



# Design of an Interactive Science Installation for Young Children Based on Urban Bird Conservation

Siyuan Wang<sup>(✉)</sup> 

Donghua University, 1882 West Yan'an Road, Shanghai, China  
876258887@qq.com

**Abstract.** Rapid economic development has brought about a series of environmental problems in the inevitable trend of global urbanization. Based on the current situation that urban birds are facing a survival crisis due to the reduction of green spaces, I have combined art with the Arduino and TouchDesigner programming languages to design an interactive science device based on the story of “All Birds Paying Homage to the Phoenix”, in order to help preschool children, develop a sense of concern for the urban environment and the survival of animals.

**Keywords:** Interactive installation · animation · children’s education · urban green space · urban birds

## 1 Introduction

In China, urban green spaces are under-utilised and tend to be islanded and fragmented, which has directly led to the loss of urban homes for wildlife, mainly represented by birds. It has become increasingly important to integrate environmental awareness into the education process. However, the fact remains that there are still many gaps in the environmental education provided to children in most educational institutions. With this in mind, I combined art with Arduino and Touch Designer programming language to design an interactive science installation with “All Birds Paying Homage to the Phoenix” as the main story to help preschool children build up the concept of caring for the urban environment and animal survival, so that they can become part of environmental protection.

## 2 Current Status of Researches on Urban Bird Survival Crisis

### 2.1 Urbanization Threatens the Survival of Birds

Urbanization is an inevitable trend of human social progress and a concrete manifestation of human civilization development. According to the World Cities Report 2022: A Vision for the Urban Future, the pace of urbanization in the world will continue to accelerate in the next 30 years, and it is expected that the world urbanization rate will increase from 56% in 2021 to 68% in 2050. The rapid expansion and development of cities also brings problems such as air pollution, water shortage, noise pollution, traffic congestion, and deterioration of security.

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According to IUCN data, the condition of the world's birds has been deteriorating since the first comprehensive assessment in 1988, with the direct and indirect impacts of human activities being the most important influencing factors. The main threats currently facing birds are habitat threats, biological invasions, climate change, and illegal hunting. As one of the main habitats of birds, urban green areas are gradually islanded and fragmented due to urbanization, which has significantly changed the habitat environment of birds and had a serious impact on the survival of urban birds, resulting in the development of urban bird species and numbers in a negative direction. For example, some common insectivorous birds, ground-nesting and tree-hole-nesting birds, etc., have shown a tendency to decrease in species and number with the deepening of urbanization [1].

## **2.2 The Importance of Birds to Cities**

In terms of urban ecology, birds have a very important role in the eradication of pests and vermin and in maintaining the seed dispersal and renewal functions of urban forest patches, while they are sensitive to habitat composition and environmental changes and are important indicator species of urban ecology and urban biodiversity [2].

In terms of human life, ornamental birds have functions for humans such as relaxation and emotional entertainment, and the sound of birdsong has a positive impact on emotional and psychological recovery. At the same time, bird watching is one of the quickest and most effective ways for children to get in touch with nature, and it has important significance in ecological education.

## **2.3 The Importance of Raising Public Awareness of Bird Conservation**

Though bird conservation in China started late but is developing fast, nowadays. However, there are still many gaps and problems that need more attention and social resources. According to the Bird Conservation Industry Scan Report published by ABC Good Society Consulting, the public has a simple understanding of the importance of bird conservation and some basic knowledge. The level of participation in bird conservation activities is low, with only 1.7% of the public having taken part in bird conservation in depth.

# **3 Early Childhood Environmental Education Science Interactive Device**

## **3.1 The Importance of Environmental Education for Young Children and Existing Problems**

Environmental protection needs to fundamentally improve the overall quality of people. To improve the quality of people's environment, we need to start from environmental education. From kindergarten to university, environmental education has always been an important part of quality education, and the success or failure of environmental education directly affects the future environmental condition of the country. Compared with junior high school and higher education, the number of papers related to

preschool environmental education is small, and the same problems of low attention and lack of implementation of environmental education in kindergartens were found in the desktop research. Strengthening environmental education in early childhood can fundamentally improve the overall quality of the nation's population and indirectly spread conservation-related knowledge to their parents to achieve increased public awareness of environmental concerns.

Compared with global environmental education, environmental education in China is still in the exploration stage. There are problems such as inadequate environmental education system, imperfect environmental education content, and single form of environmental education. There are also problems in environmental education for young children, such as superficial environment creation, lack of connotation, too rigid environment, which is not conducive to children's participation, etc. [3].

### 3.2 The Effectiveness of Science-Based Interactive Devices for Environmental Education for Young Children

The science interactive device is an interactive technology that uses computer hardware as a carrier and media such as video and sound devices for the purpose of science popularization. The interactivity and immersion of interactive science installations can remedy the problems of low participation and single form in environmental education for young children, attracting children to participate with interesting interaction and inspiring them to think with rich visual feedback, which can help children's knowledge to influence them implicitly and thus enhance their awareness of environmental protection.

For example, the interactive exhibit "Life in the Forest" (Fig. 1) features a nature center with interactive physical equipment and a projection wall, creating an explorable ecosystem play space that guides children to actively discover previously unnoticed natural laws. The interactive experience was energetic, with colorful feedback images and clear, easy-to-understand messages, and received enthusiastic feedback from the participants.



**Fig. 1.** Interactive exhibition "Life in the Forest"

## 4 “All Birds Paying Homage to the Phoenix” Interactive Installation for the Conservation of Urban Birds

### 4.1 Pre-creation Ideas

#### 4.1.1 Introduction to the Story

Using the traditional Chinese story “All Birds Paying Homage to the Phoenix” as a creative vehicle, the story is adapted from the ballad “The phoenix was sick in the mountain, and a hundred birds came to ask about its fortune”.

The phoenix has been living in harmony with human beings for a hundred years, but with the increasing industrialization of human beings, the original habitat is continuously occupied by the city, and the phoenix is gradually falling into a deep sleep because it is displaced and homeless in the crowded and gray city. When birds outside the city learned this news, they rushed to the city from all directions to visit. But the city is full of tall buildings and there is no green space to land, so the birds can only hover wearily among the buildings. The player takes the role of a human and builds a green space for the city. With the green space in the city, birds will have a place to land and roost, and new bird life will be nurtured. As the number of green spaces in the city increases, the number of white birds produced increases, and the urban environment gradually improves. Eventually, in a beautiful, green urban environment, the phoenix awakens and strolls leisurely over the city, and the birds regain their vitality.

#### 4.1.2 Creative Spot

Tree block placement as an interactive way for young children to increase their urban green space. Blocks are one of the common toys for young children. By starting with the game in a way familiar to children, it can reduce children’s resistance to exploring unfamiliar things, bring them closer and attract them to play; and the blocks have a high degree of freedom, which can better show the image interaction effect and improve the fun.

The main way to attract children to play is to use motion tracking and image interaction. Children are active and curious, so the camera tracks their hand movements and projects the release of the flying white birds, allowing them to interact with the images in time and provide feedback, increasing the immersion and freedom in the interaction process.

The traditional Chinese shadow play is incorporated into the animation, and traditional phoenix and bird elements are added to the design of the phoenix and hundred birds characters. The shadow has the characteristics of rich and full colors and interesting and diverse forms, which meets the characteristics of young children’s preference for bright colors and rich imagination, and is more attractive to the young children group.

### 4.2 Preliminary Preparation

The whole device realizes the interactive experience between the device and young children through the overall layout of three components: projector, RGB camera and tree blocks through interactive programming software and physical external hardware. Two

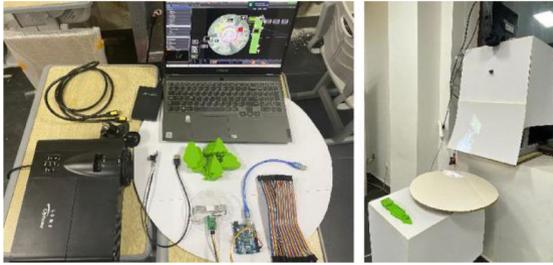


Fig. 2. Preliminary preparation

sensing methods, motion capture and weight sensing, are used. By capturing the motion to analyze the picture color, track the projection animation, and trigger the animation of each scene of the device to unfold by transmitting the weight of the blocks to achieve the interactive effect of movement, blocks and images.

According to the hand size of 3–6 years old children, experiments on the number of blocks and the common number of times children take them each time, and finally choose 12 tree blocks with a weight of 10 g and a height of 4 cm as the components of the device; according to the average height of this age, the game table is set to 45 cm, which is convenient for children to place blocks and observe the animation changes put on the table.

### 4.3 Technical Implementation

#### 4.3.1 Programming Platform

Touchdesigner visual programming platform developed by Derivative Canada is a node-based visual programming software in the field of new media interaction, for real-time interactive multimedia content, through external screen controls, MIDI (Musical Instrument Digital Interface) data and other input devices, so that they act as modular components in the project to perform operations on images, with features such as interoperability, high integration, real-time, and data visualization [4].

Arduino Electronic Interactive Platform A microcontroller-based human-computer interactive product development platform with highly modular characteristics, widely used in electronic system design and interactive product development [5].

#### 4.3.2 Programming Implementation

At first, the atmosphere of the projected animation is gray, the city buildings are spinning fast, and the phoenix is curled up in the only environment available, gradually falling asleep. The hundreds of birds that come to visit are unable to climb over the cascading

skyscrapers, and their flight becomes more and more exhausted. The flawlessly white birds fluttering by the blocks of trees on the side of the projection. A camera is attached to the top of the installation to capture the motion movement within the camera range, but when someone picks up one of the tree blocks, the Touchdesigner platform analyzes the camera feed, locates and tracks its movement, thus animating the white bird to follow the hand of the person placing the block. The troubled phoenix, the gray urban environment, the white bird due to interaction, attracts the person to participate in placing the green blocks.

When a person places the first block, the weight sensor under the desktop receives the weight information and transmits it to the arduino platform. The arduino platform recognizes it and sends the set animation jump signal to the Touchdesigner platform, thus jumping the picture. The projection screen appears a small green area, the urban environment becomes slightly brighter, the breathing action of the phoenix becomes bigger, and the flight of the hundred birds becomes relatively easy. However, the white bird flying out of the green area of the picture fleetingly, followed by the polluted bird, the number of green area blocks is still not enough.

When the fourth and eighth blocks were placed, the urban environment and the state of the birds in the picture kept turning better.

When all the trees are placed, the phoenix gradually wakes up and the urban environment returns to a bright and fresh state. The awakened phoenix waved its colorful feathers, accompanied by hundreds of birds, strolling around the city.



**Fig. 3.** Touchdesigner motion tracking animation

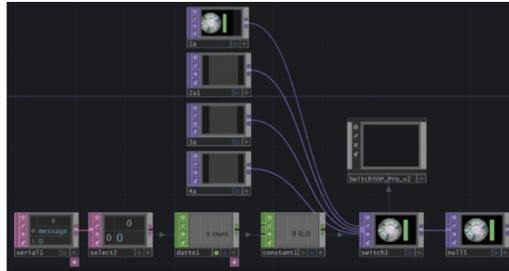
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```

extern unsigned long HX711_Read(void);
extern long Get_Weight();
///Define variables
float Weight = 0;
int HX711_SCK = 2;
int HX711_DT = 3;
long HX711_Buffer = 0;
long Weight_Maopi = 0, Weight_Shivu = 0;
#define GapValue 405
void setup()
{
  //Initialize the two io ports of HX711
  pinMode(HX711_SCK, OUTPUT);
  pinMode(HX711_DT, INPUT);
  Serial.begin(9600);
  Serial.print("Welcome to use!\n");
  delay(3000);
  Weight_Maopi = HX711_Read();
}
void loop()
{
  Weight = Get_Weight();
  Serial.print(Weight);
  Serial.print(" g\n");
  if(Weight < = 10){
    Serial.println("0");
  }else if(Weight > = 10 && Weight < = 40){
    Serial.println("1");
  }else if(Weight > 40 && Weight < = 80){
    Serial.println("2");
  }else if(Weight > 80 && Weight < = 120){
    Serial.println("3");
  }
  else{
    Serial.println("nothing");
  }
  delay(2000);
}
long Get_Weight()
{
  HX711_Buffer = HX711_Read();
  Weight_Shivu = HX711_Buffer;
  Weight_Shivu = Weight_Shivu -
  Weight_Maopi;
  Weight_Shivu =
  (long)((float)Weight_Shivu/GapValue);
  return Weight_Shivu;
}
unsigned long HX711_Read(void)
{
  unsigned long count;
  unsigned char i;
  digitalWrite(HX711_DT, HIGH);
  delayMicroseconds(1);
  digitalWrite(HX711_SCK, LOW);
  delayMicroseconds(1);
  count = 0;
  while(digitalRead(HX711_DT));
  for(i = 0; i < 24; i++)
  {
    digitalWrite(HX711_SCK, HIGH);
    delayMicroseconds(1);
    count = count << 1;
    digitalWrite(HX711_SCK, LOW);
    delayMicroseconds(1);
    if(digitalRead(HX711_DT))
      count++;
  }
  digitalWrite(HX711_SCK, HIGH);
  count ^= 0x800000;
  ///
  delayMicroseconds(1);
  digitalWrite(HX711_SCK, LOW);
  delayMicroseconds(1);
  return(count);
}

```

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**Fig. 4.** Touchdesigner signal reception and bounce drawing



**Fig. 5.** Device implementation

## 5 Conclusions

The installation is based on the story of “All Birds Paying Homage to the Phoenix” and interacts with children through tree blocks and animated images, aiming to provide children with more immersive and interesting environmental education, to inspire them to care about the survival of urban birds and urban ecological environment, and thus join the team to build a green city. In addition, the installation demonstrates to the public the mindset of combining technology, traditional culture and science education for young children, providing a new way of traditional environmental education forms and cultural heritage. In the future, there will be more science education integrated into interactive installation art-related forms. The natural integration of technology and art by writing codes to express social issues will also become the development direction of science education in the context of rapid technological development.

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