IDC School of Design
अभिकल्प विद्यालय
IIT Bombay

Project 3

# *Interactive Installation for Zoological Spaces*

Guide

***Prof. Ravi Poovaiah***


Submitted by

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22M2248 | Interaction Design

M.Des | IDC School of Design | IIT Bombay

(2022 - 24)

# Declaration

I, Anjanesh Indranil, hereby declare that this project report, titled "Interactive Installation for Zoological Spaces," is entirely my own work. All the information, data, and research presented in this report are genuine and have not been submitted in any other form for academic credit or publication. Any external sources used for reference or citation are properly acknowledged in the bibliography section. I take full responsibility for the content, findings, and conclusions presented in this report.

Anjanesh Indranil

22M2248 | Interaction Design

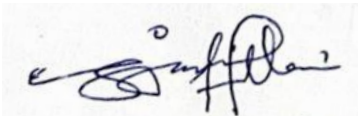
M.Des | IDC School of Design | IIT Bombay (2022 - 24)

# Approval Sheet

Interaction Design Project 3 titled "**Interactive Installation for Zoological Spaces**" (by Anjanesh Indranil, roll number 22M2248) is approved for partial fulfilment of the requirement for the degree of 'Masters in Design' in Interaction Design at IDC School of Design, Indian Institute of Technology, Bombay.

Guide: 

Chairperson: 

Internal Examiner: 

External Examiner: 

# Acknowledgement

I really want to express how thankful I am to Prof. Ravi Poovaiah for his constant guidance, support, and encouraging words throughout this project. Huge thanks also go to my respected teachers, Anirudh Joshi, Jayesh Pillai, Vidya Appu, and Ravi Poovaiah, for their keen interest in my work and their valuable advice during the stage presentations that challenged me to think more deeply and improve the quality of my project.

I'm grateful to my classmates for their helpful feedback and creative ideas during the early stages of my project. A big thank you to my friends, Tarun and Yash, for their exceptional support and guidance in bringing the practical aspects of my installation to life. My heart is full of gratitude towards my parents and friends for their endless motivation and strong support throughout this journey.

I also want to acknowledge the contributions of everyone who offered me insights, critiques, and encouragement along the way. Their perspectives have been immensely beneficial in broadening my understanding and enhancing my work. This project has truly been a collaborative effort, and it would not have reached its full potential without the collective wisdom and support of all involved.

As I move forward, I am committed to upholding the trust and support so generously given by everyone mentioned. It's my sincere hope to not only meet but exceed the expectations placed on me and to reflect the collective effort of our shared journey in the success of this project.

# Abstract

This project focuses on creating a fun, interactive installation for zoological spaces. The main goal is to educate visitors about animals that are hard to see or learn about in their natural habitats. By engaging with this installation, people can learn fascinating facts and stories about various species, emphasizing the importance of leaving wildlife in their natural surroundings. The inspiration for this project came from visiting many zoos, where I saw what works well and what's missing in current educational efforts.

The process started with gathering information directly from these zoological spaces. Afterward, all the findings were carefully analyzed to design a solution that fills in the gaps left by existing installations. This project builds on previous efforts in the field by addressing overlooked aspects, proposing a more engaging and informative approach. It aims to create an enjoyable experience that shares interesting stories about birds and their lifestyles, making learning feel like an adventure.

Ultimately, the project not only aims to enhance visitors' understanding and appreciation of wildlife but also to encourage a deeper respect for animals' natural environments. Through this interactive installation, I hope to inspire a change in how people view and interact with the natural world, fostering a more conservation-minded public.

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# Introduction

## *Motivation*

The primary motivation behind the project is the crucial role wildlife plays in maintaining the ecological balance and health of our planet. Every species, from tiny insects to majestic elephants, contributes uniquely to ecological harmony. The project is driven by the urgent need to change human behaviors and actions to protect wildlife, given their significant contributions to the ecosystem and, indirectly, to human survival.

## *Background*

Historically, wildlife thrived in their natural habitats, contributing to the overall health of the ecosystem without human disturbance. However, human activities such as deforestation, pollution, and wildlife trafficking have severely impacted these natural habitats. This has led to the endangerment and, in some cases, the extinction of many species. The disruption of natural habitats not only threatens the survival of these animals but also the ecological balance, which could have unforeseen effects on human existence.

## *The Problem*

The problem is the current human interaction with wildlife and their habitats, which has put many species at risk of extinction. The alarmin reduction in wildlife numbers highlights a pressing need for a shift in human behavior and actions towards conservation and sustainable practices. The project aims to address this problem by creating an educational interactive installation for zoological spaces to bridge the gap between humans and often overlooked or inaccessible species. The goal is to bring the stories of these species to the forefront, thereby inspiring a change in perception and behavior towards conservation and the protection of wildlife.

This structure clearly delineates the motivation for the project, provides the necessary background on the relationship between humans and wildlife, and identifies the specific problem that the project aims to solve.

## *Zoological Spaces*

Zoological spaces are complex facilities that cater to a diverse range of animal species, providing them with habitats that mimic their natural environments. These spaces blend conservation efforts, educational outreach, and recreational opportunities to create a unique experience for visitors.

They also serve as educational platforms, offering interactive exhibits, guided tours, and informational displays to increase public awareness about biodiversity and the importance of preserving natural habitats.

## *Target Users*

This project targets visitors to zoological spaces, which include a broad demographic spectrum. Narrowed down to these categories:

1. **Families with Children:** Parents seeking educational experiences for their children can use the installation to teach them about wildlife conservation.

2. **Students and Educators:** School groups visiting zoos for educational trips can benefit from the interactive installation as a learning tool that complements their curriculum on ecology and conservation.

3. **Wildlife Enthusiasts:** Individuals with a keen interest in wildlife and conservation efforts can deepen their understanding and knowledge of various species and their ecological roles.

4. **General Public:** Casual visitors to zoological spaces who may not have a strong background in wildlife conservation can gain insights and develop an appreciation for the importance of conserving wildlife.

## *Objective*

The project's primary objective is to educate and inspire a shift in perception and behavior towards wildlife conservation through an interactive installation. The specific goals include:

1. **Educational Engagement:** To provide engaging and informative content that highlights the knowledge about each species and the ecosystem and our lives, thereby increasing awareness about wildlife conservation.

2. **Behavioral Change**: To inspire visitors to appreciate the intricate connections between wildlife and humans and understand the critical role each species plays in maintaining ecological balance, which may lead to a change in behavior towards more sustainable living and conservation efforts.

3. **Conservation Support**: To encourage actions that support the survival and well-being of wildlife, fostering a deeper appreciation for wildlife and its significance to the health of our planet.

4. **Bridging the Gap**: To bridge the gap between humans and often overlooked or inaccessible species by bringing their stories to life, making the concept of conservation more relatable and urgent to the general public.

5. **Future Generations**: To ensure that the message of coexistence and the importance of wildlife conservation is passed on to future generations, emphasizing the need for sustainable practices that protect the health of our planet and its inhabitants.

# Research Work

## *Approach*

For the primary and secondary research components of this project, visits were conducted to various zoological spaces, during which direct observations and interactions were made to gather firsthand information. Additionally, a mind map was developed to systematically organize thoughts, ideas, and data collected from these visits. The research also included an extensive review of existing interactive installations within such environments. This comprehensive approach was employed to understand the current landscape of educational and conservation efforts in zoological settings and to identify potential areas for innovation and improvement in our project.

## *Primary Research: Visit to Zoological Spaces*

Primary research involved a series of methodical steps aimed at gathering first hand information directly from the source, i.e, zoological spaces. Sites that were visited are: ***Veermata Jijabai Bhosale Botanical Udyan*** and ***Zoo, Sanjay Gandhi National Park and Thane Creek Flamingo Sanctuary***. This approach was pivotal in understanding the interaction between visitors and the educational content provided by these institutions, as well as gauging the effectiveness of current installations in conveying conservation messages. Here's an elaboration on the primary research process:

1. **Direct Observation:** Observational studies were conducted to note visitor behavior and reactions to different types of exhibits and information displays. Attention was paid to which installations captured interest, facilitated learning, and encouraged further exploration of wildlife conservation topics. Observations were also made on the informational content provided, its accessibility, readability, and ability to engage different age groups and learning styles.

2. **Interaction with Zoo Staff and Conservationists:** Discussions with zoo educators, staff, and conservationists provided professional insights into the goals, challenges, and successes of current interactive installations and educational programs. These interactions offered valuable perspectives on the operational aspects of creating and maintaining engaging educational content and the impact of these efforts on conservation awareness and behaviour change.

## *Mind Mapping*

Throughout the research phase, mind mapping was utilized as a tool to organize observations, insights, and data collected from various sources. This facilitated the identification of patterns, gaps, and opportunities for innovation in the development of the project's interactive installation.

*link to full mind map>>*

## *Secondary Research: Literature Review*

The global significance of wildlife in maintaining ecological balance and biodiversity is universally recognized as from the smallest insects to the largest mammals, play critical roles in their ecosystems contributing to processes like pollination, seed dispersal, and the regulation of other animal populations. Each species has adapted to specific ecological niches. However, this diversity is under threat from human activities, including habitat destruction, pollution, climate change, and illegal wildlife trafficking. These pressures have led to a significant decrease in many populations, pushing numerous species towards endangerment or extinction. Conservation efforts worldwide aim to address these challenges, focusing on both in-situ (conservation in natural habitats) and ex-situ (conservation in artificial settings such as zoos) strategies to preserve biodiversity.

India, with its 328.7 million hectares of land mass, represents 2.4% of the world's total area but is home to about 8% of the world's biodiversity, making it one of the 12 mega-biodiversity countries. This rich biodiversity includes 350 species of mammals, 1,224 species of birds, 408 species of reptiles, 197 species of amphibians, 2,546 species of fishes, 57,548 species of insects, and 46,286 species of plants. The country's unique geographical and climatic conditions have fostered a wide variety of habitats, from the high-altitude Himalayan ranges to the lush rainforests of the Western Ghats and the extensive coastline, which support a diverse array of flora and fauna.

India's commitment to wildlife conservation is evident through its network of Protected Areas, which includes 106 National Parks, 573 Wildlife Sanctuaries, 115 Conservation Reserves, and 220 Community Reserves, covering a total of 1,75,169.42 km², or approximately 5.32% of the country's geographical area. These Protected Areas are crucial for conserving wildlife and their habitats, ensuring the survival of species and the ecological services they provide.

The National Wildlife Database Centre of the Wildlife Institute of India (WII) has been instrumental in developing the National Wildlife Information System (NWIS) on these Protected Areas. The NWIS serves as a comprehensive repository of information on the conservation status of animal species, biogeographic regions, habitat types, and the network of protected areas in India. It also offers extensive bibliographic support for wildlife research.

Moreover, in the concept paper on "In-situ ex-situ linkage - Conservation Breeding of Endangered Wild Animal Species in India" urgent need for conservation, detailing the history of forest and wildlife policies in India, the establishment of the Central Zoo Authority, and the strategic efforts towards conservation breeding is stated. It outlines the challenges faced in preserving wildlife, habitat loss and degradation, and highlights the government's initiatives in forest and wildlife preservation. It underlines the multifaceted approach India has adopted towards conserving its wildlife heritage, aiming not only to protect species within their natural habitats but also to ensure their survival through coordinated breeding programs in captivity.

## *Secondary Research: Studying existing installations*

In conducting secondary research on interactive installations worldwide, a comprehensive analysis was undertaken to understand the landscape of educational and conservation-focused exhibits in zoological spaces and museums. This research aimed to identify successful strategies and technologies that foster a deeper connection between visitors and wildlife conservation themes.

The study revealed a diverse array of interactive installations that leverage technology and design to engage audiences of all ages. Digital touchscreens, augmented reality (AR), and virtual reality (VR) experiences stand out as particularly effective in capturing visitor interest. These technologies allow users to immerse themselves in virtual habitats, interact with digital representations of species, and learn about conservation issues through interactive storytelling. For example, installations that simulate the experience of walking through a rainforest or diving into an ocean reef bring distant ecosystems to life, making the abstract concept of conservation more tangible and compelling.

Lastly, the effectiveness of these installations in promoting conservation awareness and action is often enhanced by storytelling. Narratives that center on specific animals, conservation heroes, or significant environmental events create emotional connections and a sense of urgency, driving home the message that every visitor has a role to play in wildlife conservation.

**Interactive animal models scattered in Bristol:**
Laboratory for Architectural Experiments – has won Watershed's Playable City Award 2015, and will be scattering kangaroo, dolphin, rabbit and beetle installations that respond to movement around Bristol. It includes animated dolphins, rabbits, kangaroos and beetles, which will be scattered around Bristol to encourage interaction with the city.

**Input:** motion/gestures
**Output:** visual
**dynamic, digital**

**Penguins Mirrorl:**
It comprised of 450 motorised stuffed animals that formed part of Daniel Rozin's solo show at the Bitforms Gallery in New York. Playing with the compositional possibilities of black and white, each penguin turns from side to side and responds to the presence of an audience. As they perform, the penguins' collective intelligence is puzzling, yet somehow familiar, as the plush toys enact a precise choreography rooted in geometry.

**Input:** motion
**Output:** visual
**dynamic, physical**

**Impossible Animals:**
In the summer of 2012, Lumo Play and the Manitoba Children's Museum are showcasing a 3 month special exhibit featuring interactive 3D animals. The animal is motion reactive (fish swim away, birds flock and drop feathers when touched, land animals follow the children and spawn hearts when they are touched).

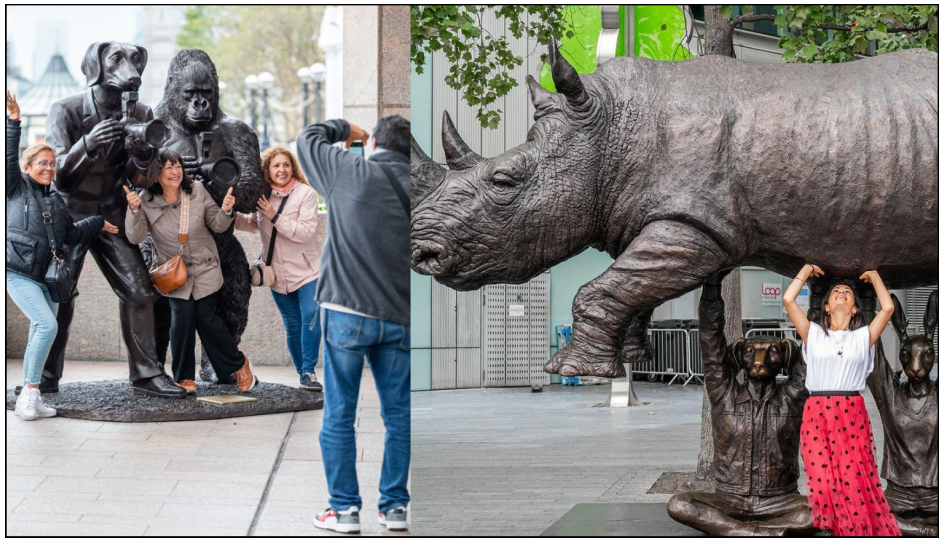
**Input:** motion/gestures
**Output:** visual
**dynamic, digital**


**Planet Ice: Mysteries of the Ice Ages:**
Moment Factory collaborated with the design team at the Canadian Museum of Nature (CMN) to enhance their "Planet Ice: Mysteries of the Ice Ages" exhibit. To create a new way for visitors to connect and engage, we integrated two touchless, interactive multimedia installations that encourage active participation.

**Input:** motion
**Output:** visual
**dynamic, digital**

**Great Ormond Street's interactive animal wall:**
Jason Bruges Studio has created an interactive 'distraction artwork' at Great Ormond Street Hospital, designed for patients aged 1-16 on their way to operating theatre. The installation, called The Nature Trail, runs along a 50m length of corridor and aims to create a calming and engaging route to surgery. The installation features illuminated and interactive animal characters, which appear in a forest and foliage wallpaper.

**Input:** motion/gestures
**Output:** visual
**dynamic, digital**



**A Wild Life For Wildlife:**
The exhibition invites the public to become integral part of the journey with endangered animals through interactive sculptures. By taking a seat on a tandem bike, joining a game of chess, or throwing a ball in a pool, visitors connect with the stories of these species. Each sculpture is accompanied by QR code that leads to info about the animals' lives, needs, threats, and provides a deeper understanding for their conservation.

**Input:** stationary
**Output:** visual
**static, physical**

**WildLife Interactive Exhibition:**
The WildLife Interactive Exhibition 2017 at Siam Center utilized shadows to highlight the urgency of wildlife conservation. This innovative approach captivated visitors, vividly illustrating how species can vanish if not safeguarded. By engaging audiences through this unique visual medium, the exhibition effectively emphasized the importance of conservation efforts, showcasing the thin line between species existence and extinction.

**Input:** motion
**Output:** visual
**dynamic, physical+digital**

**Welcome Into The Future:**
In the interactive installation “Welcome Into The Future,” spectators use cube-shaped devices to control projections that are mapped on to two animal sculptures. A collaboration by Dutch design studios Sober Industries and Studio Rewind, the installation was displayed at Rotterdamse Museumnacht in Rotterdam back in 2011.

**Input:** stationary
**Output:** visual
**static, physical**


**Disappearing Species:**
The show aims to highlight the plight of endangered species across the globe, but is focused on Hong Kong’s destructive ecological footprint across a range of species.

**Input:** motion
**Output:** visual
**dynamic, physical**

**Welcome Into The Future:**
In the interactive installation “Welcome Into The Future,” spectators use cube-shaped devices to control projections that are mapped on to two animal sculptures. A collaboration by Dutch design studios Sober Industries and Studio Rewind, the installation was displayed at Rotterdamse Museumnacht in Rotterdam back in 2011.

**Input:** stationary
**Output:** visual
**static, physical**

**Animal Statue photo spots:**
Real sized statues of animals are put alongside the animal enclosure. Vistors can pose for photo and are able to grasp the size difference between them and wildlife.

**Input:** stationary
**Output:** visual
**static, physical**

### *Key Findings*

1. Majority of the installations featured animals or reptiles (land based species).

2. Installations are very static in nature.

3. Most common form of interaction used in these installations were touch and digital.

4. Kids were the common audience for all the installations.

5. The installations were made for daylight time targeting maximum visitors.

6. Less use of sensors for interacting with the audience.

The analysis of interactive installations in zoological spaces reveals a notable gap: a predominant focus on land-based species over birds and bird conservation. This oversight misses an opportunity to educate and engage the public on the critical roles birds play in ecosystems. The installations, primarily static and operating during daylight, rely heavily on touch and digital interactions, targeting mainly children. This approach underutilizes advanced sensor technologies that could offer more dynamic, immersive experiences reflective of birds' diverse behaviors and habitats.

The lack of bird-centric installations highlights a missed opportunity for promoting avian conservation. Future efforts could benefit from integrating sensor technology to simulate bird flight, migration, and ecological roles, making the experiences more engaging and educational. By expanding the thematic focus of these installations to include birds, there's potential to enhance public awareness and support for bird conservation, fostering a more inclusive approach to wildlife education.

### *Identifying features of a bird*

Key identifiers for recognizing birds include their distinctive calls, allowing for identification even without visual contact. Feather patterns offer another layer of distinction among species, while their habitats serve as a constant backdrop for their presence. Flight patterns vary significantly across species, adding to the methods of identification. Furthermore, the size, color, and pattern of their eggs are unique to each species, as are their dietary habits, ranging from specialized to varied.

The focus on birds' voices is particularly notable, as their unique sounds are a primary method for recognition in the wild, providing a compelling aspect for bird enthusiasts and researchers alike.

# Ideation

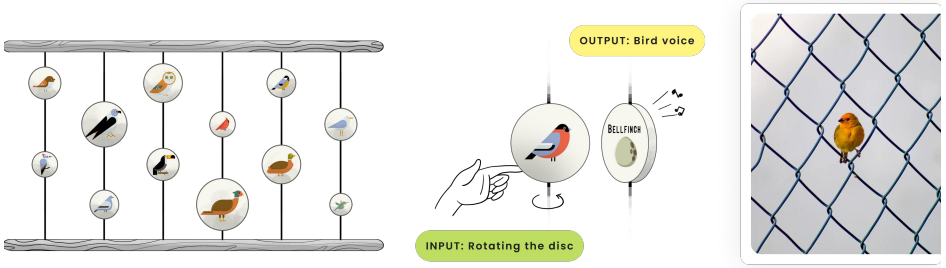
During the ideation process for the installations, a deliberate emphasis was placed on utilizing bird voices as the central element of the experience as it is recognized as one of the most distinctive and key identifiers. This is complemented by additional features, such as plumage patterns, habitats, flight behaviors, and dietary habits, to provide a comprehensive understanding of each species.

## *List of ideations*

1. Singing Fence
2. Hide and beak
3. Fly Away
4. Friendly Birds
5. Food Maze

Several practical considerations were taken into account, including time constraints, the availability of technology, space limitations, size constraints, and the ease of interpretation by users. These factors played a crucial role in shaping the concepts and ensuring that they are not only innovative and educational but also feasible and accessible within the given logistical parameters.

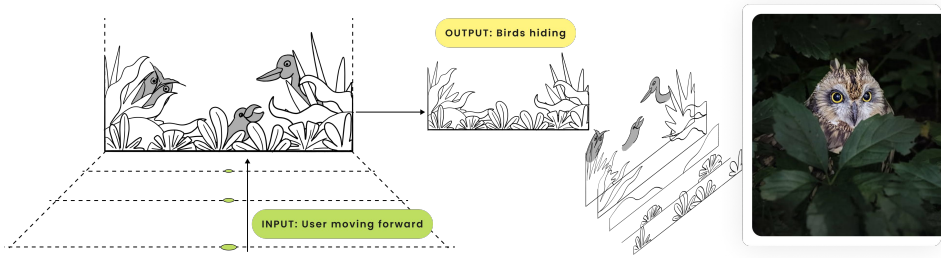
## *01. Singing Fence*




**Target Audience:** Kids & Families
**Technology Used:** Arduino and sensors

**Interactivity Type:** Touch
**Educational Goals:** Eggs of Birds

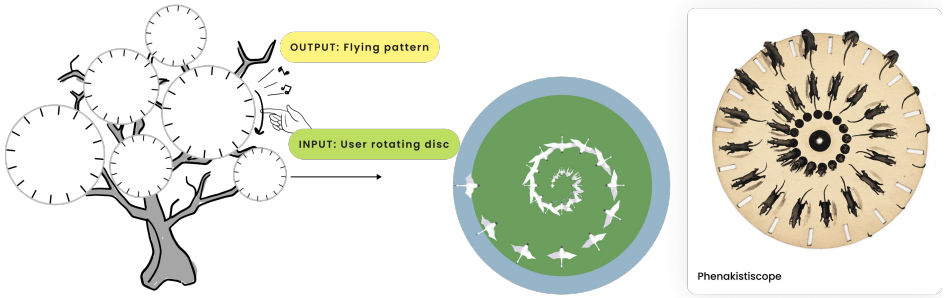
## *02. Hide and beak*




**Target Audience:** Kids & Families
**Technology Used:** Arduino and sensors

**Interactivity Type:** Inductive
**Educational Goals:** Bird Watching

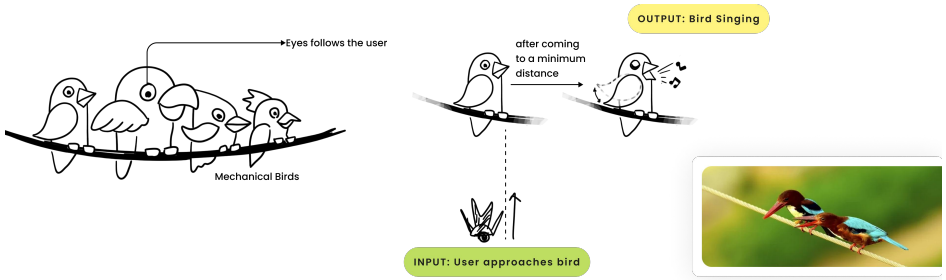
## *03. Fly Away*




**Target Audience:** Kids & Families
**Technology Used:** Arduino and sensors

**Interactivity Type:** Touch
**Educational Goals:** Bird flight pattern

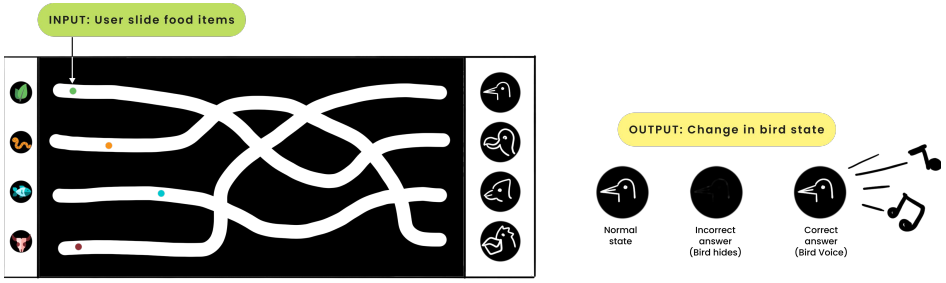
## *04. Friendly Birds*




**Target Audience:** Kids & Families
**Technology Used:** Arduino and sensors

**Interactivity Type:** Inductive
**Educational Goals:** Singing Birds

## *05. Food Maze*

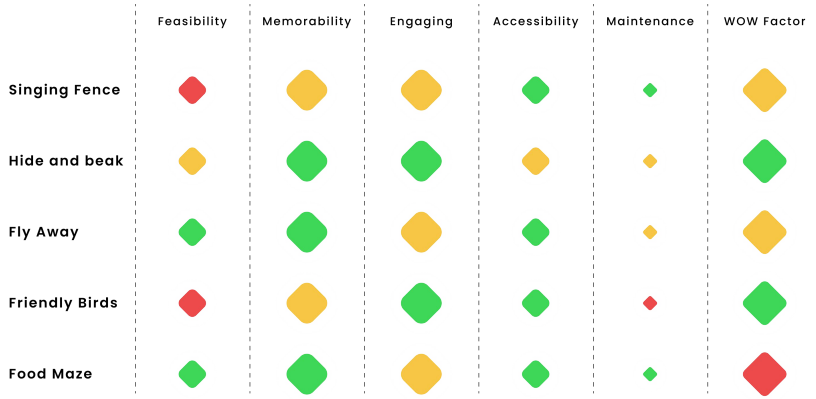



**Target Audience:** Kids & Families
**Technology Used:** Arduino and sensors

**Interactivity Type:** Touch
**Educational Goals:** Bird food habits

## *Analysis of ideations*

Size of diamond shows importance of judging factor and color depicts score. red is low, yellow is medium and green is high



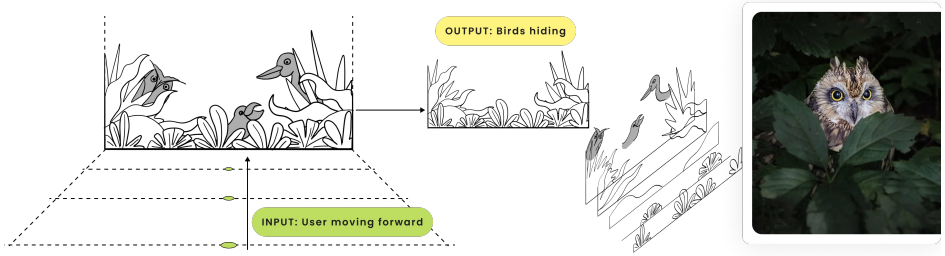
# Prototyping Installation

## *Idea finalization*

After the analysis and discussion with guide, idea 2, i.e, Hide and Beak was finalized for prototyping and testing.

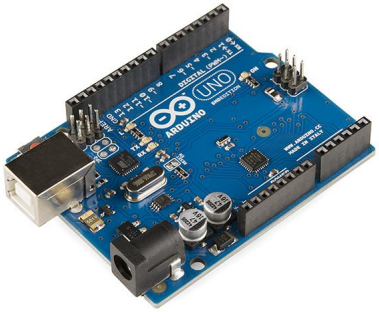
## *Breaking down actions in installation*

1. User moves towards installation
2. Installation detects movement
3. Bird hides in the bushes
4. Installation plays bird voice




**Target Audience:** Kids & Families
**Technology Used:** Arduino and sensors

**Interactivity Type:** Inductive
**Educational Goals:** Bird Watching



Arduino Uno
(microcontroller)

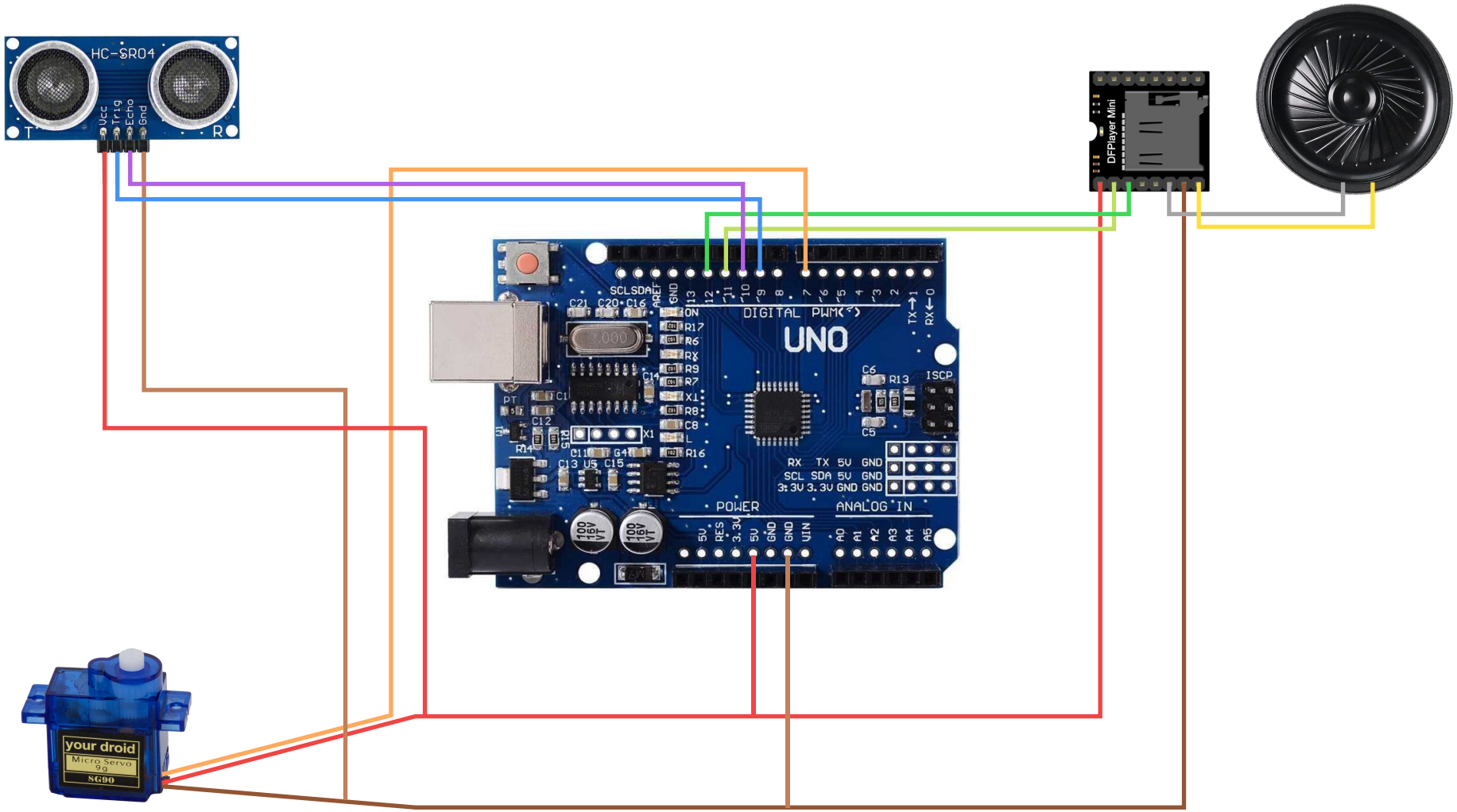
HC-SR-04 Ultrasonic
Distance Sensor
(for detecting distance)

TowerPro SG 90 Micro
Servo Motor
(for movement of the bird)

dfplayer mini mp3 module
(for storing bird voice
audio file)

dfplayer mini mp3 module
(for storing bird voice
audio file)

# Circuit Diagram



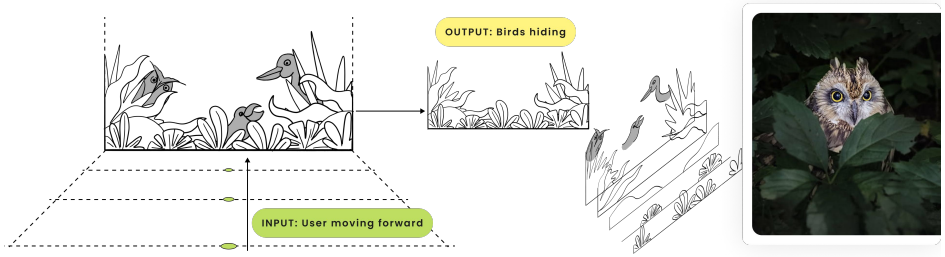
# Designing the outer form

## *Concept*

Bird hiding in a bush when user approaches

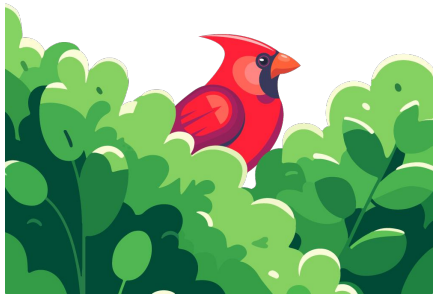
## *Colors and Artstyle*

Simple flat 2d vector artstyle with contrasting colors red and green are used

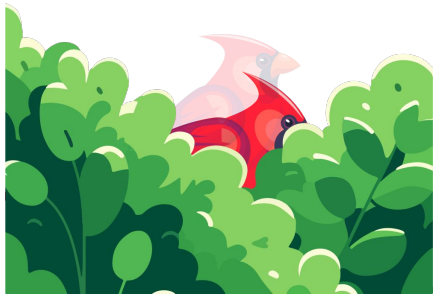



**Target Audience:** Kids & Families
**Technology Used:** Arduino and sensors

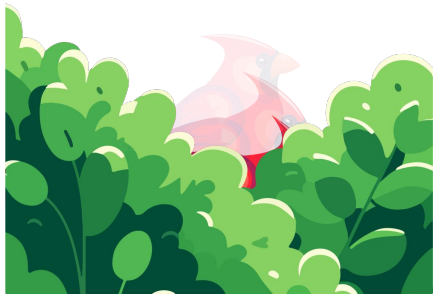
**Interactivity Type:** Inductive
**Educational Goals:** Bird Watching



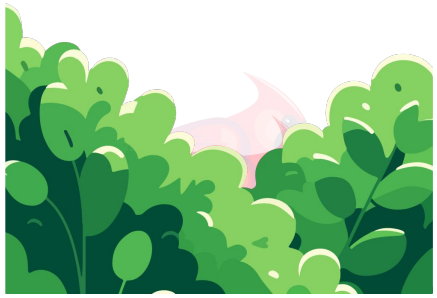
when distance of the user is more than 90 cm



when distance of the user is between 60 to 89 cm



when distance of the user is between 30 to 59 cm



when distance of the user is between 0 to 29 cm

## *Material used for creating prototype*

Sunboard was selected for the prototype model due to its lightweight nature, durability, and ease of manipulation. Additionally, its cost-effectiveness and versatility in thickness cater well to prototype development, ensuring a practical and visually appealing model.

## *Breaking actions*

When a bird senses an approaching predator, its response can typically be divided into several stages, reflecting an escalating series of behaviors aimed at avoiding predation.

1. **Alert Stage:** The bird becomes aware of a potential threat through visual cues, sounds, or the alarm calls of other birds. During this stage, the bird stops its current activity and focuses on the source of the threat to gather more information.

2. **Evaluation Stage:** The bird assesses the level of threat posed by the predator. This involves determining the predator's distance, movement, and behaviour. Based on this assessment, the bird decides whether to stay put and continue monitoring, start displaying warning signals, or prepare to flee.

3. **Alarm Signal Stage:** Some species may emit alarm calls or engage in visual displays aimed at warning nearby conspecifics of the danger. This can also serve to deter the predator by indicating that it has been spotted.

4. **Avoidance Stage:** If the threat persists and approaches closer, the bird may attempt non-flight avoidance behaviors. This could include moving to a more concealed position, making itself appear larger, or engaging in deceptive behaviors to mislead the predator about its actual position or intentions.

# Programming

## *Using Arduino IDE*

The Arduino IDE (Integrated Development Environment) is a pivotal tool for programming Arduino boards, widely used by hobbyists, educators, and professionals for developing interactive projects that interact with the physical world. It's an open-source platform that supports a wide range of Arduino boards and clones, facilitating the writing, compiling, and uploading of code to the Arduino microcontroller.

```
#include <Servo.h>

#define TRIG_PIN 9
#define ECHO_PIN 10
#define BLUE_LED_PIN 4
#define GREEN_LED_PIN 5
#define RED_LED_PIN 6
#define SERVO_PIN 7

Servo myservo;
int servoPos = 90; // Initial servo position
long prevDistance = 0; // Store the previous distance

void setup() {
  myservo.attach(SERVO_PIN);
  pinMode(TRIG_PIN, OUTPUT);
  pinMode(ECHO_PIN, INPUT);
  pinMode(BLUE_LED_PIN, OUTPUT);
  pinMode(GREEN_LED_PIN, OUTPUT);
  pinMode(RED_LED_PIN, OUTPUT);
  Serial.begin(9600);
  myservo.write(servoPos); // Move servo to initial position
}

void loop() {
  long duration, distance;
  digitalWrite(TRIG_PIN, LOW);
  delayMicroseconds(2);

  digitalWrite(TRIG_PIN, HIGH);
  delayMicroseconds(10);
  digitalWrite(TRIG_PIN, LOW);

  duration = pulseIn(ECHO_PIN, HIGH);
```

# Feedback

## *From the Guide and other professors*

1. There was jitter and noise of motor which was hampering the overall smooth experience.

2. In the final bigger design, there needed to be a message or a thought to be provoked in in the mind of user while interacting with the installation.

3. There was feedback to add multiple birds to enhance user experience.

4. The path for the user needed to be fixed as the ultrasonic sensor works only linearly.

5. The birds needed to hide not altogether at a time but grouped as per the criticality of their existence.

6. Sound needed to be improved. It was very fibble for the user at a distance to understand. Hence needed to think of an alternative way to produce bird sounds.

7. The prototype was a size of a table lamp. It was advised to create the final work of the size of 5-6 feet for a better impact.

# Final Design

## *Installation Scope*

Initially, we explored various factors and boundaries that would influence our project. Here are some key considerations:

- Space Constraints: We had a set area to work with for building the installation, which affected the size and design.
- Industrial Design Expertise: Our team had limited experience in industrial design, impacting our ability to create complex structures.
- Time Limitations: Due to time constraints, we had to streamline our design and construction process to meet deadlines.
- Arduino Knowledge: Our understanding of Arduino technology and its functionality was limited, posing challenges in implementing certain features.

## *Installation Setup Inspiration*

Setting Up an Interactive Puppet Show for Kids

Interactive puppet shows are a fantastic way to engage and entertain young audiences. With colorful characters and exciting stories, they effortlessly capture children's attention, keeping them enthralled throughout the performance.

These shows offer more than just entertainment; they serve as a platform for storytelling. By weaving educational narratives into the performances, we can effectively educate children about endangered bird species and the importance of conservation efforts.

To make the experience even more immersive, we can incorporate innovative puppet mechanisms with sensors. These sensors can detect and respond to the movements or actions of the audience, adding an element of interactivity to the show. As children interact with the puppets, they become active participants in the learning process, further enhancing the educational impact of the puppet show.

# Final Design

### *Illustration of the setup*

- Flat Vector Style: The illustrations are made in a simple style with clear lines and shapes, like a cartoon. This makes them easy to understand and visually appealing.

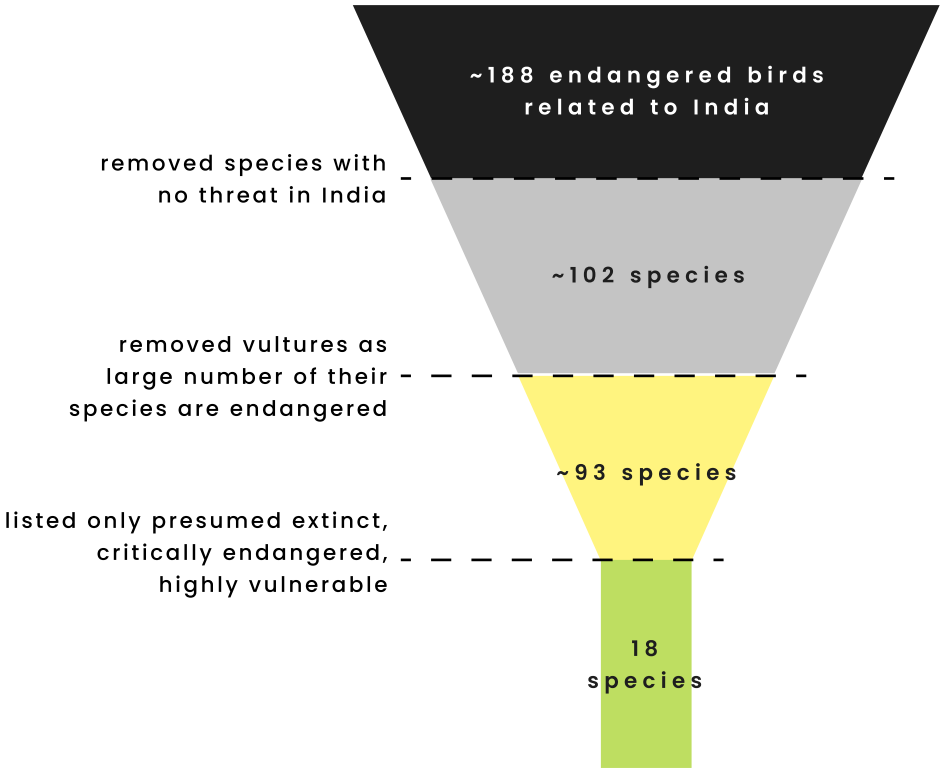
- Ensures illustrations can be scaled to different print sizes without loss of quality: No matter how big or small the illustrations are printed, they will still look clear and sharp. This is important because it means the illustrations will always look good, whether they're on a small flyer or a large poster.

- Simplifies the cutting process for creating physical elements: When the illustrations are printed out and cut to make physical objects, like decorations or game pieces, the simple style makes it easier to cut along the edges neatly. This means less time and effort spent on cutting, and the final result looks cleaner and more professional.

# Final Design

## *Selecting Birds*

A secondary research was done to find the list of endangered birds that can be put in the setup. But due to a large list, funnelling down of list was done:




1. Birds Presumed Extinct:
- Himalayan Quail
- Pink-headed Duck
- Manipur Bush Quail

2. Birds Critically Endangered:
- Jerdon's Courser
- White-bellied Heron
- Bugun Liocichla
- Bengal Florican
- Great Indian Bustard
- Spoon-billed Sandpiper
- Sociable Lapwing
- Yellow-breasted Bunting

3. Birds Highly Vulnerable:
- Forest Owlet
- Nicobar Serpent-Eagle
- White-winged Duck
- Pallas's Fish-eagle
- Green Peafowl
- Black-bellied Tern
- Swamp Grass-babbler
- Banasura Laughingthrush
- Nilgiri Laughingthrush
- Nilgiri Sholakili

In selecting birds, we categorize them based on their conservation status. The birds presumed extinct, such as the Himalayan Quail and Pink-headed Duck, are those believed to no longer exist. Critically endangered birds, like the Great Indian Bustard and Spoon-billed Sandpiper, face a high risk of extinction. Highly vulnerable birds, including the Forest Owlet and Green Peafowl, are at significant risk of population decline. These classifications help prioritize conservation efforts and highlight the urgent need for action to protect these avian species and their habitats.

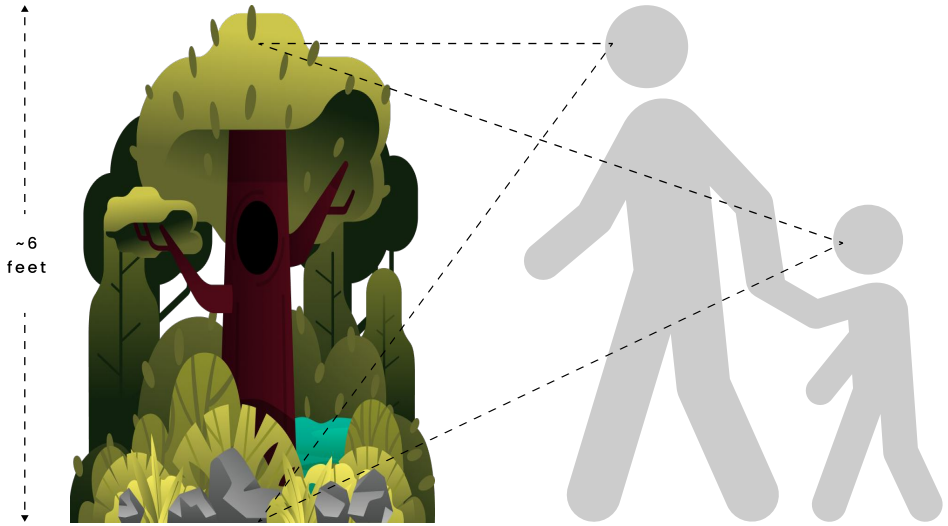
# Final Design

## *Illustrating Birds*

At first, I tried to draw birds by myself, but they didn't all look the same, which made the experience less smooth. So, I decided to use illustrations from the Birds of World website, which has drawings of all the bird species in the world.

## *Defining Size*

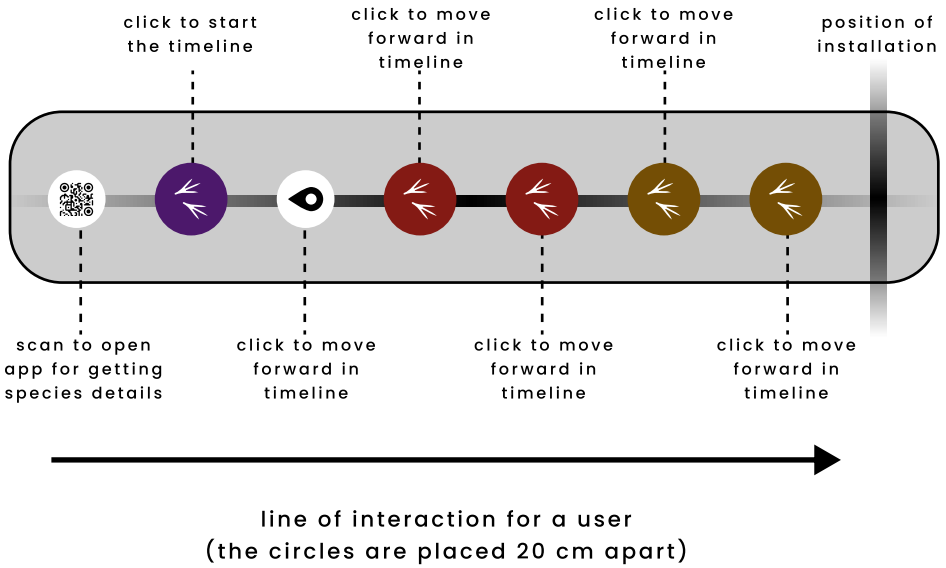
The illustration shows the size of the installation. On one side, there's a drawing of the installation, and on the other side, there are drawings of an adult and a child. A line parallel to their maximum height demonstrates how tall the installation will appear from the perspective of a child and how much of it will be visible to an adult. This helps viewers understand how the installation will look to different people based on their height.



# Final Design

## *Adding Pathway*

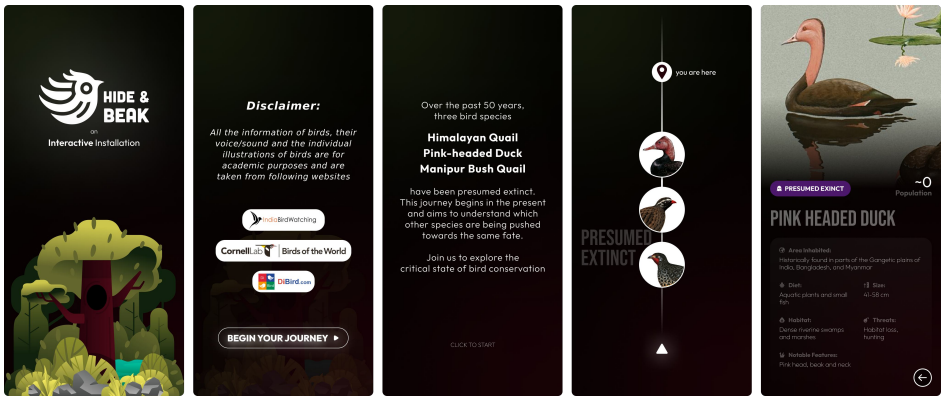
The  specific areas were marked for users to step on, showing them where to put their feet next to interact with the installation. By scanning, they can open an app to learn more about the different species featured in the installation. This helps users engage with the installation and learn about the species by using their mobile device.




## *Designing Digital Guide*

A supporting app prototype is created for the user to be guided about birds during the interaction. This will help them in getting knowledge about these species and a good takeaway for them to revisit these data. Below is the series of screens and link to check this digital guide.

link to prototype>>




## *Installation Working Guide*

For the final installation, a video was created to understand the final working and interaction a user will do. Below is the link.

link to video>>

# Final Design

*Final Setup illustration along with Birds positioning:*

*Building the setup:*

My knowledge of industrial design was limited to my Bachelors in Production Engineering. Hence, I took help from my friends in Industrial Design. From the discussions, following pointers came out:

1. Using Sunboard as material is a big no. Although it worked while building the small prototype, It wont be able to withstand when scaled up on the huge level.

2. The cutting of the shapes can't be done manually hence laser cutting was the only option.

3. Mountboard is a good option but sticking the print and then cutting it will be a huge amount of labour.

By further discussion with printing shops, the option of vinyl print over mountboard was selected as it will be easy to laser cut it also. Here is the final file given for the individual part:

# Final Design

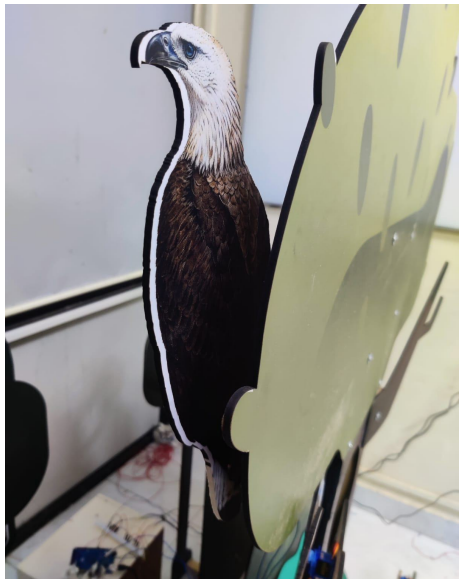
*Final Setup*:

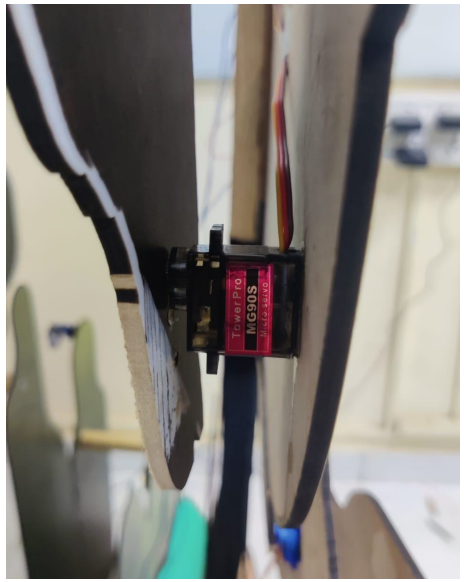
*Final Setup along with birds*:

# Final Design

### *Adding movements to birds:*

In the prototype, Arduino Uno was used to automate the movement. But now the final design has 18 birds. Hence, it was replaced with Arduino Mega as it has greater number of output pins to cater all the servo motors attached to the birds.






### *Perfecting Sound*

The idea of using a DFmini player for sound was not working as per the requirement. Hence needed to think of an alternative way.

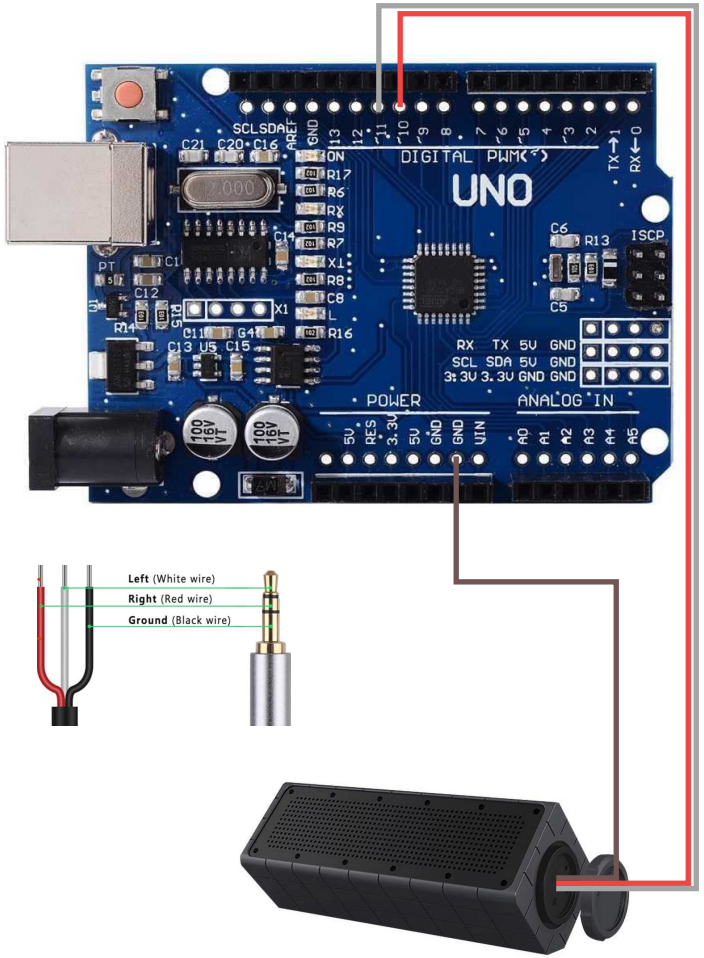
First the problem was found to be with the DFmini player module as it required an external SD card for storing the mp3 files of bird sounds. It was replaced by a DFplayer pro module with inbuilt storage. But it was giving the same error.

Next i switched to going to the basics. A mp3 file is converted to numerical data by the DFplayer module for the arduino to understand. Hence I used EncodeAudio.exe to convert mp3 files to numerical value. This numerical value was then directly put in the main code itself which eliminated the use of DFplayer modules. A speaker with inbuilt amplifier and stablizer was directly connected to arduino and surprisingly it worked perfectly.

The speaker used for this is Boat Stone 600 and was connected to arduino by rewiring the aux cable connected to speaker with arduino board. Since the speaker has its own power source, hence no external power source was required.

Here, Black is connected to ground, and the Red and White which are right and left output were connected to pins 10 and 11.

# Final Design




### *Connecting Circuit:*

In the final circuit, first from the prototype and second from the sound output needed to be linked together. Additionally, it needed to be repeated 18 times for each of the 18 birds. Following details the connections of each component to he main processer Arduino Mega:

Ultrasonic Sensor:
Trig to Pin 10
Echo to Pin 11
VCC to 5V
GND to GND

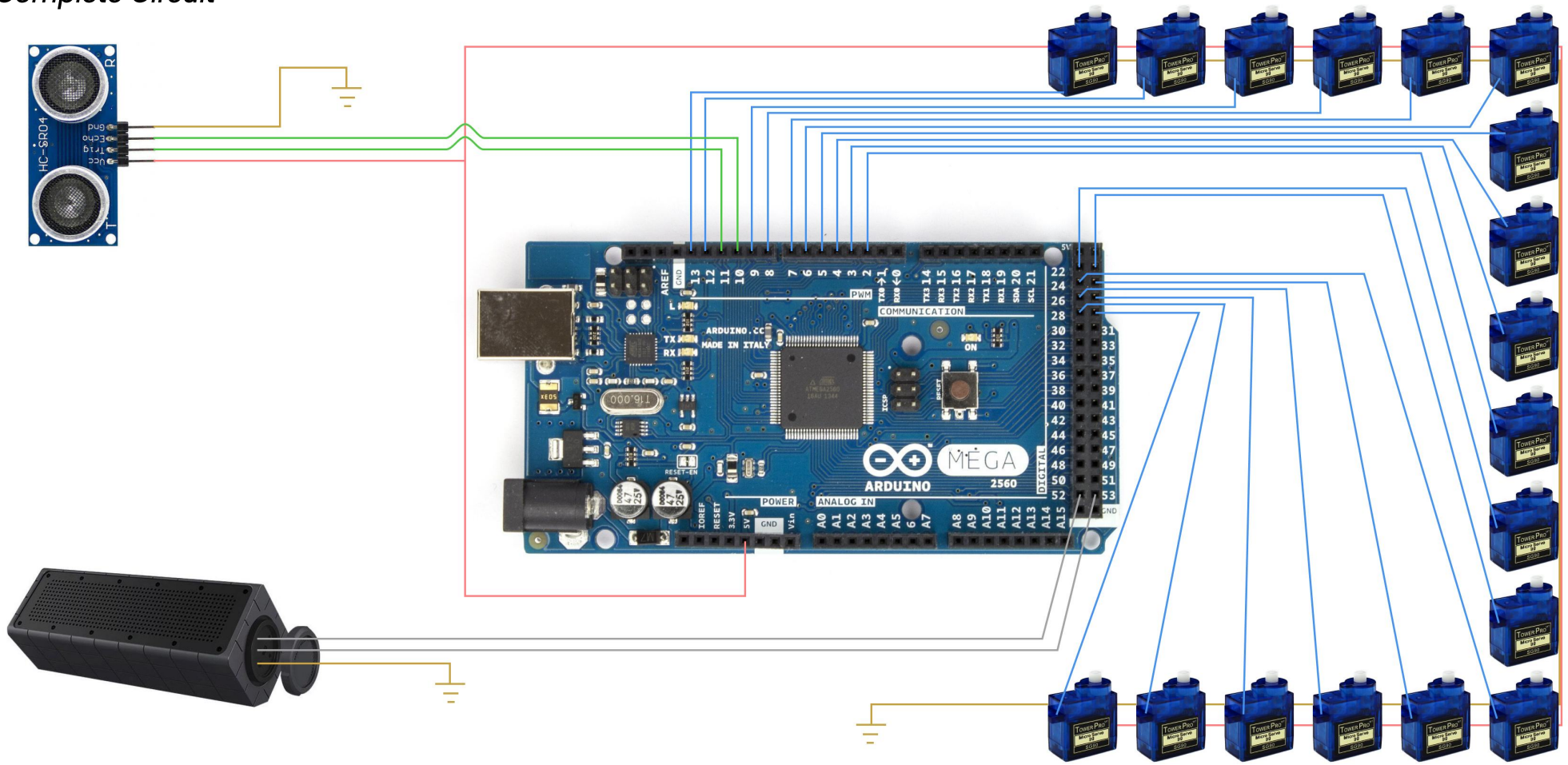
Speaker through an aux cable:
Aux Red wire to Pin 52
Aux White wire to Pin 53
Aux Black wire to GND
Speaker won't be needing a power supply as it has its own battery to store power.

Servo Motors:
Red wire to 5V
Orange wire to Output pin
Brown wire to GND

Servo 1 (s01) to Pin 2
Servo 2 (s02) to Pin 3
Servo 3 (s03) to Pin 4
Servo 4 (s04) to Pin 5
Servo 5 (s05) to Pin 6
Servo 6 (s06) to Pin 7
Servo 7 (s07) to Pin 8
Servo 8 (s08) to Pin 9
Servo 9 (s09) to Pin 12
Servo 10 (s10) to Pin 13
Servo 11 (s11) to Pin 22
Servo 12 (s12) to Pin 23
Servo 13 (s13) to Pin 24
Servo 14 (s14) to Pin 25
Servo 15 (s15) to Pin 26
Servo 16 (s16) to Pin 27
Servo 17 (s17) to Pin 28
Servo 18 (s18) to Pin 29

# Final Design

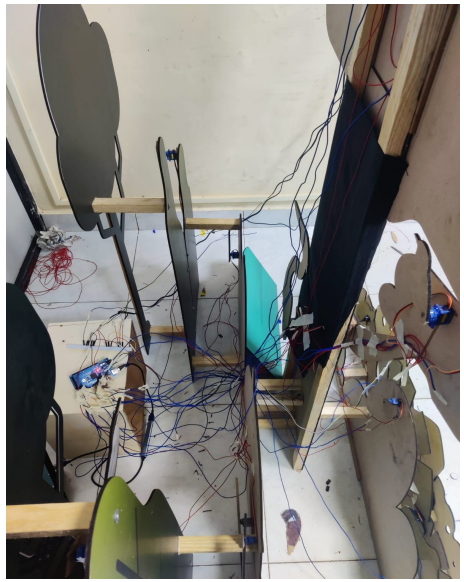
*Complete Circuit*



# Final Design

### *Adding Circuit:*

During the final implementation of the circuit, it initially appeared quite cluttered and disorganized. However, to maintain a clean and professional appearance, I strategically concealed the wiring and components behind the installation parts. This approach ensured that the front view remained seamless and aesthetically pleasing, without compromising the functionality and interactive elements of the installation.



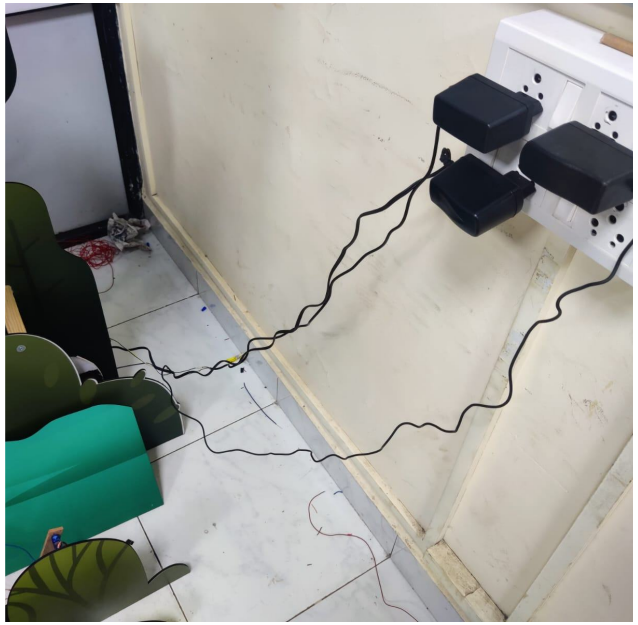
### *Increasing Power to Circuit*

Since there was 18 servo motors added, the Arduino mega was not able to supply power to the circuit properly. Calculating Total Current:

Idle servo motor Current requirement:
100mA × 18servos = 1,800mA = 1.8A

Normal Operation servo motor Current requirement:
250mA × 18servos = 4,500mA = 4.5A

Maximum Load servo motor Current requirement:
500mA × 18servos = 9,000mA = 9A



Hence, three 5V 3A adaptors were connected to provide extra power supply. The Adaptors were connected parallel to provide 9A current

## Final Installation

## Limitations Found

### *Electrical Resistance in Wiring*:

The use of long and thin electric wires introduced resistance, which hindered signal transmission. This resulted in disruptions and randomness in the movements of the birds, affecting the overall performance of the installation.

### *Audio Output Issues*:

Arduino boards are not inherently designed to play audio files effectively. Consequently, the audio output quality did not meet the desired standards, impacting the immersive experience intended for the installation.

### *Weight and Momentum of Birds*:

The weight of the birds attached to the servos posed another challenge. Some birds slipped over the axis of rotation due to their momentum during movement, leading to inconsistent motion.

### *Design and Fabrication Precision*:

Achieving high precision in the design and fabrication of physical components proved difficult. This led to potential mismatches and assembly issues, affecting the overall integrity and functionality of the installation.

## My Learnings

### *Understanding Endangered Bird Species*:

Gained comprehensive knowledge about the critical state of endangered bird species in India, highlighting the urgent need for conservation efforts to protect these vulnerable populations.

### *Integration of Arduino and Sensors*:

Acquired skills in effectively integrating Arduino and sensor technology into an interactive installation, enhancing the project's interactive capabilities and user engagement.

### *Design and Fabrication Complexities*:

Learned about the complexities involved in designing and fabricating tangible products, with particular attention to material selection, durability, and usability considerations to ensure a functional and sustainable installation.

### *Creating Dynamic Educational Experiences*:

Developed the ability to create dynamic and interactive educational experiences, moving beyond traditional static displays to engage visitors more effectively and provide a more immersive learning environment.

## Future Scope

### *Expanded Species Coverage*:

This installation can be redesigned to include a variety of other endangered species, broadening the educational impact and raising awareness about a wider range of conservation issues.

### *Educational Outreach*:

Develop partnerships with schools and educational institutions to utilize the installation as an effective teaching tool, enhancing environmental education and fostering a deeper understanding of wildlife conservation among students.

### *Technological Innovations*:

Integrate augmented reality (AR) features and enhance the accompanying mobile app to provide additional layers of information and interactive experiences, making the installation more engaging and informative for users.

These future developments will help extend the project's reach and effectiveness, ensuring it continues to educate and inspire a diverse audience about the importance of conservation.

# Conclusion

This project on creating an educational interactive installation for endangered bird species in India has been highly informative. It provided a deep understanding of these species' critical state and the urgency of conservation efforts. Integrating Arduino and sensors enhanced the installation's interactivity and educational impact.

Through this journey, I learned about the complexities of designing and fabricating tangible products, including material selection, durability, and usability, which are crucial for a functional and sustainable installation. This project demonstrated the potential for creating dynamic educational experiences that surpass traditional static displays, offering a more engaging way to educate the public about conservation issues.

Looking forward, the project's future scope includes expanding species coverage, forming educational partnerships, and incorporating advanced technologies like augmented reality to enrich the interactive experience. This project has achieved its primary objectives and set the stage for future advancements in educational installations aimed at wildlife conservation awareness.

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