Interactive Installation Exploring Conservation of Endangered Asian Elephants for Popular Science Art Design

Yi Qiu

Huazhong University of Science and Technology, Wuhan, Hubei, China

717547795@qq.com

Abstract. The Asian elephant, evaluated as an endangered species by the International Union for Conservation of Nature (IUCN), faces increasing threats due to population growth and habitat degradation. More and more Asian elephants migrate from protected areas to surrounding state-owned and communal forests, leading to frequent human-elephant conflicts in nearby villages. To mitigate these conflicts and preserve the elephants' original habitat, raising public awareness of the conservation of wild Asian elephants is imperative. Interactive installation art design integrates interactivity, artistry, and education, guiding individuals to reflect on their relationship with nature and society through interaction with the installations. Through immersive experiences, users become fully immersed in the narratives conveyed by the design, eliciting multiple emotional responses through kinetic effects, sound, and tactile sensations. Using "Elephant Roars Heard Just a Stone's Throw Away" as a design prototype, this paper focuses on the changes brought about by applying the Arduino open-source platform to interactive communication methods in modern museums and science communication platforms. It aims to promote the concept of shared nature among humans, ecological habitats, and wildlife, offering novel insights for integrating art design and mass communication in the future.

Keywords: Asian Elephant, Animal Protection Art, Arduino, Popularization Installation.

1 Introduction

1.1 Current Status of Research Based on the Endangered Status of Asian Elephants

Asian elephants are the largest extant animals on the Asian continent and the second largest land animals globally, typically around 2.9 meters tall and weighing up to 6 tonnes. They are primarily found in South and Southeast Asia, and select regions are Xishuangbanna Dai Autonomous Prefecture, Pu'er City, and Lincang City in Yunnan Province, China. However, due to habitat destruction and prolonged hunting and traf-

Y. Feng et al. (eds.), *Proceedings of the 4th International Conference on Internet, Education and Information Technology (IEIT 2024)*, Atlantis Highlights in Social Sciences, Education and Humanities 26,
https://doi.org/10.2991/978-94-6463-574-4_53

ficking by humans, the International Union for Conservation of Nature (IUCN) has assessed wild Asian elephants as an endangered species[1]. With the escalating population growth and habitat degradation, an increasing number of Asian elephants are venturing from protected areas into villages, leading to ever more severe human-elephant conflicts. In the study of endangered Asian elephants, experts have concentrated on restoring and enhancing their habitats. However, from a micro perspective, they have overlooked the elevation of public self-consciousness and environmental awareness. This oversight warrants further discussion and contemplation.

1.2 The Current Situation of Science and Art Design for the Endangered Status of Asian Elephants

For an extended period, the efforts towards Asian elephant conservation and publicity have been hindered by inconsistencies in the understanding of information transmission between the promoters and the target audience, resulting in inefficiencies in communication[2] .Additionally, the design and presentation of thematic publicity information need more involvement from relevant designers, leading to overly professional and uninteresting content devoid of visual appeal. Consequently, audiences exhibit indifference and aversion towards the information, further perpetuating ineffective communication methods. Furthermore, the predominance of singular publicity channels and media forms, coupled with a lack of understanding of the target audience's attention preferences, has resulted in a misalignment between the content and form of information dissemination, hindering the expansion of its impact. These issues undoubtedly contribute to the challenges faced in the scientific publicity, protection, and visual design communication surrounding Asian elephant conservation efforts.

Currently, mainstream widespread science communication remains entrenched in conservative and traditional modes. However, the channels and methods through which potential target groups access information are diverse, as are their preferences for receiving information. This necessitates designers to organize and design specific content that caters to the majority's interests. Generally, the prevailing method for the public to access information leans towards the combination of audio and video, facilitating quick and relatively effortless consumption of information, with video-based memory being more robust and identifiable. Therefore, in advocating for the popularization of science regarding endangered Asian elephants, it is recommended to combine audio-visual and tactile sensing in both the content and presentation, enabling a vivid, engaging, and artistic portrayal[3]. This approach can effectively stimulate the curiosity and interest of the target audience, facilitating active engagement with and understanding of the information.

Secondly, the selection of communication content also demands meticulous planning and targeting. It is essential to adopt a "people-centric" approach, starting from the target audience's requirements. Different information content and presentation styles should be chosen depending on the varying reading habits and media channels[4].

2 Materials and Methods

This design presents an interactive installation centered around protecting endangered Asian elephants. Utilizing Arduino programming technology, the work seamlessly integrates gesture interaction, sound interaction, and light interaction into a narrative that highlights the challenges faced by Asian elephants and the importance of assisting. As individuals enter the installation, they are immersed in scenarios depicting conflicts and accidents between Asian elephants and villagers, offering a firsthand perspective on the plight of wildlife. Extensive research and GIS data collection have enabled the team to identify areas of intense human-elephant conflict, providing a factual foundation for the installation's narrative. The combination of visual and auditory stimuli within the installation captivates viewers, drawing them into the experience of hearing the distant calls of the elephants and witnessing their struggles. The innovative aspect of the design lies in incorporating 5 buttons, each corresponding to a different low-intervention method for protecting Asian elephants in the wild. As shown in Figure 1. By engaging with these buttons, participants actively contribute to resolving conflicts and safeguarding wildlife. Through dynamic interactions and experiential learning, participants gain knowledge about wildlife conservation and develop a deeper emotional connection with the issues at hand. This transformative journey—from tension and curiosity to emotional resonance and knowledge absorption—ensures that the impact of the installation extends beyond mere information dissemination, leaving a lasting impression on the audience.

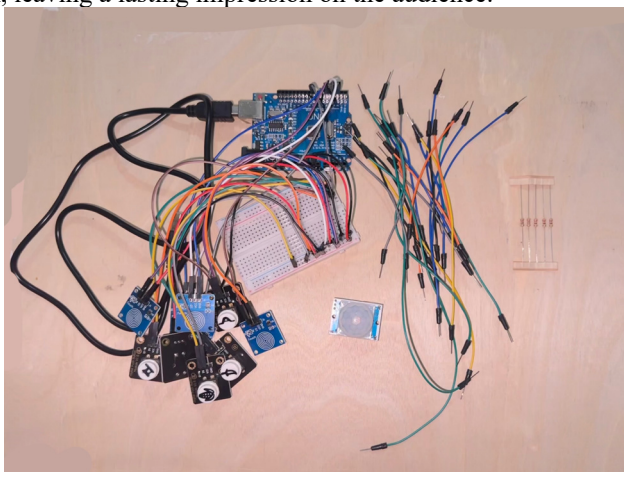

Fig. 1. Preparation of materials for the pre-installation

3 Preliminary Preparations

The entire installation achieves interaction between the device and the user through the combination of three components: buttons, sensors, and an external display, facilitated by interactive programming software and physical maps. As shown in Figure

2.Three types of sensing methods are utilized: touch sensing, infrared sensing, and physical pressure sensing. These sensors detect biological signals to trigger the dynamic display of different land parcels, creating an interactive effect both within and outside the screen.

The interactive experience is initiated and activated as the user approaches the map. Touching the button signifies the commencement of the interactive experience. The main switch controls both the external screen and the touch sensors. Upon touching the buttons, the sensors collect tactile and auditory inputs, which are then transmitted to the Arduino. Through digital technology, the Arduino visualizes the information regarding the pathway interaction for animal protection. This setup facilitates interaction and mutual assistance between the user and the wild Asian elephant depicted on the screen. As the user touches the corresponding buttons, the elephant on the screen engages in rescue activities triggered by the user, enabling it to evade human harm and environmental threats.

```
void loop() {
  irSensorOutput = digitalRead(irSensorPin);   //
  if (irSensorOutput   == HIGH) {   //
    Serial.println("B");       //
    delay(2000);
  //
  touch1 = digitalRead(2);
  touch2 = digitalRead(3);
  touch3 = digitalRead(4);
  touch4 = digitalRead(5);
  touch4 = digitalRead(6);
//
  if(touch1 == true){      //
  Serial.println("C");      //
  delay(10000);
}else if(touch2 == true){
Serial.println("D");     //
delay(10000);
}else if(touch3 == true){
Serial.println("E");     //
delay(10000);
}else if(touch4 == true){
Serial.println("F");     //
delay(10000);
}else if(touch5 == true){
Serial.println("G");     //
delay(10000);
}
else{
Serial.write(" ");
delay(1000);
  }

buttonState = digitalRead(pushButton);    //
    if(buttonState == HIGH){    //
      Serial.println("H");     //
      delay(32000);
      }

  }
}
bool touch1;     //
bool touch2;     //
bool touch3;     //
bool touch4;     //
bool touch5;     //

int irSensorPin = 7 ;              //
bool irSensorOutput;               //

int pushButton = 8;

int buttonState;

void setup() {
  Serial.begin(9600);
  //
  pinMode(2, INPUT_PULLUP);
  pinMode(3, INPUT_PULLUP);
  pinMode(4, INPUT_PULLUP);
  pinMode(5, INPUT_PULLUP);
  pinMode(6, INPUT_PULLUP);

  pinMode(pushButton, INPUT);
  pinMode(irSensorPin, INPUT);

    Serial.write("A");     //
}
```

Fig. 2. Arduino code display

4 "Elephant Roars Heard Just a Stone's Throw Away" Design Process and Result Presentation

4.1 Project Design Positioning

The normal life of wild Asian elephants necessitates a certain amount of habitat. As the number of individuals within each population grows, the required range of activities also expands gradually. However, human activities persistently encroach upon the habitats crucial for the survival of elephant herds, exacerbating human-elephant conflicts. Over the years, nature has provided Asian elephants with abundant food sources. Traditionally, Asian elephants primarily consumed plants from the gramineous and palm families, rarely venturing into farmlands for crops. However, environmental changes in the past two decades have led to an increasing frequency of wild Asian elephants venturing into farmlands to consume crops planted by humans. This shift in their diet further intensifies the conflict between humans and elephants. Elephants are among the most dangerous herbivore species, and their intrusion into hu-

man communities results in severe damage and injuries, often leading to fatalities, injuries, and widespread panic among residents (Parker et al., 2007)[5].

After years of research, scholars have recognized that human-elephant conflict is unavoidable and can only be mitigated to a certain extent (Hoare, 2015)[6]. However, the explosion in human population, excessive cultivation of cash crops, and deforestation of natural vegetation have exacerbated the fragmentation of suitable habitats for Asian elephants, dividing and fragmenting them into multiple habitat patches (Gross, 2018)[7]. Repairing habitat fragmentation for Asian elephants has thus become a primary step in mitigating human-elephant conflict. The use of controlled burns or selective logging in secondary successional forests to restore the growth of natural forests, artificial enhancement of food guidance, assistance for Asian elephants in opening up sentinel ponds, and establishment of stable ecosystems represent the actual original suitable habitats for Asian elephants.

In addition, traditional methods of mitigating human-elephant conflict include isolation and displacement, utilizing techniques such as firecrackers and burning to disturb Asian elephants, constructing elephant-proof fences, and incorporating additional measures such as electrification to augment their deterrent effect. Regarding biocontrol measures, African bees have proven effective in deterring African elephants (Vollrath & Douglas-Hamilton, 2002)[8]; furthermore, the immediate effectiveness of chili pepper-based deterrents against elephants is notable.

4.2 Programming Implementation

In alignment with the low-intervention ecological conservation measures for wild Asian elephants discussed earlier, the team devised the following illustrative aid for educational purposes. At the project's outset, users are presented with a map depicting human-elephant conflicts in East Asia, specifically in Xishuangbanna, Yunnan Province, China. This map delineates human settlements, elephant habitats, and conflict zones. As individuals approach the screen, the tranquil map changes dynamic; the border region between humans and elephants becomes unsettled and agitated. Additionally, the sounds of humans and elephants grow increasingly intense, with tearing and roaring becoming more pronounced, leading to the entire map shaking and trembling. As shown in Figure 3.

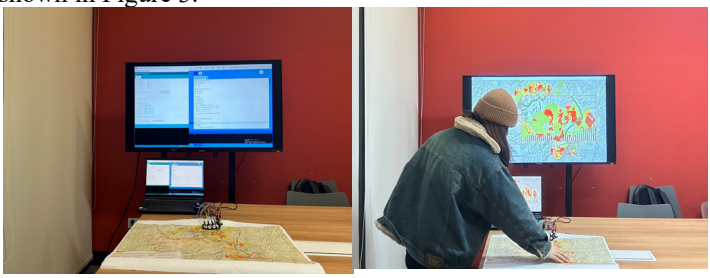

Fig. 3. Operation process display

When users touch elephants in different conflict zones on the map, a sound effect is triggered, blending the sound of human footsteps with the tearing sound of elephants. Different interactive icon buttons will also appear at the top of the map. Touching these buttons will activate corresponding protective measures:

1) Clicking on the torches and axes will display the message "Eliminate secondary successional forests, open up forest windows, increase light, and promote habitat plant growth".

2) Clicking on the whistle pond will display "Hydrate and salt passing elephants."

3) Clicking on corridors will display "Guide elephants to habitable addresses, avoiding villages and people".

4) Clicking on maize will display "Creating a natural cycle of food sources to provide stable shelter for elephants."

5) Clicking on chilli and beehive will display "Blocking elephants' access to villages and preventing human-elephant conflict".

After each icon is clicked, the corresponding conflict area on the screen will gradually zoom in accordingly, transforming into the indicated dynamic image acting on the elephants and the conflicting villagers. This process helps the shaking map gradually calm down, and the elephant's whining sound decreases.

Using an interactive physical implementation pathway, the sounds of the villagers and the herd of Asian elephants are mapped onto a digital screen through visualization. When the motor is running, it acts on the movement of the digital map and controls the sound engine by reading the touch signals to stabilize the sound. This not only represents the restoration of one piece of the natural habitat but also signifies another peaceful coexistence between humans and wild Asian elephants.

Finally, after the user learns about the low-intervention conservation measures for wild Asian elephants one by one, the noisy sound effects slowly disappear, returning to the peaceful sound of insects and birds chirping. The screen displays a peaceful scene where humans and elephants live happily in their residences.

5 Result & Discussion

After conducting preliminary simulations and tests, we invited many students to experience this device and collected 100 post observation questionnaires about the device. The specific survey results showed:

Fig. 4. Questionnaire data analysis

1) Most people have a habit of caring about rare animals (65.69%), and only a few people do not have this habit.

2) 74.51% of the participants in the survey expressed willingness to contribute to the protection of rare animals, with relatively fewer being very willing.

3) 67.65% of people believe that the sound of elephants within reach can help them better understand the conservation methods of wild Asian elephants and improve their understanding of their conservation.

4) According to data analysis, after experiencing the device, 73.53% of people expressed willingness to join the ranks of protecting wild Asian elephants, indicating that the device experience has had a positive impact on their willingness to participate in protecting wild Asian elephants.

5) Overall, most people are willing to recommend this art popularization installation to others. As shown in Figure 4.

Through this survey, we found that most of the respondents hold a positive attitude towards rare animal protection, and have a high degree of recognition and recommendation of the art popularization installation of "the sound of the elephant at hand". Based on the research results, it is suggested to strengthen the promotion of similar art science popularization devices in the publicity of rare animal protection, so as to attract more people's attention and participation in the protection work.

6 Conclusion

With the evolution of global ecological conservation concepts and the continual advancement of interactive sensing technology, researching and protecting endangered wildlife will significantly expand into new communication realms by integrating programming technology[9].Moreover, the secondary fusion with digital art will infuse fresh vigor and vitality into its presentation. As an intelligent hardware design and development platform, Arduino can effectively engage bystanders, who constitute the target audience, to participate in the forefront of advocacy efforts actively[10]. This innovative fusion not only facilitates the comprehensive advancement of wildlife protection efforts worldwide but also heralds a new era of digital transformation and integration within industries in the forthcoming innovative age, inspiring numerous designers to contribute to the wave of design innovation.

References

1. Zhu Gaofan. Experimental Research on Habitat Restoration and Food Source Construction for Asian Elephants [D]. Yunnan University, 2022. DOI: 10. 27456/ d. cnki. gyndu. 2022. 002878.
2. Xu Peipei. Popularization and Protection of Rare Wildlife in Yunnan and Its Visual Design [D]. Yunnan Arts Institute, 2017.
3. Ou Jing, Wu Yufan. Research on Creative Materialization Assistance Tools for Intelligent Interaction Design [J]. Design, 2024, 37(03): 14-18. DOI: 10.20055/j.cnki.1003-0069. 00 1505.
4. Xuan Yixiao. Research on immersive multimedia interactive art installation based on synesthesia and synesthesia [D]. Xian university of science and technology, 2023. DO: 10.27398/, dc nki. Gxalu. 2023.000338.
5. Parker G E, Osborn F V, Hoarse R E. Human-elephant conflict mitigation: a training course for community-based approaches in Africa (Participant's Manual).Elephant Pepper Development Trust, Livingstone, Zambia, and IUCN/SSC AfESG, Nairobi, Kenya, 2007.
6. Hoare R E.Lessons from 20 years of human–elephant conflict mitigation in Africa[J].Human Dimensions of Wildlife, 2015, 20(4): 289-295.
7. Gross E M, Lahkar B P, Subedi N, et al.Seasonality, crop type and crop phenology influence crop damage by wildlife herbivores in Africa and Asia[J].Biodiversity and Conservation, 2018, 27(8): 2029-2050. Vollrath F, Douglas-Hamilton I.African bees to control African elephants[J].Naturwissenschaften, 2002, 89(11): 508-511.
8. Wei Wen, Tang Anqi. Evaluation of Asian elephant habitat network in Xishuangbanna Prefecture based on InVEST-graph theory model[J/OL].Acta EcologicaSinica,2024,(12):1-13[2024-04-23].https://doi.org/10.20103/j.stxb.202308091718.
9. Tang Zhuan. Research on Interactive Narrative Design based on open source hardware and art coding [D]. Central China normal university, 2023. DOI: 10.27159 /, dc nki. Ghzsu. 2023. 000189.
10. Fan Wanyi. Exploration of New fields: The innovative application of Mind+Arduino Uno in Public art [J]. Artist, 2022,(12):18-20+84.