

Design with Data

(2023-2024)

Project: Invisible Kingdom

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Introduction

Invisible Kingdom

What did you see when you explore the forest? Birds, sunlight, wind, branches, there's a lot to observe at eye level and above. However, underneath the forest floor, intertwined with the roots of the trees, is a fascinating microscopic network of fungus.

Our installation aims to draw public attention to this underground mycelial network and heighten awareness of the damage that urbanization and human activities inflict on this invisible kingdom.



Background



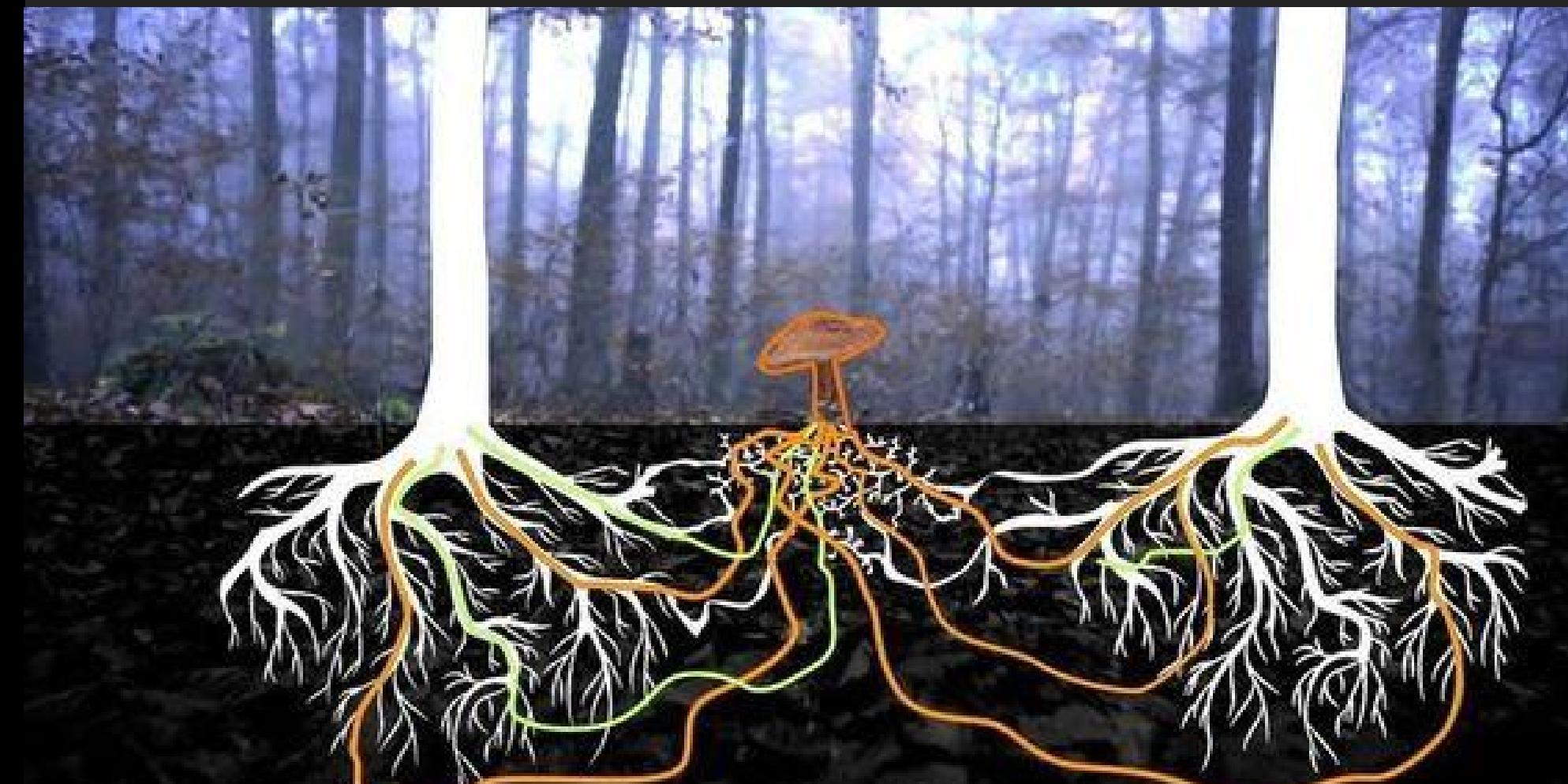
We're all familiar with the extensive and intricate root networks of trees and plants, yet many of us are unaware that fungi possess a similar mesh-like structure. The mushrooms we see above ground are merely the fruits of these fungi. Below the surface, the majority of a fungal organism exists as mycelium, a vast network intertwined with tree roots, forming a hidden but essential part of the forest's ecosystem.

Wood Wide Web

Mycorrhizal fungal networks provide a wide range of services to plants and ecosystems, includes:

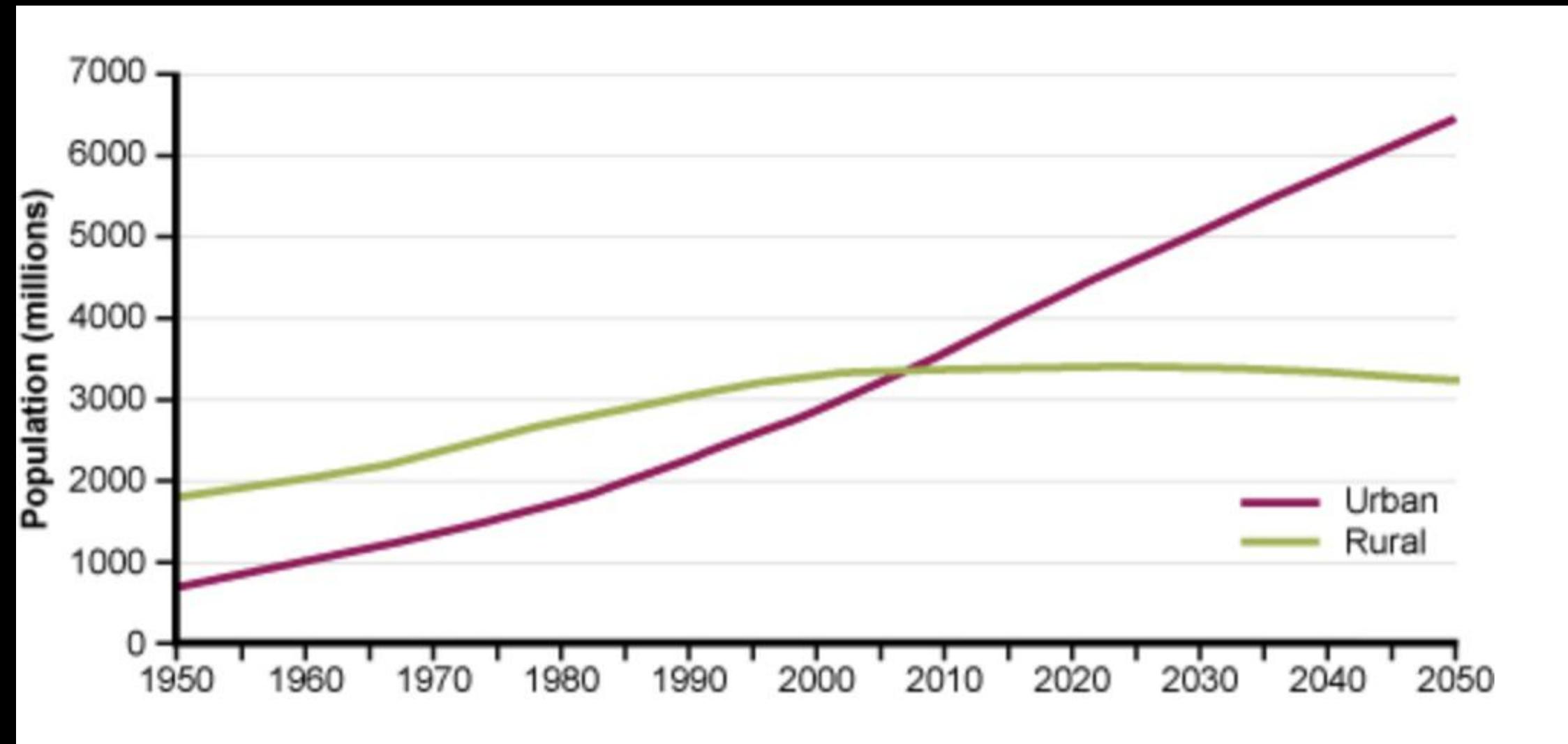
- Facilitation of seedling establishment
- Transport of substances between plants
- Decomposition of litter
- Food for other organisms

Similar to the World Wide Web in human communities, the many roles that mycorrhizal networks appear to play have earned them a nickname: the Wood Wide Web.



Background

Urbanization



Urban and rural population of the world, 1950–2050. (UNDESA, 2014)

By 2050 the proportion living in urban areas is expected to reach 66%
(UNDESA, 2014).

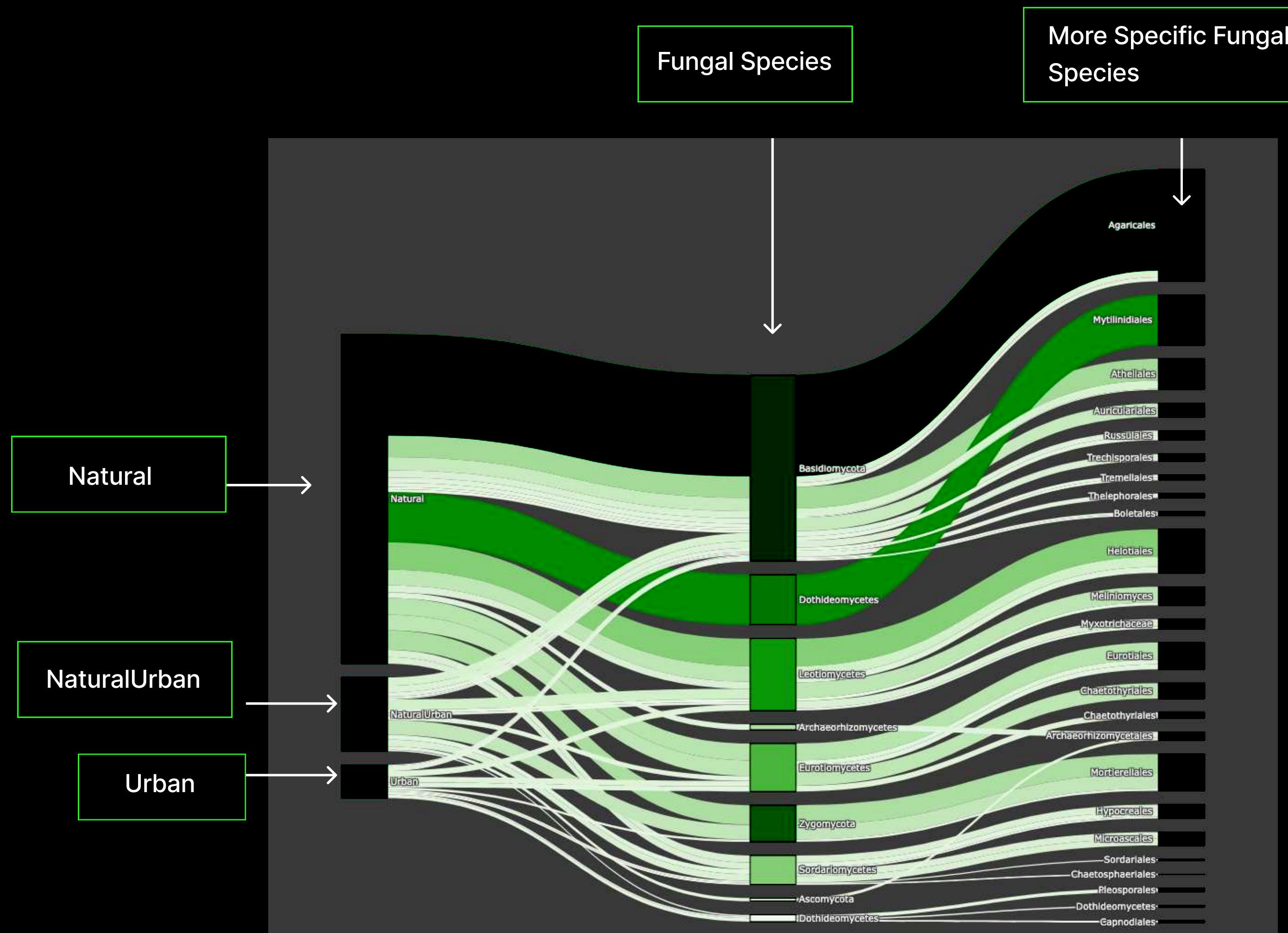
Urbanization's potential impact on fungi

- Changes in soil composition and pH affect fungal ecological dynamics.
- The urban heat island effect impacts the growth cycles of fungi.
- Decline in biodiversity alters fungal hosts
- Habitat loss reduces fungal reproduction areas.

Research shows that urbanization has diminished fungal diversity and disrupt network integrity.

Research and Methodology

Dataset



The Sankey diagram illustrates the distribution of fungal species across three areas: urban centers, urban peripheries, and natural habitats. The flow thickness in the diagram represents the relative abundance of fungal DNA.

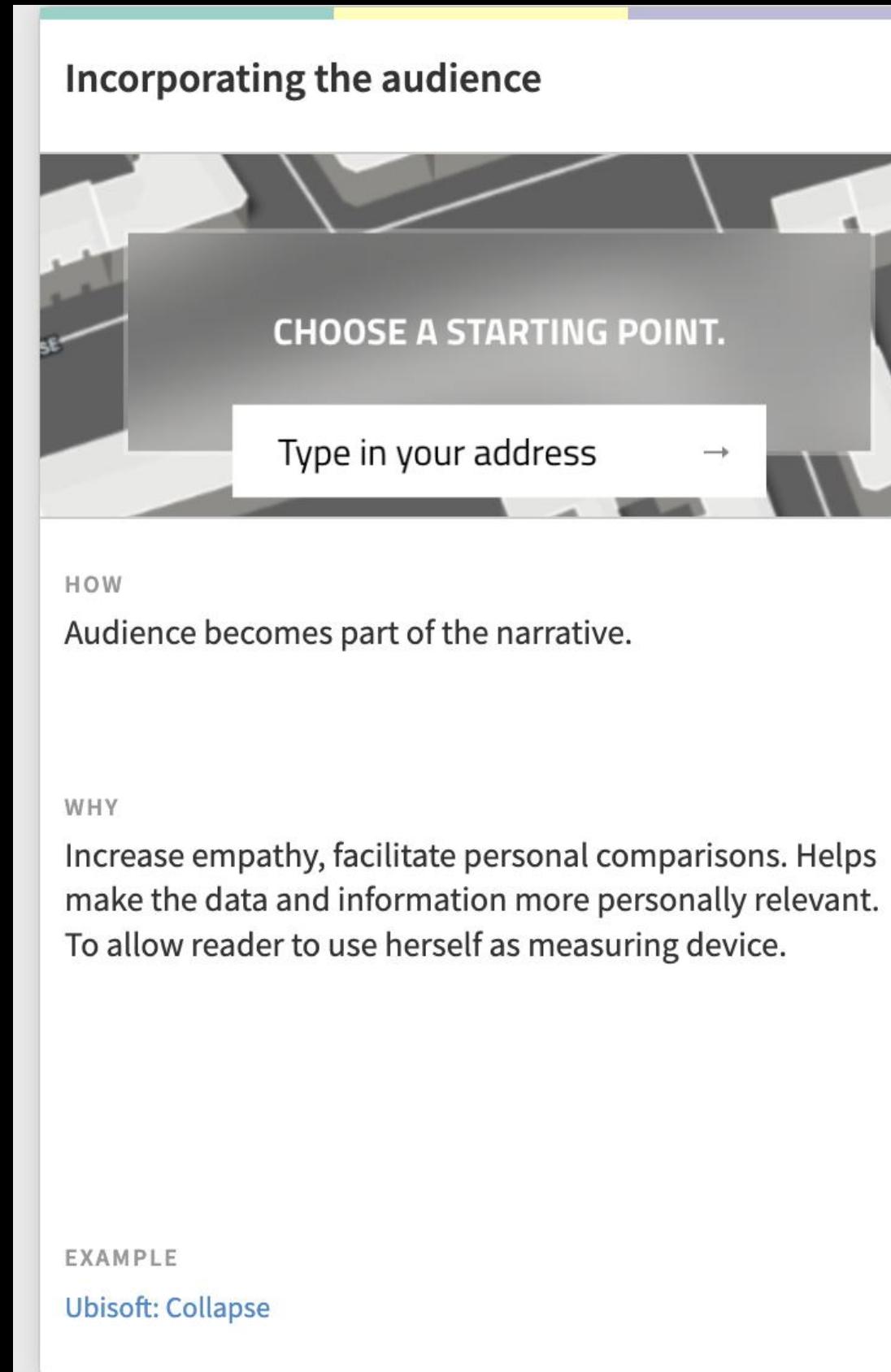
Fungi are predominantly specialized to natural environments. **Urbanization tends to homogenize soil microbial communities**, affecting fungi more significantly than bacteria.

More detail on data in the report.

Fungal diversities decline with urbanization

Research and Methodology

Story-telling



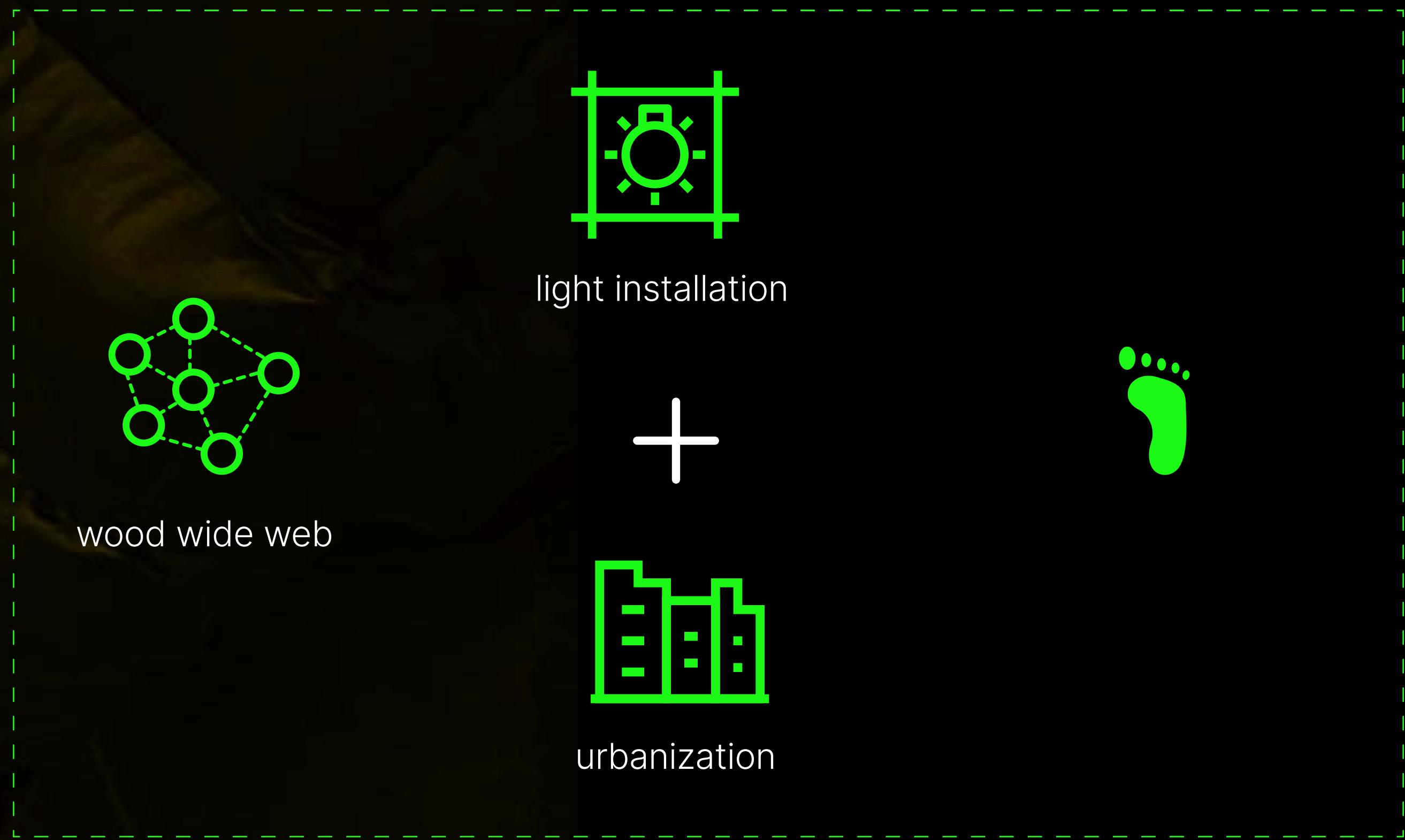
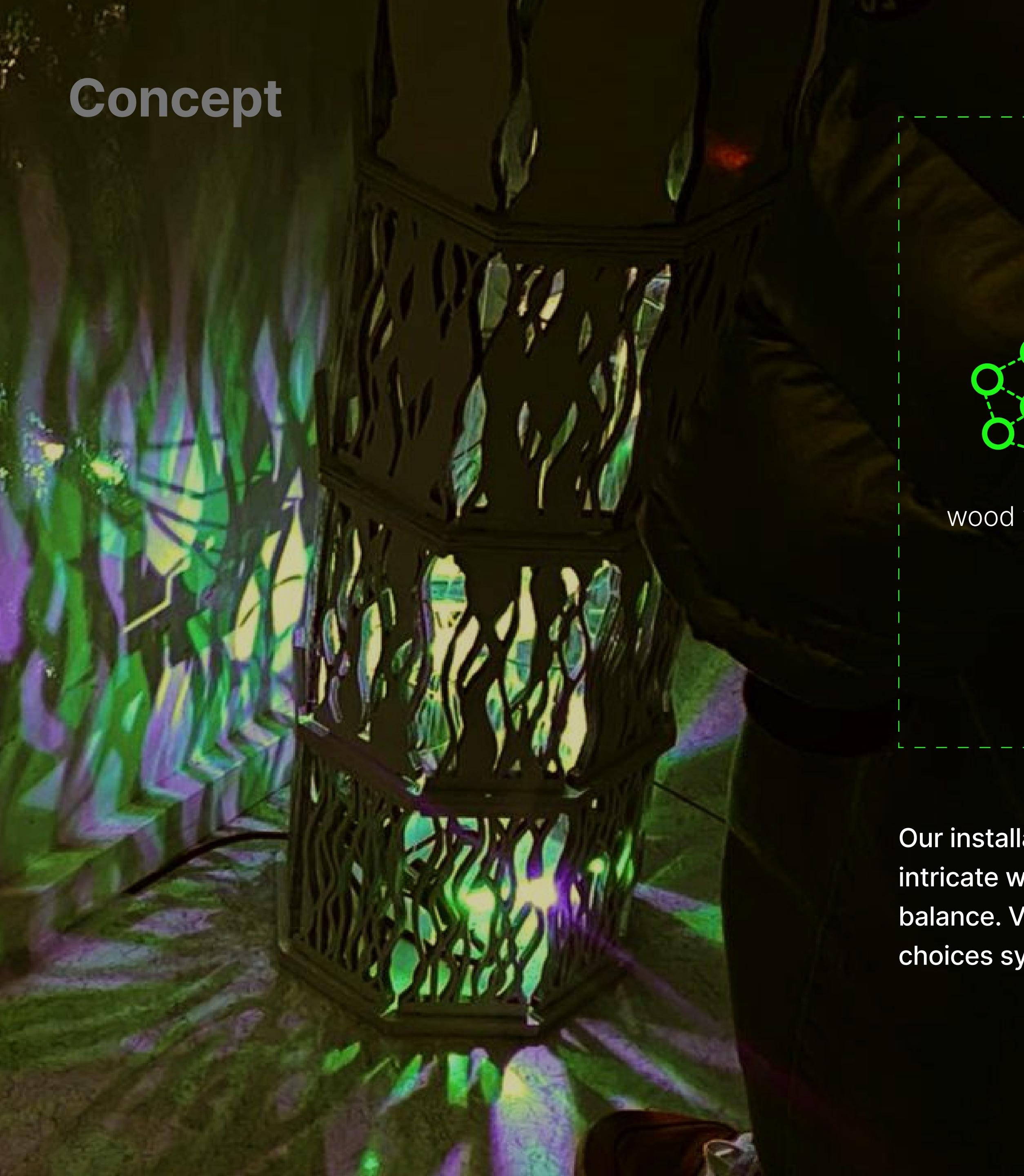
What is your choice?

To enhance the immersive quality of our exhibition, we incorporated interactive **decision-making elements** based on the data-driven storytelling approaches outlined in the NAPA cards (2016).

Our design features three installations representing urban, fringe, and natural habitats. Visitors engage by making choices at each installation, witnessing the direct consequences of their decisions.

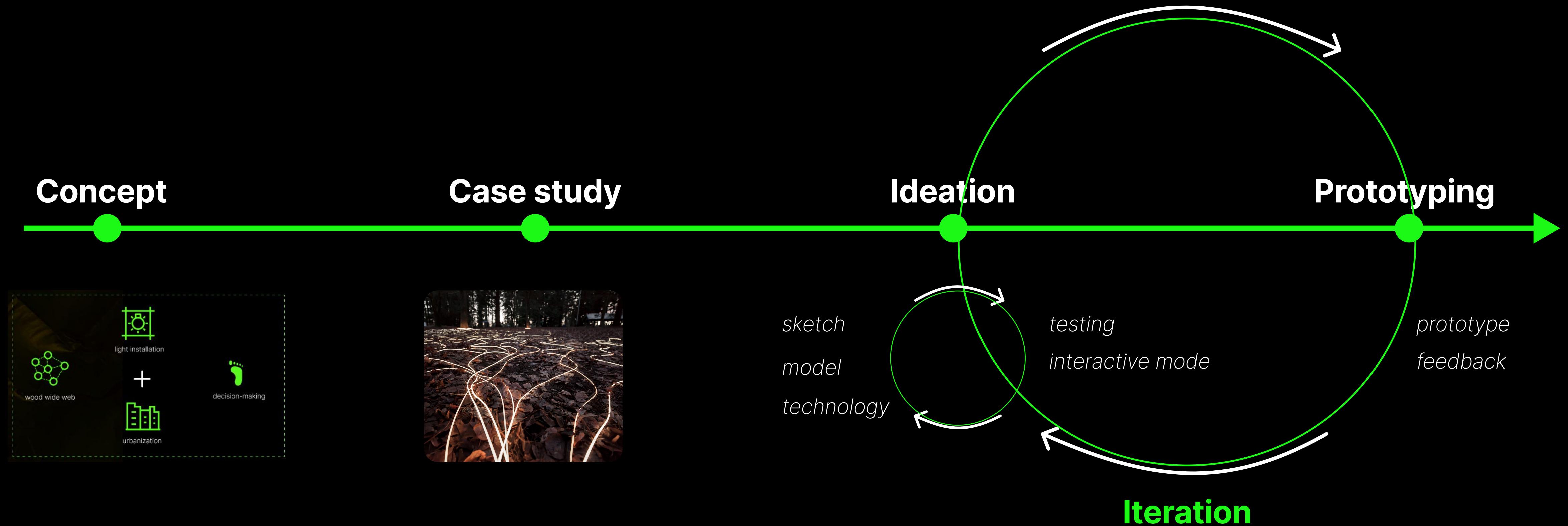
This approach not only increases engagement but also serves as a metaphor for the real-world impact of human activities on the environment, encouraging visitors to reflect on ecological implications.

Concept

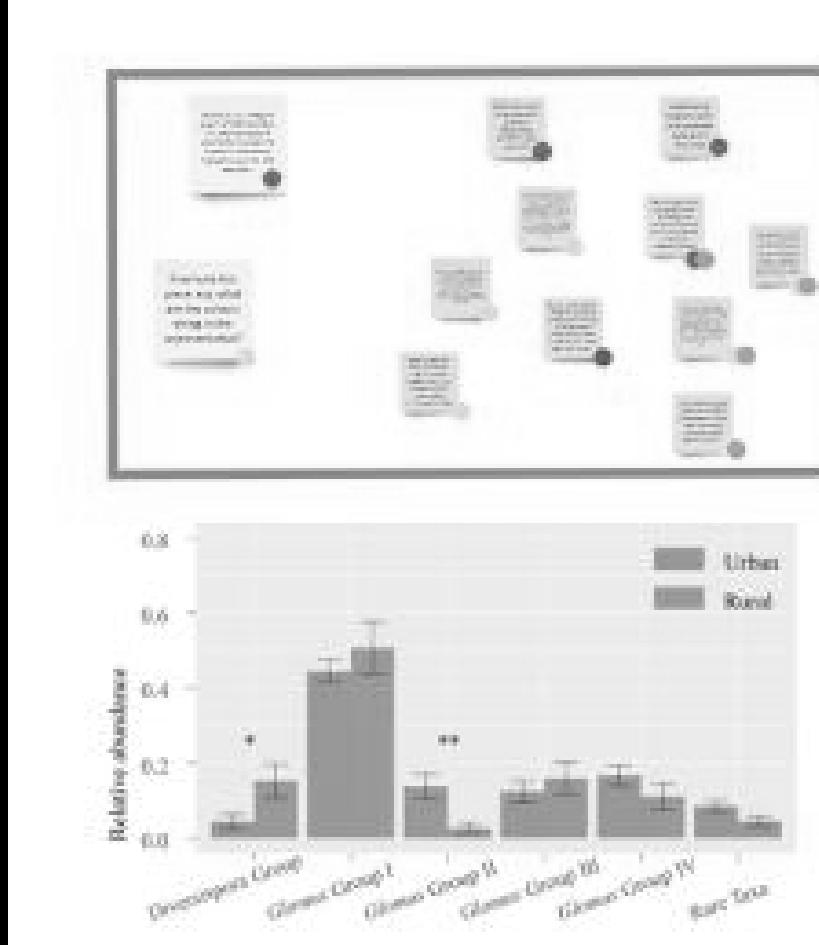


Our installation leverages complicated surface structure and lights to simulate the intricate web of fungal networks, revealing how urban development alters this delicate balance. Visitors are invited to interact with the exhibit, wherein their movements and choices symbolize urban growth and its effects on this underground network.

Design process



Iteration



CONCEPT COMMUNICATION

- 1 Reinforce the symbiotic relationship between fungi trees and ecosystem
- 2 Consider adding display boards to present symbiosis background information to aid understanding.

DATASET

More supportive data related to how urbanization has impact on the fungi system is needed.

INSTALLATION FORM

- 1 How to express living woods in a non-literal way?

USER INTERACTION

- 1 Replacing the current interaction (slider) allows the interaction to remind the user of the context of urbanization.
- 2 How the user sees the results, seeing the root system in soil is a more intuitive choice.

mid-term feedback

• Research

Reinforce the symbiotic relationship between fungi trees and ecosystem

• Dataset

More supportive data related to how urbanization has impact on the fungi system is needed.

• Interactive mode

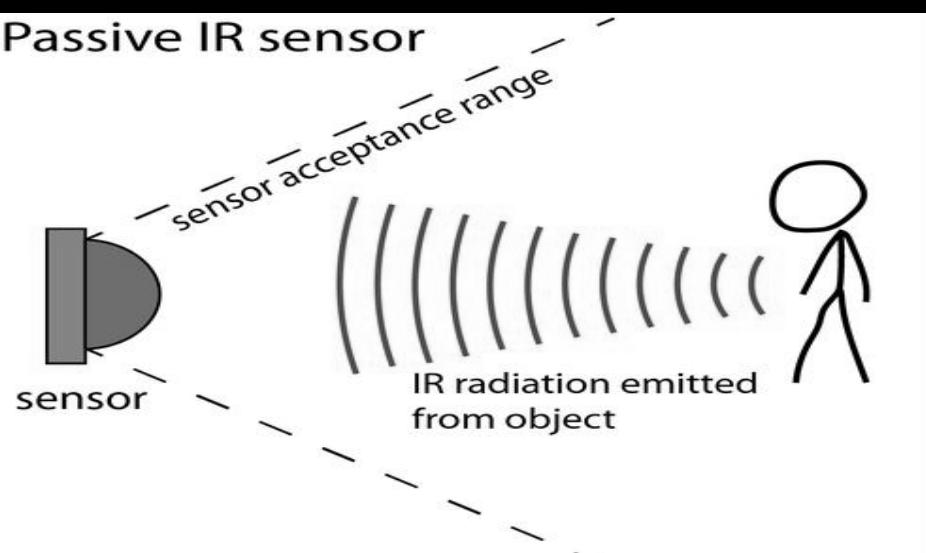
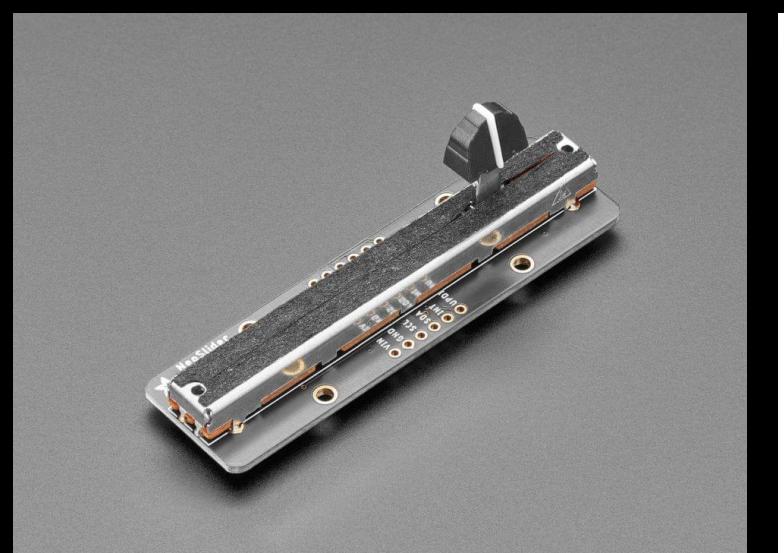
Replacing the current interaction (slider) allows the interaction to remind the user of the context of urbanization.

modeling



box installation → floor-standing installation

single installation → series (3 units) installations



manual slider → infrared sensing

interactive mode

Prototyping



1

inspiration

2

3D model

3

laser cutting

4

spray painting

5

build up

6

testing

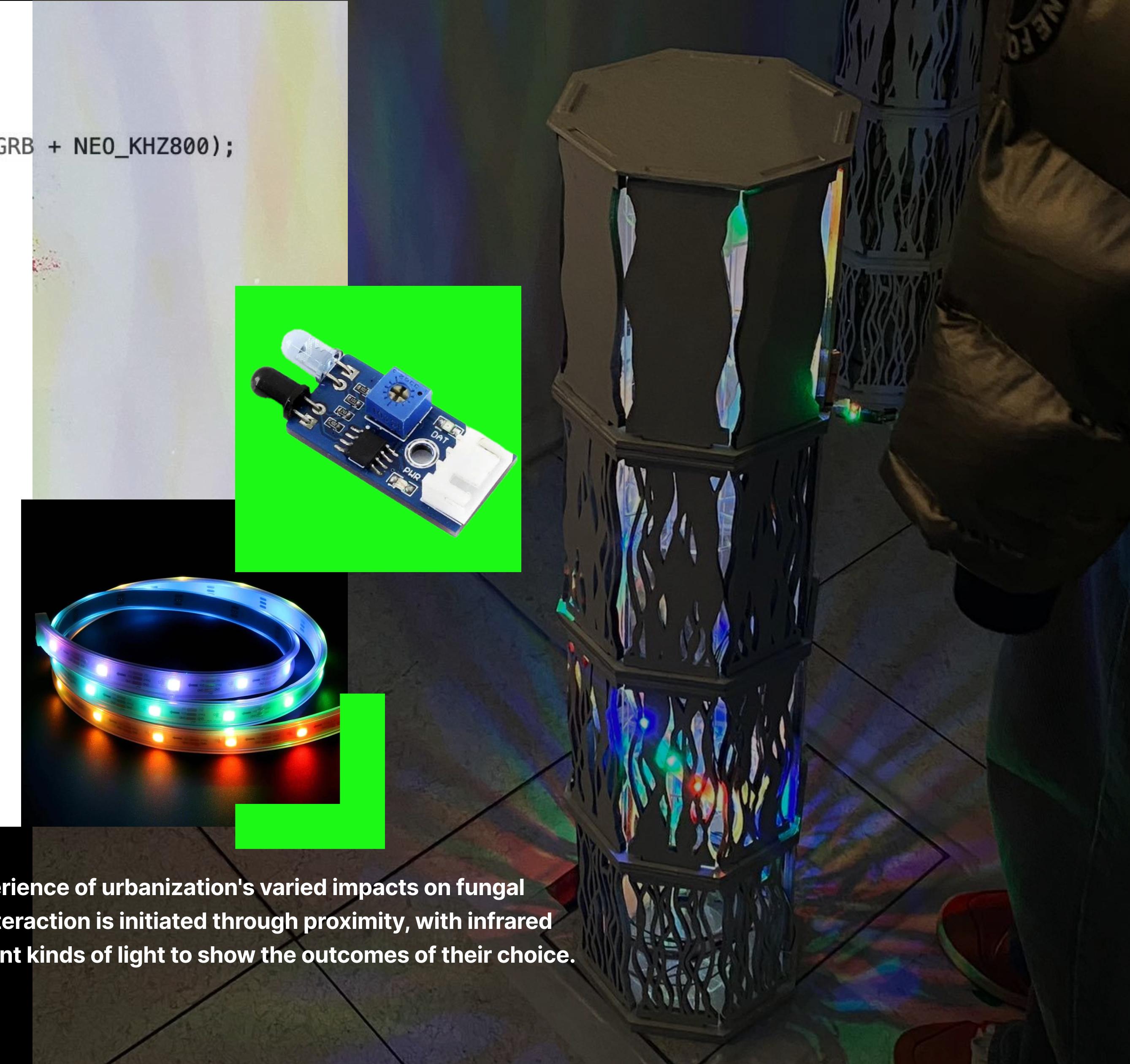
7

prototype



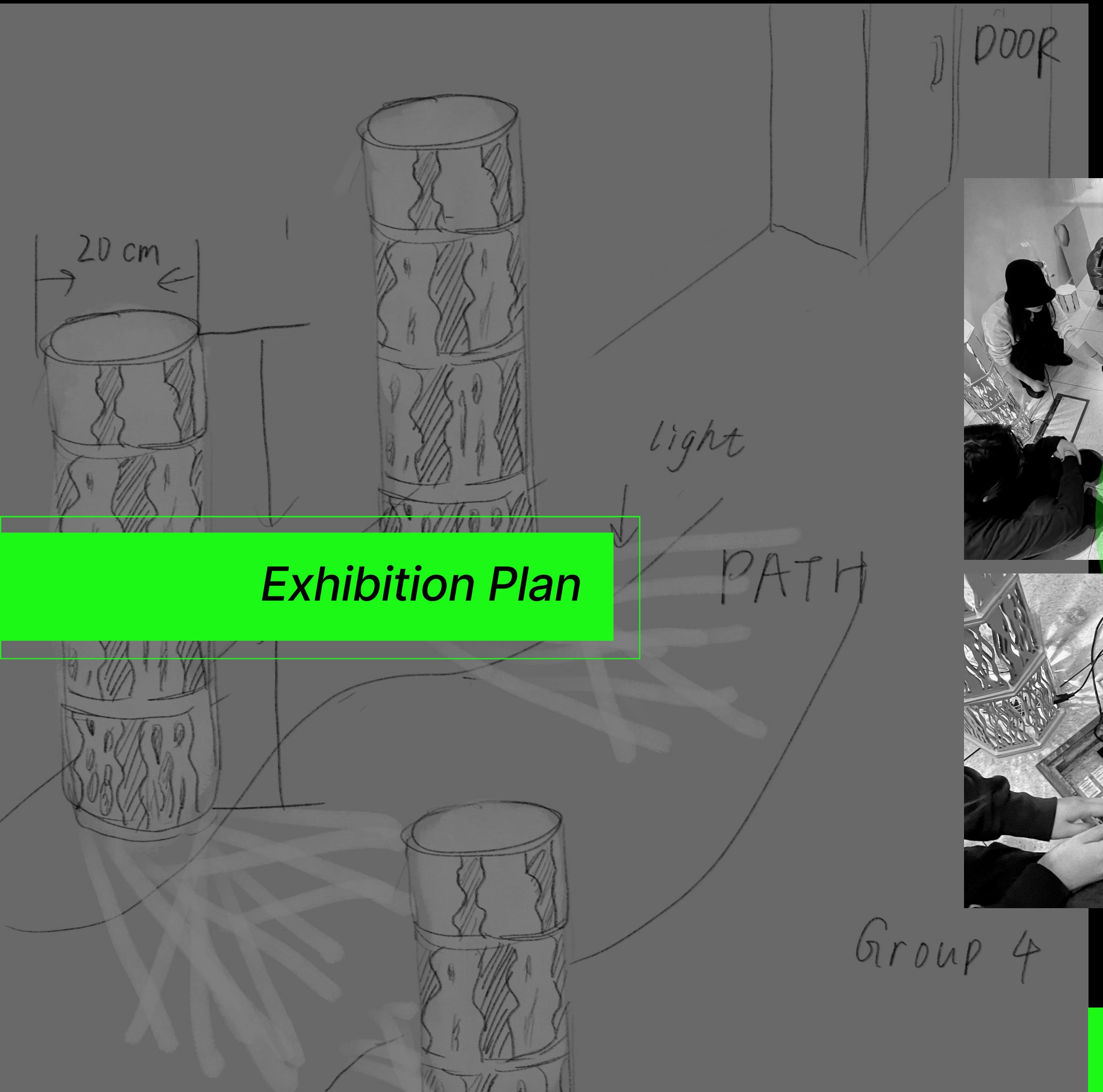
Technology

```
1 #include <Adafruit_NeoPixel.h>
2
3 #define PIN 6
4 #define NUM_LEDS 30
5 Adafruit_NeoPixel strip = Adafruit_NeoPixel(NUM_LEDS, PIN, NEO_GRB + NEO_KHZ800);
6
7
8 int Obstacles_din=2;
9 int Obstacles_ain=A0;
10 int ad_value;
11
12 void setup()
13 {
14     strip.begin();
15     strip.show();
16     pinMode(Obstacles_din,INPUT);
17     pinMode(Obstacles_ain,INPUT);
18     Serial.begin(9600);
19 }
20 void loop()
21 {
22     ad_value=analogRead(Obstacles_ain);
23     if(ad_value<400)
24     {
25         Serial.println("Near the Obstacles");
26     }
27 }
```

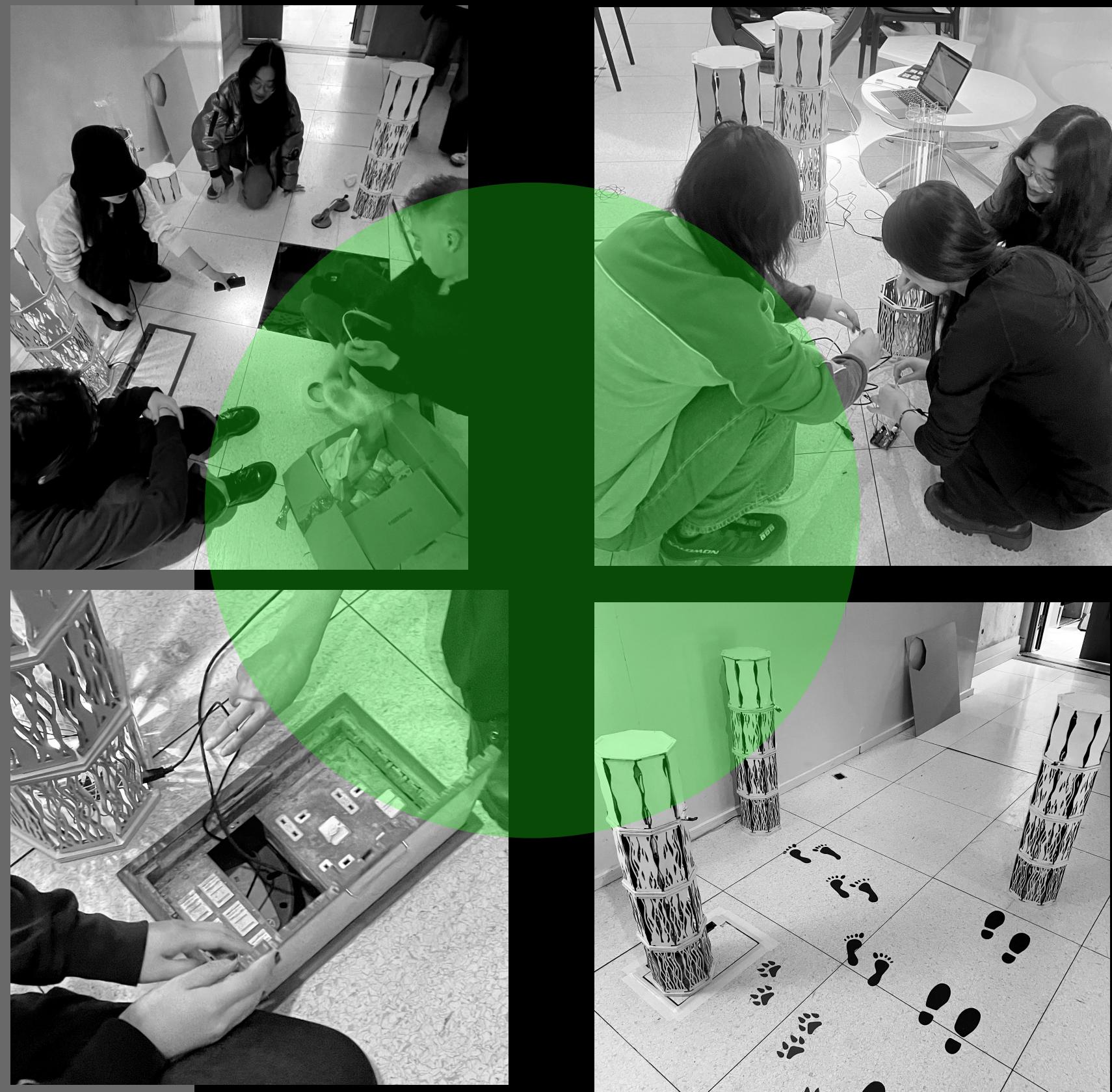


For the interactive component of our installation, we decide to immerse visitors in the experience of urbanization's varied impacts on fungal network by let visitors make choices to directly influence the exhibition's outcome. This interaction is initiated through proximity, with infrared proximity sensors detecting visitors' approach to mimic human activity, and display different kinds of light to show the outcomes of their choice.

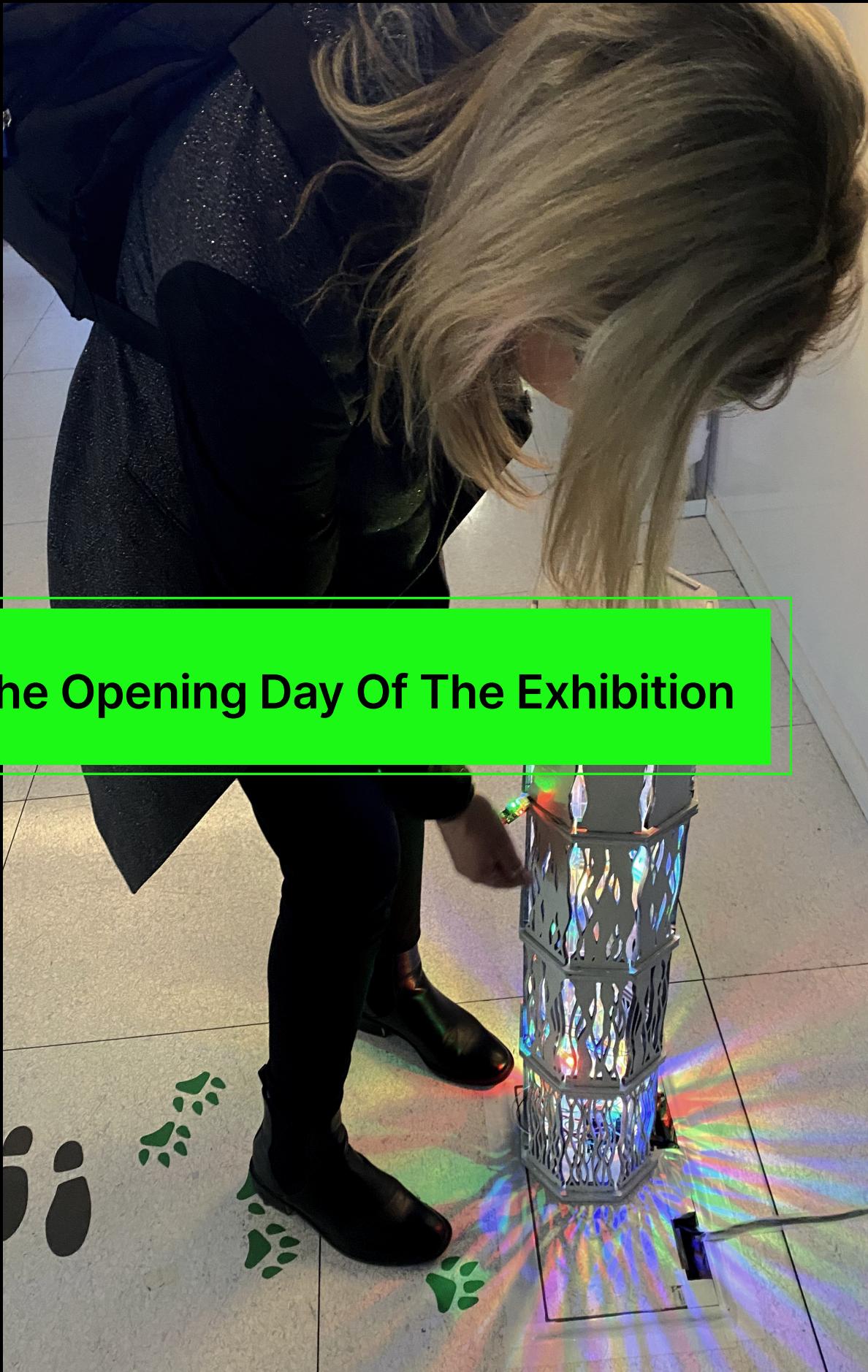
Installation



Installation



EXHIBITION

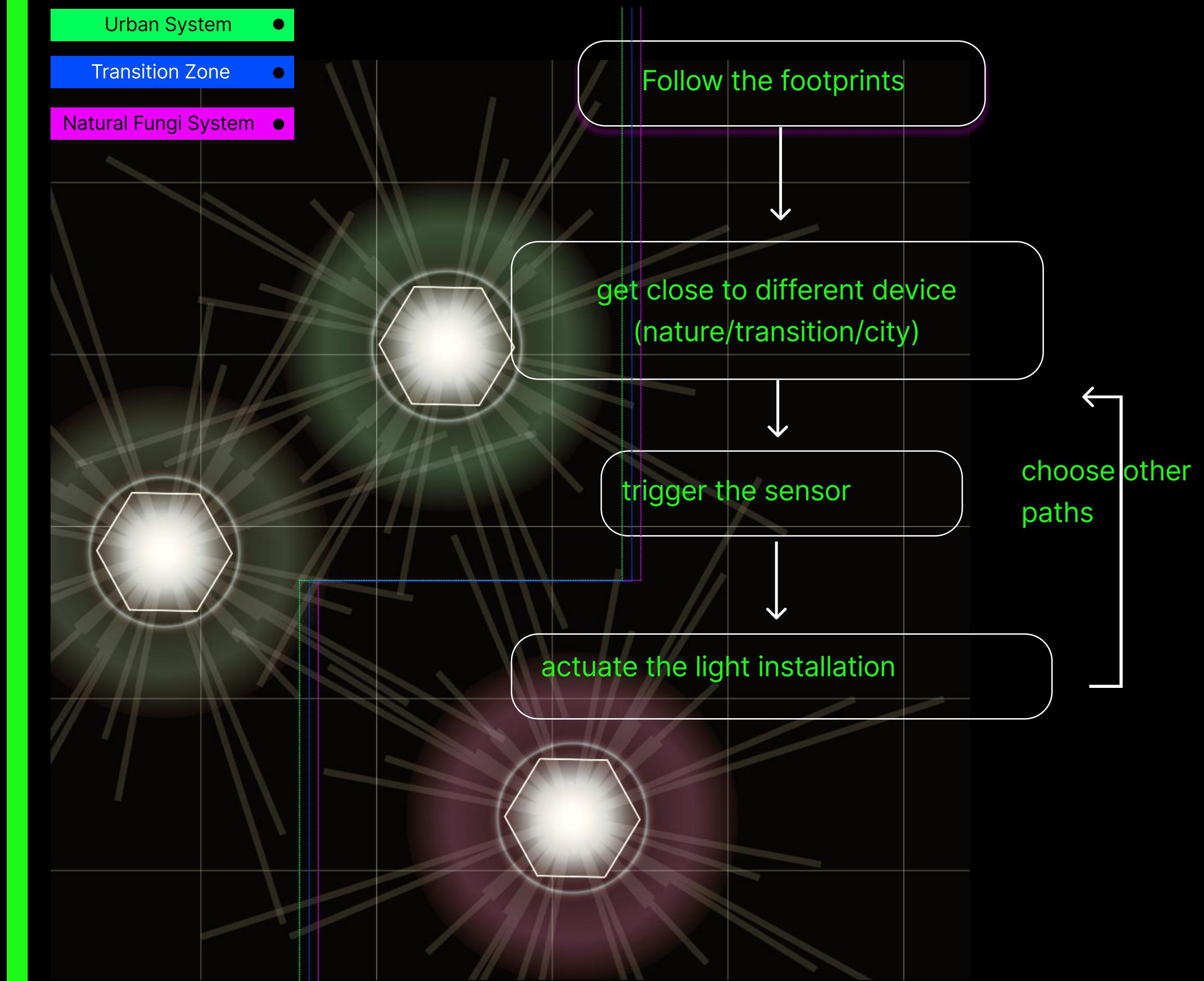


Taken On The Opening Day Of The Exhibition



Interaction

Urban System •
Transition Zone •
Natural Fungi System •



EXHIBITION

Feedback Summary

1

Device Collaboration and Interaction:

- Consider collaboration and interaction among the three devices, which may involve technical adjustments related to data sharing and information transmission.
- Adjusting the sensitivity of infrared detection.

2

Design and Scale of Devices:

- Enlarge the scale of the devices, which may create a more immersive experience.
- Placing the devices against the wall to create better lighting effects may necessitate considering the design of brackets or fixtures.

3

Sound and Materials:

- Including sound elements may require adding speakers or adjusting the audio output of the devices.
- Adopting biomaterials to give a material metaphor related to the ecological theme.

4

Content and Presentation:

- Providing more contextual presentation may require adjusting the content and interaction methods of the devices to better convey information to the audience.

Words from Visitors



"Lighting would be much better if there were panels around the device"



"Is there any collaboration between the units?"



"Biomaterials might have an interesting effect"



"How to play, please?"

REFLECTION

1 scale of installation & sensor

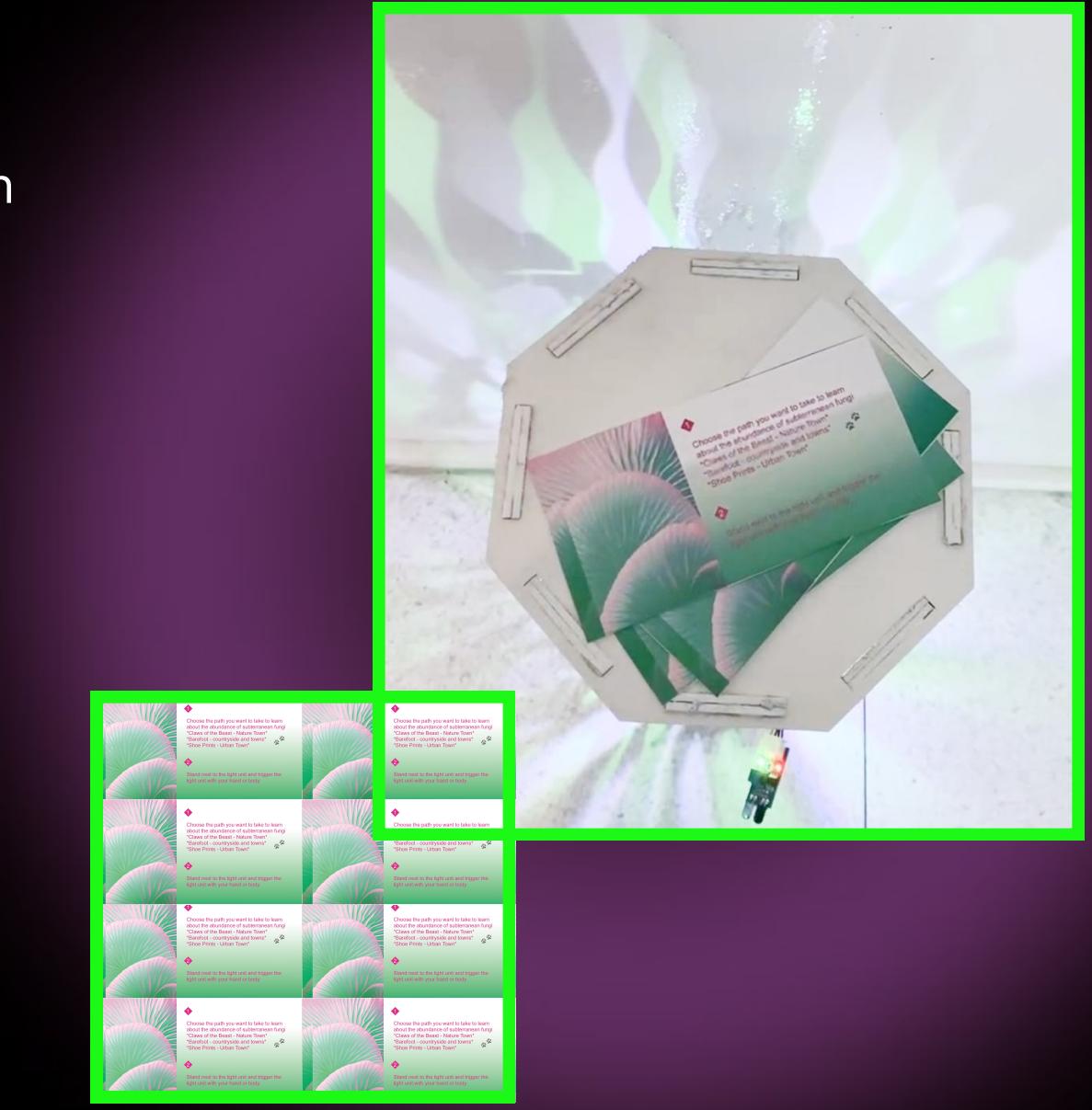
During the course of the exhibition, there were both adult and child users, and we noticed that in order to trigger the light effects, adults often needed to **crouch down** and **trigger them with their hands**. From this, we thought that **pressure sensors** might be a better choice, satisfying the interactive function while also being more in line with people's **behavioural intuition**.

Furthermore, we should consider the gadget's scale; if we want to form a feeling of **immersion** in the underground fungal world, the device should **be close to human size**; nevertheless, it is currently failing to accomplish the required effect.



As we are a light installation, we should be more considerate of the environment. Due to Light changing on site, sometimes the lighting cannot achieve an ideal effect. Therefore, some **auxiliary measures** should be employed, such as **baffles**, or the use of **black curtains** around the installation to create a relatively **dark area**.

2 Exhibition set-up (lighting concerns)



3 contextual information

On the day of the launch, on-site attendees frequently required our explanations to understand the exhibits, which reminded us the value of **context** and relevant information. As a follow-up, we designed **cards** to enhance comprehension.