Processing-based interactive installation art design—An example of a potentially hazardous odour identification device for the vision-impaired

Dongchao Xue*
*Humanities, Arts and Digital Media College, Hangzhou Dianzi University, HangZhou, Province, 310016, China
*Corresponding author’s e-mail: xuedongchao@hdu.edu.cn

Abstract. Nowadays, as cutting-edge technologies such as information technology and artificial intelligence continue to develop at a rapid pace, the integration of technology and art is being promoted, which has led to an unprecedented development of interactive installation art. Processing, as one of the open-source programming languages, plays an important role in the applications of the creation of dynamic visual art and interactive media art. This paper examines the application of Processing in interactive installation art, using the example of a potentially hazardous odour identification device for the vision-impaired, and explores the significance of programming techniques in interactive installation art, offering new ideas for the future direction of interactive installation art creation.

1. Introduction
Processing is theatially a branch of the Java language, except that it does not require a difficult syntax compared to Java. Artists and media workers can design and create their own works following the documentation provided by the open source community without the specialist programming training. Meanwhile, Processing can be combined with Arduino which shares the same development environment, to create more user-friendly interactive installation artworks.

Processing is becoming an increasingly popular software for artists, designers and those who are interested in the intersection of art and science. Processing effectively provides a way for artists and designers to use their programming language skills to realize their ideas and express their creativity, without being limited to existing production tools and software, such as Photoshop, Illustrator. It is based on the Java language and can be easily applied to operating systems such as Windows, Linux, MAC OS X. At the same time, it integrates an effective 3D OpenGL graphics engine, enabling programmers to call upon the graphical interface and make full use of the graphic design of the computer device's graphical display capabilities. Drawing, animation and interactive design can easily interact with common input devices such as mouse and keyboard, which means it is very easy to learn and master.

2. Interactive Installation Art
Interactive installation art belongs to new media design, a new form of artistic expression. Based on the hardware and software platform of computer, the viewer could become a part of the work, making humanity and machine interact[1]. The interactive relationship between human and installation seems like an exchange between technology and emotion, promoting the integration of art and technology. Thus, artists could express their ideas to people effectively. The interactive installation is therefore an
important channel for the artist to communicate with the audience, and the interactive effect can reflect the viewer's feedback on the interactive installation from the other side.

Interactive multimedia technology creates the possibility of interaction for installation art design. It upgrades the general zero-interaction installation art into interactive installation art, thus enhancing the expression power and influence of installation art design. From the perspective of interactive multimedia technology, its interaction methods are mainly divided into two categories: the interface-based and the immersive. Currently in most countries, interface-based interactive installation is the most frequently used art form in exhibitions. It interacts with the installation mainly through the user's words, touch, gestures or objects. Immersive interactive installations are often set in large scale exhibitions such as museums because of the large space they take up and the immersive user experience they require. When interacting with an immersive installation, the user has more freedom to interact without the constraints of the interface. The Immersive Gulf Stream Experience is an immersive interactive projection installation created by team Fomila D. As visitors walk through these virtual multimedia projections of Gulf Stream, they will see computer-generated 3D animations of virtual sardines and other rare creatures in this water area, then it will guide visitors in the right direction to enjoy the exhibition. The installation introduces visitors of the Patricia and Phillip Frost Science Museum located in Miami to the far-reaching impact of Gulf Stream on the food chain and fish-rearing behaviour in the underwater world. The designers have created an interactive spatial environment in which the visitors can immerse themselves in interaction and experience the infinite fascination of the marine realm.

3. The Impact of Processing on Installation Art Design

Installation art is designed in a more innovative way than ordinary art forms, which not only creates a sense of novelty and gives the public a diverse viewing experience, but can also more fully demonstrate the value and role of interactive multimedia technology[2]. With the advancement of science and technology, Processing plays an indispensable role in the technical support of interactive installation art. It is more practical, creating more possibilities through the programming language and graphic design, increasing the plasticity of the installation and making it more valuable.

3.1. Multidimensional interactive installation experience

Processing programming technology can be used to create a variety of art forms, combining with light, sound and other elements as the design needs change, giving interactive installations a powerful dynamic that people can touch, feel and immerse themselves in. It helps to break through the spatial limitations of the installation, presenting a colourful visual effect and bringing the work to life. The viewer's imagination can be stimulated in this kind of specific setting.

3.2. Diversification of interactive installation works

The installation creates an emotional connection between the creator and the viewer through the Processing programming technology, transmitting to the viewer some of the creator's ideas about the work and his or her perceptions of life, thus producing emotional resonance. The artistic atmosphere created by narrative expression gives the participants a higher degree of freedom to create new scenes without intermission and to feel the thoughts expressed by the creator through the artwork. It is an interactive effect that the artists pursue, in order to achieve their artistic concepts, to convey the charm of art, and to encourage people to care about society while also daring to express their own values.

3.3. The involvement of the viewer in the interactive installation

The viewer is an important element of the interactive installation, it is assumed both as the person who is going to experience and a creator. Most viewers are not able to fully appreciate art by looking at a work from multiple perspectives and thinking carefully about its connotations. But Processing programming techniques inspire viewers to participate in the interaction of the work, allowing them to employ the interactive features of the work to develop their own ideas. Thus, the application of
Processing into interactive installation art increases the intimacy between the work and the viewer, who will feel the value and meaning of the installation art design more intimately.

4. Processing-based art design of an installation to identify potentially hazardous odors for the vision impaired

4.1. Background
According to WHO, at least one billion people worldwide suffer from otherwise preventable or unresolved near or distance vision impairments. Not everyone in this population with visual impairment has optimal sensory efficiency and they all need some training to improve their sensory acuity. Sensory integration is the process by which the brain organizes information from the different senses (touch, sound, smell, taste, proprioception, balance, etc.) [3]. When the user is multitasking, odor stimuli provide assistance to the user in making decisions as well as in processing distracting information. In the meantime, performing odor-related training plays a key role for users to make better assumptions and decisions [5]. It usually develops from early childhood, not only can it gives us an insight into the processes of sensory functioning, but also promotes our individual cognitive abilities. However, some blind children may have certain deficits in sensory integration and are unable to make timely sensory feedback in the face of some specific situations, which eventually leads to hazards.

Odors are mixtures of airborne compounds that combing with olfactory receptors in the nose and can have certain effects on the human body[4]. For people with visual impairment, the auditory and olfactory senses assume an indispensable role in their lives, so they need to obtain information through other senses. There are some potentially harmful gases such as gas and second-hand smoke, and the odor emitted by these gases can indirectly cause some harm to people's body. Due to lack of specific smell training, the blind have difficulty or cannot identify these potentially harmful gases. Also, in some schools for the blind, education on the identification of hazardous gases is not sufficiently relevant and interesting. That is the reason why we propose an artistic design of a potentially hazardous odor identification device for the vision impaired, hoping to help them to identify odors, to correct cognitive biases, and protecting their health and safety through this device.

4.2. Process of creation
The vision impaired is unique, so we need to effectively incorporate interactive technology to compensate for the deficiencies in olfactory guidance. The artwork of the potentially hazardous odor discrimination device for the vision impaired uses a Processing program to connect five buttons and a blower that releases gas by Arduino. Combining the interactive buttons with the odor feedback device, the user touches the corresponding five buttons by touching the five Braille characters on the identification device. When one button is pressed, the blower releases the corresponding potentially harmful odor: cigarette, gas, plastic, paint, ink. These gases are eventually emitted from the pipe, and visually impaired people can approach the device and use their sense of smell to effectively identify these gases, thus learn how to prevent those potential hazards in their lives.
The way to make the gas blow out from the carton is by defining the name of each interface on the Arduino board, setting the interface output mode for the button and the fan respectively. The time when the user triggers the button, it triggers the blower corresponding to the button at the same time, then the blower starts operating, making the corresponding gas blow out from the upper air hole in the carton.

```
int button1 = 3;
int button2 = 4;
int fan1 = 8;
int fan2 = 9;
void setup() {
  pinMode(button1 , INPUT);
  pinMode(button2 , INPUT);
  pinMode(fan1 , OUTPUT);
  pinMode(fan2 , OUTPUT);
}
void loop() {
  if (button1 == HIGH){
    digitalWrite(fan1,HIGH);
    digitalWrite(fan2,LOW);
  }
  if (button2 == HIGH){
    digitalWrite(fan1,LOW);
    digitalWrite(fan2,HIGH);
  }
}
```

4.3. Development prospect

The work concerns about the deficiencies of educational facilities in some schools for the blind, and focuses on the education of odor discrimination, helping the vision impaired to be more aware of the potential hazards in life through the form of interactive installation art. It is highly interactive, funny and scientific. The addition of interactive programming technology greatly enhances the interest of the vision impaired towards taking part in the interactive installation, while allowing the blind to experience the sense of smell that cannot be depicted by the sense of touch or hearing. This device also makes people aware of the dangers of potentially hazardous gases. The design also urges people to care for the vision impaired and provide them with general knowledge and more reliable help in their lives. The device can be exhibited or applied in schools for the blind, urban public spaces, and exhibitions concerning barrier-free design. It is firmly believed that the device would make more people aware of the current situation of people with visual impairment and the development of special education.
5. Conclusion
The integration of technology and art makes more and more interactive installation art, and makes it more expressive and influential. What’s more, application of Processing in installation art allows artists and designers to break through the limitations of expression tools and have ampler creative possibilities. The employment of technology in installation art not only optimizes the audiovisual experience of the installation art, but also creates a higher aesthetic value for the installation art. The trend of crating art with the help of technology is becoming more and more pervasive. With the continuous development of cultural and creative industries, the integration of technology and art will reach an unprecedented level and bring more value to the whole society.

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