Application Research of Programming Platform in Interactive Installation Art

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Abstract. Following the advancement of computer technology and the incorporation of the programming language Arduino, there is a greater degree of interactivity, connectivity and experience in contemporary interactive art installations. By getting involved in the artworks, one can touch and feel them, thereby enhancing one's appreciation of things. It is also possible for them to resonate with the creators with regard to material and spiritual feelings, which transforms the users' perceptual knowledge into the more profound spiritual-rational knowledge, yielding an extraordinary experience. By taking the work "Listen to it" as an example, this paper presents the endangered birds endemic to China and appeals to people to cherish all wild creatures by connecting humans with installations through Arduino in a new way of expression.

Keywords: Human–Machine Interaction · Interactive Installation Art · Arduino

1 Introduction

Interactive installation art converges technology and art as an innovative multi-sensory experience model. It functions as a bridge, connecting the spiritual worlds of the participants and the designers. As audiences interact with the installation, a constant stimulation of the audiences' imagination generated by the installation triggers them to think. Interactive installations widen the performance and appeal of the works, while offering new channels and possibilities in terms of the users' visiting forms [4] At the same time, technology also provides more possibilities for the display forms and functions of interactive installation art design. Especially the programming platform, which meets the technical needs of designers, makes it more and more used in the field of art. Therefore, this paper will explore the application value of the programming platform in the interactive device art from the perspective of creators and user experience, hoping to provide more ideas and possibilities for the future interactive installation art design.

2 Interactive Installation Art

Interactive art installations constitute new media art, which is increasingly widespread in the field of interactive installation art following the progress of science and the prevalence

of computers. On the basis of computer graphics technology and computer technology for collecting, processing and arithmetic of information as hardware facilities, interactive installation art employs a variety of integrated materials for the construction of interactive spatial scenarios between human and machine or among humans [5].

Interactive experience represents the most fundamental feature of interactive installation art, in which the involvement of designers and users forms an integral part. An installation requires active participation and communication between users and the machine or other users, with the intention of perceiving the ambient conditions brought about by the art, as well as the design concepts and ideas conveyed by the designer. For the sake of boosting the participants' enthusiasm to engage in interaction, designers usually display the works on electronic control panels dynamically, rather than merely presenting them statically [2] Controlling the changes of audio, light, electricity and shape will enable the work to be more vivid for a better display effect to be achieved. It is thus evident that interactive installation art is no longer constrained by conventional public art. It incorporates a variety of disciplines, elements or presentations such as literary art, audio art, and video art, which communicates the emotions and central ideology of the work per se. Moreover, it is also more diverse with respect to the significance and value of its creation, bringing the audience to access and understand the work better.

3 Application of Programming Platform in Interactive Installation Art

3.1 From the Perspective of Designers' Creation

3.1.1 A Convenient Technology Platform for Creators

Arduino is a development platform with quick activation of open-source code, which is user-friendly, economizes learning costs, shortens development cycles, enables the communication between interactive installations and human beings, and empowers intelligent installation design. It fulfills the needs of designers in technology, leading to the increasing applications of Arduino in the art field.

Today, Arduino has exhibited its value in a growing number of areas, where Arduino features a functional library that is unparalleled by almost any single microcontroller, with a wide variety of sensors being universal. Almost every controller in the Arduino system is compatible [7] Such compatibility is designed to bring Arduino to possess mostly hardware, yet to be closer to programmers and even the public than other software. Arduino primarily comprises two platforms, where the first one, the hardware board, controls various sensors and appliances through connecting circuits, whereas the second platform is the software component of the Arduino IDE. It is possible for developers to upload code directly to the chip on the board via the USB interface, which is done by programming the code on the compiler and informing Arduino directly of your needs [3].

There are sensors on the circuit to receive various physical signals from real space, such as heat sources, sound waves, light waves, etc., which are channeled back to the Arduino uno chip. In accordance with the pre-written program, the received information is processed and outputted correspondingly as needed. In this manner, observations of human behavior are made with the aim of influencing the environment and humans [8].

3.1.2   Reinforcing the Interactivity of Interactive Installation Artworks

Interactivity, being the main characteristic of interactive installation art, distinguishes it from other forms of art, where interaction refers to the process of communicating information between users and installations. Arduino programming technology applications offer a platform for this interaction, whereby participants can better integrate into and become part of the works. Participants are empowered to take full initiative in the process of interaction [10] As a result, the works often evolve in response to the participants' involvement, creating a new form and experience for the works. For this reason, the interaction between the participants and the works remains one of the most significant parts of perfect works.

3.1.3   Enhancing the Connectivity of Interactive Installation Artworks

The second characteristic is connectivity. In contrast to conventional installation art that is mostly static to be appreciated only externally, interactive installation art emphasizes more on the connection between the individual and the installation. The application of Arduino programming technology grants it a new life, as it requires the participants to be immersed in the works before they can fully engage in and appreciate them from a multi-dimensional perspective. Furthermore, a connection between users and designers is also highlighted in interactive installation art, establishing an emotional bond between designers and participants and transmitting the creativity and ideas of the creators [1].

3.2   From the Perspective of User Experience

3.2.1   Enriching User Perception System Experience - Centered on Audio-Visual Experience

The concept of sensibility was first introduced by Kant, who argued that sensibility refers to the capability of acquiring representations after one is stimulated by an object, which is the form of reflection generated in the brain by objective things acting directly on human sense organs. As a result, it is apparent that only by personally participating in social practice and being in contact with objective things can we gain perceptual knowledge. Consequently, it is only possible for participants to upgrade the perceptual knowledge acquired by the senses into theoretical knowledge by enriching the expression of interactive installation art, so that they can deeply comprehend the content and ideas to be expressed by the installation.

Arduino programming technology brings powerful vitality and vigor to installation art design. In the installation art design, electronic control is employed to control the changes of audio, light, electricity and shape for progressive diversification of art forms, thereby rendering the works more vivid and delivering a unique audio-visual experience to users [6] People are allowed to literally take a journey into the works, to touch and sense them, to perceive their functionality with a view to enhancing their understanding of things, and also to contribute to a greater sense of satisfaction and pleasure for the participants.

3.2.2 Reflecting the Principles of User-Oriented Design Better

Interactive installation art involves the dual combination of art and technology, which requires human participation to accomplish the works. Therefore, "humanization" plays a key role in the design direction of interactive installation art. Designers typically attach great significance to the physical, emotional and spiritual perceptions of participants, which leads to the utilization of technology to achieve the goal of "user-oriented" design.

The user-oriented design principle of interactive installation art firstly observes interestingness. Leveraging modern technological means, such as the application of Arduino programming technology, elements such as light, electricity and information are incorporated as per design needs, in such a way that the works can capture the visitors' attention, mobilize users' motivation and be involved in interaction. It not only fulfills the basic needs of users, but also appeals to the psychological needs of fun seeking, humor and relaxation.

The second aspect concerns the pursuit of works with more experiential value. More experiential value implies that users can resonate with creators in their physical and mental senses upon interacting with the installation, transforming the users' perception into a deeper level of rational knowledge, thereby gaining an unusual experience [9] The application of Arduino programming technology enables the works to possess an inherent cultural connotation, to express the thematic core of the works in a clearer way, and to demonstrate to the users the contents and ideas intended to be communicated by the creators.

4 "Listen to It" Installation Art Design Based on Arduino

4.1 Pre-creation Thoughts

4.1.1 Creation Background

Wild creatures constitute an indispensable part of natural resources and a precious property gifted to the world by nature. With the evolution of approximately 3 billion years into the present splendid and colorful animal universe, it is imperative for humans to cherish and treasure them. However, following the continuous expansion of industry, there have been changes in various social activities and lifestyles of human beings, destroying the natural environment. On the other hand, humans have failed to recognize the necessity of the presence of wildlife for nature as a whole, leading to a gradual increase in the number of extinct wildlife. In China, a serious degree of endangerment of wild creatures has also been discovered. Among the endangered wild species in China, there are 128 species of mammals, 183 species of birds, 96 species of reptiles and 96 species of amphibians at risk, accounting for 25.6%, 14.6%, 24.6% and 10.4% of the total number of relevant animal species in China, respectively. In the case of birds, for example, there are numerous endemic bird species in China, each of which is valuable. Yet, two populations are currently at extreme risk and eight populations are at risk.

4.1.2 Creation Ideas

Taking the endemic yet endangered birds of China as the starting point, the overall design of the project features two parts: "sky" and "earth". For the sake of providing

the participants with an overview of various bird species in different provinces or nature reserves in China, a map of China is outlined with light belts on the "earth" and the corresponding bird species are indicated in the "sky". The "sky" section comprises clouds, birds and headsets. As participants join in, the brightness and color of the clouds will vary as they step onto the map and stand under a particular cloud, thereby allowing them to visualize the endangered birds living in the area. The headset symbolizes a communication medium between nature and humans, introducing knowledge about the endangered bird species with the sound of the birds' chirping, and calling on users to recognize and protect all wildlife. Throughout the operation of the installation, the programming language is involved, bringing the installation a sense of fun. Furthermore, via the participants' step-by-step actual operation, they can interact with the installation, which causes changes to the installation. It is a great opportunity for participants to gain some sensory experience and spiritual insight, and to resonate with the creators or various creatures in nature (Fig. 1).
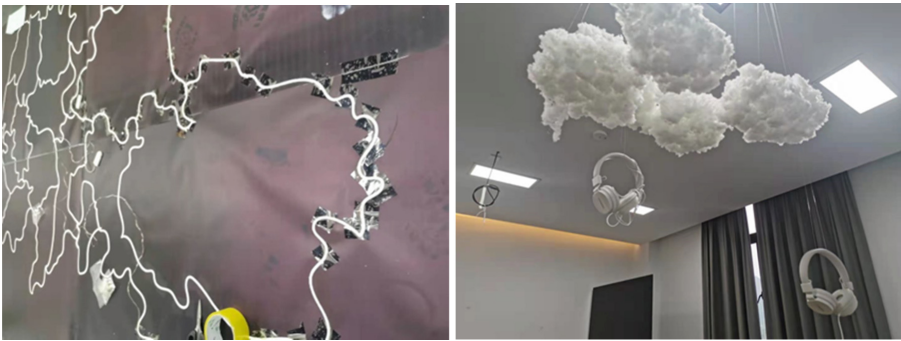
Fig. 1. Ready to work

Fig. 2. Process of working.

4.2 Preliminary Preparation

The map of China, which is placed on the ground and outlined with the light belts in the installation, is always illuminated. On top of that, the two components of the light belts and the headsets interact with the participants through the programming software Aduino and the overall layout of the physical external hardware. Wherein the application of infrared sensing, motion sensing, physical sensing approaches, scenarios are developed by recognizing bio-signals to stimulate the installation at each step, in order to realize the interactive effect of lighting and audio (Fig. 2).

4.3 Programming Achievement

Prior to the participants' interaction, the whole installation exhibits a relatively tranquil atmosphere. The map on the ground is always illuminated, the clouds in the sky are only

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int cm;
int trigPin = 4;
int echoPin = 5;
int led = 9;
int sound1 = 2;

  void setup() {
pinMode(trigPin,OUTPUT);
pinMode(echoPin,INPUT);
pinMode(led,OUTPUT);
pinMode(sound1,OUTPUT);
}

void loop() {
    digitalWrite(trigPin,LOW);
    delayMicroseconds(2);
    digitalWrite(trigPin,HIGH);
    delayMicroseconds(10);
    digitalWrite(trigPin,LOW);
    cm = pulseIn(echoPin,HIGH)/58.0;
    cm = (int(cm*100.0))/100.0;
if (cm<50){
digitalWrite(led,HIGH);
digitalWrite(sound1,HIGH);
    }
else{
    digitalWrite(led,LOW);
    digitalWrite(sound1,LOW);
    }
}
```

Fig. 3. Programming achievement.

faintly lit, and the audio within the installation plays the sounds of insects and birds at night, the voice draw the audiences closer to the interactive installation. The lights inside the clouds are attached to infrared-sensing sensors. When participants approach a particular province of interest within 20 cm of the infrared sensor, the lights inside the clouds over that province will be activated. At this point, audiences will be able to spot the endangered birds endemic to China in this region.

The headsets are connected to an acceleration sensor. When one holds up the headsets, the acceleration sensor will signal to trigger the playback of the audio files for the birds' information and chirping. Once the participant is done with listening to the audio file and the participant puts down the headsets to proceed to the next province. Then the

Fig. 4. Works assembly connection and operation

previous light goes out and the next light lights up, cycling through the previous step (Fig. 3).

4.4 Final Assembly and Presentation

The installation is located in the indoor area of a nature museum, which receives numerous visitors of all ages every day. It is hoped that people of all ages will be intrigued by this installation and interact with it, in order to develop a general understanding of the endangered birds which are endemic to China and to serve the purpose of advocating the slogan "Care for Wildlife". Having assembled the light set, headsets, sensors, and main control board with all the components functioning 333 properly for feedback, the light belt map will be set up and the other units will be hung in place (Fig. 4).

5   Conclusions

In line with the progress of science and technology and the advancement of computer technology, the integration of technology and art has emerged as a remarkably vital trend in the development of contemporary interactive installation art design. The proliferation of multiple user-friendly software such as Arduino and Processing has offered artists a technological platform and infinite possibilities for their interactive installation works. In accordance with the principles of user-oriented design, designers are allowed to create new audio-visual experiences with their own distinctive expressions, inspiring associations and evoking thoughts amidst the constant transformation of installations. There is an emotional bond between designers and users created by programming technology, which conveys the creators' creativity and ideas. In spite of the fact that the current level of technology has not yet completely fulfilled our desire for any technology to be applied in design, artistic design expression will eventually attach practical wings and soar to various fields with active exploration and research.

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