science and technology application of the contradictory attitude. Representative of the Frankfurt School of Walter Benjamin (Walter Benjamin, 1892-1940), Hawke Heim (MaxHorkheimer, 1895-1973), Herbert Marcuse (Herbert Marcuse, 1898-1979) (TheodoreW Adorno, 1903-1969, Adorno), they inherited the rationalism and skepticism, since Descartes, the merits and demerits of contemporary technology of deep philosophical review and they even believe that science and technology as leading to social corruption ideology, cover a variety of social contradictions, destroyed the people's sense of innovation and the spirit of rebellion. Hawke Heimo pointed out: "when people neglecting the glorious future social yearning and pursuit, while trying to prove the rationality of science to modern society of eternal existence, the motive force of the revolution of science will be lost as a deadly and destructive potential science itself show a more serious obstacle to the development of the society in the power of will." Marcuse argues science alienated thought, he thought that people find the "scientific method" to control nature; the result is "provides concepts and tools for people to rule the people". He attacked the "modern industrial equipment and its high productivity...... In the process of satisfying personal needs, deprived of (a person) have independent thinking, autonomy and opposition rights ", the society became a one-dimensional society, the life in which people become" one dimensional man". "Science and technology is more developed, more comprehensive, and personal to break the state of the slavery of the means and methods cannot be imagined. The word "public" is derived from the "Focus Media" of communication, which refers to the relative mass media, and the media information is aimed at a particular audience. The mention of cognition, it is necessary to understand the related concepts of cognitive psychology: Cognitive Psychology (Cognitive Psychology) is the originator of the opposition from behaviorism, but absorbed the reasonable composition of behaviorism formula, and inherits the overall view of Gestalt psychology. It believes that psychology is not only the
study of behavior, but also to study the law of internal psychological activity as the basis of behavior. Cognitive psychology is the core of the information processing point of view of psychology, also known as the information processing psychology. It is based on the view of information processing cognitive activities to study human: how to get information from the outside world, and how this information into knowledge representation and knowledge and storage is, and how to guide our attention and behavior. The schematic diagram of the coordinated work of Arduino and Processing is shown in Figure 14.

Figure 14. Schematic diagram of the coordination work.

4.2. An aesthetic analysis of interactive media

In terms of the subject attribute of the interactive media based on Processing, it can be attributed to the intersection of computer science and art. In the form of interactive media is based on the digital technology as a physical basis, and the soul of the soul - the theme of the work, ideology and other cultural factors are still subject to the influence of traditional art design theory. In a sense, the interactive media can be regarded as the core of aesthetics. The interactive media work, digital art (Digital Art) a special branch, can be interpreted as a form of art that artists use computer as the core of the various types of digital information processing equipment, through the construction in the digital information processing technology based on creation platform is described and the achievement of their own creative ideas, eventually complete works of art based on digital technology, media and through various digital technologies and related (with network) will work to enjoy the group released for appreciation in a participatory and interactive way to appreciate art, complete the aesthetic process of interactive mode. Various unity refers to the form of a combination of the various parts to have a common structural form and rhythm, so that people feel the whole work of art is not only changes and differences, but also a unified whole. He also refers to the diversification of the form of the United States in the creation of the law in the United States to create a unified application. A variety of things reflect personality vary, uniform embodies the inner link between the various artistic works, only according to certain rules, to combine them into a whole both changes and order, to give people the feeling of beauty. The diversity of things in line with the reality of life - unity to achieve harmony, and harmony is the highest form of the United States and the requirements of the United states. Diversity and unity is the general rule of the form of beauty, and other forms of the law of the United States should be unified with this general rule, it is the highest form of formal law. Contrast is the emphasis on differences, is through the comparison between the elements of the elements to enhance the performance of the work. Specifically, the comparison is divided into two categories: "formal comparison" and "emotional contrast"[13]. The form of contrast depends mainly on the changes of design elements and mutual contrast to enhance the visual impact, such as line thickness, color intensity, light strokes and so on; emotional contrast is on the overall style positioning works to impress people, such as movement, speed, weight, flexible and so on. Harmony is the approximation of the prominent, is an important method for unity from the difference, by volume, proportion, color and other aesthetic elements, looking for changes in the law, and related
elements, to meet the people in the subconscious for "stability" in the pursuit of. Contrast and harmony is the two sides of the unity of opposites, too much will lead to imbalance, harmony will bring mediocre, only accurate grasp of the "degree", in order to create a satisfactory interactive media works. People get the information of the external world through the senses, this information through the processing of the mind (Synthesis and interpretation); resulting in a reflection of the overall phenomenon of things, this is the perception. In other words, it is the perception of the objective things directly acting on the senses, and in the mind of the overall reflection of things. Perception is not a simple superposition of it by way of feeling, a series of integration of various elements of the feeling of relative independence, form a complete perception system, combined with the unique personal experience, complete the subjective reflection of things. According to the laws and characteristics of the subjective reflection, the perception can be divided into three types: space perception, time perception and motion perception. Spatial perception reflects the size, shape and position of the object. The time perception reflects the continuity and order of things, and the movement perception reflects the displacement of the object in the space [14]. An example of color contrast based on Processing is shown in Figure 15.

4.3. The value system of interactive media

Related data show that: the feedback of the audience, for the author to determine the performance of the works, to adjust the creative goal has a very important reference value. Before, other forms of art and design interactive media outside while also aware of the importance of the audience (or user), but due to technical limitations and ideological barriers between the creator and the audience, communication is not smooth. And interactive media, due to their own interactive characteristics, can be very direct to complete the feedback of the relevant design, so as to achieve a virtuous cycle of development model. Interactivity is a link between the users to experience the sense of immersion, is one of the important realization conditions of interactive media design works, but also the human and the virtual world to interact with the entrance. Compared with other forms of art, interactive media's "interaction" is its uniqueness, especially in combination with the computer network, the concept of art works and influence through the network to achieve interaction with the audience. For example, when the traditional art works in the art gallery and gallery show, the author is often absent, and interactive network art shows that the artist has been "presence", to maintain communication with the audience. It should be noted that the value of the interactive nature of art is to explore the diversity of views, not to fear the challenges arising from the non - linear or non - linear form of feeling. The interactive media design based on WEB is that, in the traditional art creation, the author can control the whole creation process, the physical form of the finished product is determined by the author's own consciousness, only when the viewer works appreciation, emotional interaction started, although the content will change the mapping works according to watch the different[15], but from the viewer's perspective, receiving this information is still
passive; while in web design, because the viewer participation (such as clicking on a hyperlink, fill out the form, select the page and so on), the information providers can not completely control the whole communication process, users interact with the web site at the same time, also participated in the construction of Web site, the role of the visitors from passive to active, this also means that the nature of the site and location decision The decision maker is not just the author, but also has become one of the factors that determine the final outcome of the site. What is interesting is that due to the unpredictable nature of the web site, the development of the site itself is very difficult to predict, and even eventually may be completely contrary to the original intention of the author.

5. Summary and Prospect

One of the characteristics of art design is full of emotion; interactive media design is no exception. From the application effect, based on the communication of interactive media not only can move the user from the function, but also can arouse everyone’s sympathy in the emotional. From this point, the interactive media design is no national boundaries. The advantage of interactive media lies in the efficiency and effectiveness of the dissemination of information. Most of the traditional art form by the spread of personal communication or in hard carrier based, so inevitably in effectiveness is not satisfactory, and the interactive media design can deeply, vivid and delicate people reveal complex mentality. This is very effective in dealing with various conflicts due to the ideological differences that is, by interacting with the nature of the work itself to communicate the feelings of different countries and ethnic groups. Interactive media as the most effective information carrier, to a large extent, promote the process of globalization, with the further development of the information age; this influence will play a more and more important role. Objective analysis, at present, the application of interactive media technology is still stuck in the creative stage, has not formed a complete application system from the design to the market. Professional setting high level interactive media as we usually see are mostly concentrated within the museum, the development of science and technology, although some forward-looking ability of manufacturers to use some technical means to do the relevant brand derivative promotion, but that is only a way of business operation, and further does not involve the popularization of science and technology the sense of social responsibility.

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