Science Popularization-oriented Art Design of Interactive Installation based on the Protection of Endangered Marine Life-the Blue Whale

*Jiahe Liu
School of Journalism and Cultural Communication, Zhongnan University of Economics and Law, Wuhan, 430000, China
201821120005@stu.zuel.edu.cn

Abstract. In today's world, marine pollution is becoming more and more serious, and the protection of marine ecosystems and endangered marine organisms has become an important international issue. In 2012, the blue whale was officially listed on the IUCN Red List of Threatened Species. As the top predator in the ocean, blue whales are seeing a drastically decreasing population, which will break the ecological balance of the region. The interlocked food chain in the ocean means it would eventually lead to the forming of an "ocean desert". Therefore, it is urgent to start the popularization of science to protect the endangered marine organisms for the public. Based on human-computer interaction and sound visualization, the author designs an interactive installation with the theme of "The Last Whale Sound", aiming to increase the public's attention to endangered marine organisms, to arouse people's self-reflection and environmental awareness, and to make the public consciously participate in protecting marine ecosystems.

1. Introduction

1.1. Current status of research on Marine Endangered Species
At present, it is rare for the academic research about the scientific publicity from the perspective of protecting endangered marine life, some books and articles covered public welfare and scientific exhibition are discussed from the perspectives of public poster and marine scientific exhibition hall, which cover a wild aspect, however, they are mostly in normal form, and lacking the scientific publicity on the specific reasons of endangered status of marine life. Taking China as an example, it signed “International Trade Convention on Endangered Wildlife” in 1980, however, when domestic researches have related studied on it, they merely discuss about the protection on endangered marine life from the perspectives of law and science, but not integrate with scientific publicity, and besides, the current means for publicity and protection are only law and news. As to the research on endangered marine life, experts mainly focus on the macro doctrines of salvation, while neglect the physically protecting methods from micro perspective, so it is really a direction deserved to be studied and discussed.

1.2. Current Status of Marine Endangered Species Popular Science Design
Marine is the cradle of humankind. From ancient times till now, the creative desire of artists is always wandering on the intimate relationship between human and marine life. Marine animal is a normal
creation subject, while it is really to insert the thought on protecting marine animal, especially endangered marine animal, into art design creation.

As to the current publicity designs for broadcasting protecting endangered marine life to public, most of them are presented on traditional paper, and TV, and other media, which only completes information broadcasting, while the way to receive the information by audience is passive, which is hard to have two-way exchange and lacking interaction. For instance the book “Life Story” and documentary “Last Chance to See” released by BBC are platforms to help people know about endangered animal, from the perspective of scientific publicity, they are authoritative, but also limited to theory, so it is really difficult to attract the consistent attention of audience. Under such circumstance, interactive digital technology rises in response to the proper time and conditions, which greatly enriches the forms of display. In some marine exhibition halls, data visualization and interactive digital technology have been wildly used[1].However, most of the scientific interactive installation art works displayed in the marine exhibition hall are about introduction on basic species knowledge, which have less scientific information about relationship between human and marine animal and weak scientific education force, so that visitors are still lacking recognition on the specific means in protecting endangered marine animal. Besides, the communication form of interactive installation in some exhibition halls are traditional, which mainly takes the recurrence of marine ecological environment at the core, and displays the abyssobenthic environment by means of the combination of projection and model [2]. At the same time, the exhibition and publicity with text introduction and audio and video do not break through the traditional way of audience in receiving information passively, the interaction is not profited properly, thus, there is still great limitation on the scientific publicity in current exhibition hall, audience can not reality the serious result of marine pollution truly, and consciousness on marine protection can not enjoy popular support.

2. Materials and Methods

2.1. "The Last Whale Sound" design positioning
As to this design, taking the protection of endangered marine life, Blue Whale as topic, taking human voice and whale sound as the important elements of the whole interactive experience, and scientific publicity on the relationship between human behavior with life of blue whale as main objective, it completes the publicity logic, deepens scientific publicity content, so that it can be more interesting and precise. When blue whale is contacting with partners, it will make a low but thought-provoking sound to realize the purposes of finding food, delivering environmental information, and avoiding danger. Besides, by means of the collaboration of human voice and whole sound, the experiencer can travel the ocean together with blue whale, avoid danger, know the damage on blue whale by some behaviors of human during the process of experiencing multiple impairments, establish intimate relationship with blue whale, optimize experience of participant, and break through the traditional and single thought for scientific publicity.

Blue whale is one of the longest-living species in marine life, however, due to the marine pollution and global warming and other reasons in recent years, the average lifetime of blue whale is greatly shortened, so that it takes the lifeline of blue whale as the final output display of data visualization in content setting, and then, participant can not only experience the process of fighting together with blue whale, but also observe the result of their common efforts. The writer hopes to arouse people’s consciousness in knowing the status of endangered marine animal actively with this scientific interactive installation, so that they can give a hand and participate in the activity of ecological protection physically.

2.2. Interactive class sound visualization implementation path
This interactive installation will use two implementation paths of sound visualization, which are physical implementation and digital implementation. Both of them profit the effect of synaesthesia, have stimulation on organs of audience with sound, so that the concepts of obscurity and abstractness can be more vivid. [3]. Besides, the physical implementation path on interactive sound visualization adopts
resonance principle, which can display the objective materiality; the digital implementation path of interactive sound visualization is realized by the visualization principle made by designer with digital technology, and it finally presents the subjective initiative. As to the implementation technique, compared with physical path, digital path has stronger dependence on multiple techniques. The presentation effects of this two implementation paths have different visual aesthetics, and designer can have selection in accordance with the mapping mode and design objective.

As to the specific application, the physical implementation path on interactive sound visualization presents the sound wave by means of sound mapping, and presents the visual difference of different vibration frequency sounds. Besides, physical implementation can have multiple visualization presentations according to the diversity of specific material quality, while it still adopts resonance principle naturally. In addition, in recent years, the physical implementation path combined with electronic technique also becomes the research direction and creation method of some scientists and artists. With the combination of digital technology and cymatics, when physical implementation path can realize interaction, it also has scientificity and interestingness, diverse presentation forms, and also strong visual appeal on audience.

The basic principle of realizing interactive sound visualization by means of digital technology adheres to the transformational rule of sound and visual picture custom-made by designer, and completes the process of sound visualization in accordance with specific rule with the combination of computational programming software and scientific and technological method. During the process of program execution, user inputs or triggers the sound, the program will have analysis on the sound and extraction on the key features in accordance with the established roles, and have real-time transformation, so that it can arouse the output and presentation of visual picture. Furthermore, digital implementation often has technical treatment from the sound collection, sound noise reduction, touch sensing, sound analysis, sound visual programming, and multimedia presentation, and finally realizes the digital sound visualization with real-time interaction[4]. As to designer, there is comparatively large space for presentation by means of digital implementation, and besides, there are more possibilities for the visual presentation effect.

3. Result and Discussion

3.1. Implementation of key technologies

In order to realize this installation interaction, it combines computer software (video image and sound), visual software in code form (processing), and external hardware (projector, touch button, and Arduino, and etc) for usage. As to the specific principle, it starting the installation for operation by means of touching the button, experiencer inputs sound into Arduino, after sound collection, sound analysis, and feature extraction, the system can have digital visualization feedback in the screen, during the process of playing game, the output port can be combined with cymatics by means of programming technique, and present the sound wave in physical visualization by means of resonance principle.

Processing is a visual programming software integrated with programming algorithm and sound visualization design, which combines the genes of scientificity and art, and requires the designer to have knowledge of aesthetics and programming code at the same time, although it is complicated to operate, the presentation of visual effect is rich with powerful interactive function, which has the feature of multi-platform. Its emergence overturns the people’s understanding on the insipidity of programming software, and designer can have complicated visual presentation design within limited knowledge on programming algorithm, as picture 1:
Figure 1. Visual graphics created by designer FAL using Processing

Arduino is the most popular aggregation of open source hardware and software development of the whole world, if it is operated with components and parts or various sensors, it can have interaction with the surrounding world and enjoy the fun to people brought by interaction. The digital signal or analogue information sent by sensor is transformed into data by means of Arduino, Processing reads data through serial port, and presents them on computer screen after treated by correlation function. Processing and Arduino have common programming environment and similar grammar, their combination can better integrate electronic technology, single-chip microcomputer technology, and graphic programming technique, so that programming design can be more humanized, and world-wide amateurs are expanding its application gradually.

3.2. Creation process

3.2.1. Creative idea and implementation

Since 1996, the SSC of IUCN has begun to focus on the endangered marine life, and officially listed endangered marine life into red list of INCU. However, after that, the intervention and damage of human on marine environment is not held, overfishing, marine litter, and petroleum pollution have severely damaged the marine ecological system, the reducing speed of endangered marine species has been over endangered land species, so that the scientific publicity to public is in urgent need.

“Finale Whale Sound” is the interactive installation work based on the idea of protecting endangered marine animal. The species name of blue whale, musculus, is from Latin, with the meaning of “strong and healthy”, while it also be translated into “mouselet”. In 1758, Linnaeus denominated this species in his seminal text, “Natural System”, who drolly used this ironic pan. Now, blue whale becomes the most powerful but also weakest species, although it is the species with largest figure and loudest voice, it is still confronting the danger of near extinction. Besides, it’s sound fundamental frequency is 10-40 hertz, although it can reach to 180 db in ocean, people can not feel it by ears in daily life. For instance, although blue whale has great space in oral cavity, its throat is narrow as the fist of adult male. Thus, when blue whale eats food, a plastic bottle or a rubber glove can suffocate it to death. This interactive installation design aims to generate the related environmental knowledge with marine protection for people, which can arouse their attention and avoid the behavior causing damage on marine ecologic environment in daily life, so that it can solve marine pollution in root, and restore marine ecological system.

As to the installation principle, experiencer touches the main switch to start this interactive game, the main switch controls motor and the starting of other sensor and picture, then, it collects sound into Arduino, which can receive human voice and whale sound in mp3 in real-time, and by means of the digital implementation path for interactive sound visualization mentioned above, it can realize the interaction and collaboration of participant with blue whale in the screen. With the changes of voice tone, frequency, and volume, the blue whale in the screen can avoid the non-environmental behavior of human and life threat by floating up and down.
void setup(){
size(617,453);
whale = loadImage("whale.png");
background = loadImage("bkg.jpg");
trash1 = loadImage("trash1.png");
trash2 = loadImage("trash2.png");
trash3 = loadImage("trash3.png");
trash4 = loadImage("trash4.png");
trash5 = loadImage("trash5.png");
font = loadFont("SitkaDisplay-48.vlw");
port = new Serial(this,"COM4",9600);  }
void draw(){
frameRate(20);
while (port.available()>0){
char input = port.readChar();
switch(input){
case 'a':
background_loop();
trash_loop();
val = port.read();
val = map(val,0,1023,0,height);  }
image(whale,0,val);
if(sqrt(y1-val)<25||sqrt(y2-val)<25||sqrt(y3-val)<25||sqrt(y4-val)<25||sqrt(y5-val)<25){
stop();
port.write(y);  }
over();
font();  }}
void background_loop() {
image(background, x, 0);
image(background, x + width, 0);
x -=5;
x %= width;}
void trash_loop() {
x1 = width + x;
y1 = height/2;
x2 = width + x;
y2 = height/2;
x3 = width + x;
y3 = height/2;
x4 = width + x;
y4 = height/2;
x5 = width + x;
y5 = height/2;
image(trash1,x1, y1);
image(trash2,x2, y2);
image(trash3,x3, y3);
image(trash4,x4, y4);
image(trash5,x5, y5);}
void font(){
textFont(font);
fill(0);
text(timeshow,550,50);}
void over() {
time -= 1;
timeshow = time/20;
if (time==0){
image(background, 0, 0);
stop();
port.write(y);;}

Figure 3. Code of the processing program
At the recording output end, this work combines the physical realization path of interactive sound visualization, visualizes the sound waves by physical means according to the sound mapping of human whale harmony. Then it drives the paper to roll out, controls the steering gear to move through the read sound analog signal, connects the penholder with the steering gear, and makes the penholder move mechanically on its surface to output a waveform diagram. This is not only a concrete display of sound waves of human and blue whale, but also represents the lifeline of blue whale. Finally, the experiencer will get the "Blue Whale Life Record Sheet" from the output port. This record sheet does not show the real experience time and sound waves, but abstracts them into the lifeline and vitality value of the blue whale. The two variables are not directly related, and only serve to increase the infectivity of the device. The regular waveform is blue whale random waveform, which is the harmony between human voice and whale, because human voice is random when encountering game obstacles.

Figure 4. Device internal structure
void loop() {
    int button1 = digitalRead(button);
    if (button1==HIGH) {
        Serial.write("a");
        digitalWrite(whaleSound,HIGH);
        delay(30000);
        digitalWrite(roll,HIGH);
        delay(30000);
        d = analogRead(sound);
        d = map(d, 0, 1023, 30, 120);
        myservo.write(d);
        delay(15);
        p= analogRead(sound);
        Serial.print(p);
        delay(100);
        if (Serial.available()){
            y=Serial.read();
            if(y=121) {
                myservo.write(90);
                digitalWrite(whaleSound,LOW);
            }
        }
    }
}

Figure 5. Code of the Arduino program

3.2.2. Installation form and final display
The whole installation work has two dimensional visual presentations, the and writer starts from the visual feeling of experiencer, presents the concord of human and whale from the two-dimensional and three-dimensional visual space forms respectively, which are screen port and output port, which hopes to strengthen the expression effect of sound information. Before formal construction, the writer conceived the specific size, space size, setting, and light in advance. The digital presentation in the screen is disposed and placed by means of Photoshop and After Effects. (Some of the original images come from the Internet.)The entity construction of the whole installation is divided into two parts, the worktop contains touch function and sound-receiving function, touch will be realized by means of the sensor switch, while the sound receiving module and MP3 module of whale sound inside are wrapped by real trumpet shell, which can not only protect the components and parts and Dupont wires, but also strengthen the sense of substitution of experiencer with its share as phone. The output port shall satisfy the function of sound visualization entity output, so that it requires motor, coupling, and extension screw rod these mechanical parts, and out of the consideration on its aesthetic perception, it adopts paper, shell, and degradable cloth, and other environmental materials to have external decoration.

Figure 6. Device presentation
3.3. Outlook
"Final Whale Sound" presents the specific behaviors of human causing endangered status of blue whale to public by means of this interactive installation more directly, and besides, the living environment of blue whale can be improved and their life can be extended by avoiding these behaviors. This work expands from small to big, throws a sprat to catch a herring, has profound significance and interactive fun and scientificity with education, science, society, and culture these functions integration, and besides, it is has easy structure, accounts for small area, which is suitable to the exhibition hall, park, and display of marine subject, and furthermore, with the combination of marine ecological environmental protection, and human-machine interaction, it can arouse more people’ attention to the endangered marine life with blue whale as representative, and improve the environmental protection consciousness of people.

4. Conclusions
With the development of science and technology, the production method and life style and thinking habit of people are changing silently. The human-machine interactive technology from life is growing mature gradually and stepping into every corner of life by means of a benign, positive, and exploring way, which greatly expends the art presentation space. Compared with traditional art works, its rich presentation methods, convenience in acquiring, and improving interaction can have wilder and more profound audience. At present, with the rapid development in creative industry, the writer believes that there will be more new designers and artists who know about and apply programming language, connect art, science and technology with the development of human society closely, and create more art works with social value.

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