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Space Echo 2.0:

Exploring Social Interaction Through

Communication Barriers in VR

# TABLE OF CONTENTS

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01 Motivation & Theoretical Framework

---

02 Space Echo 1.0: Initial Prototype

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03 Designing Space Echo 2.0

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04 Implementation Journey

---

05 Spatial Design and Narrative

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06 Experimental Findings

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07 Conclusion

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08 References

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# Social VR

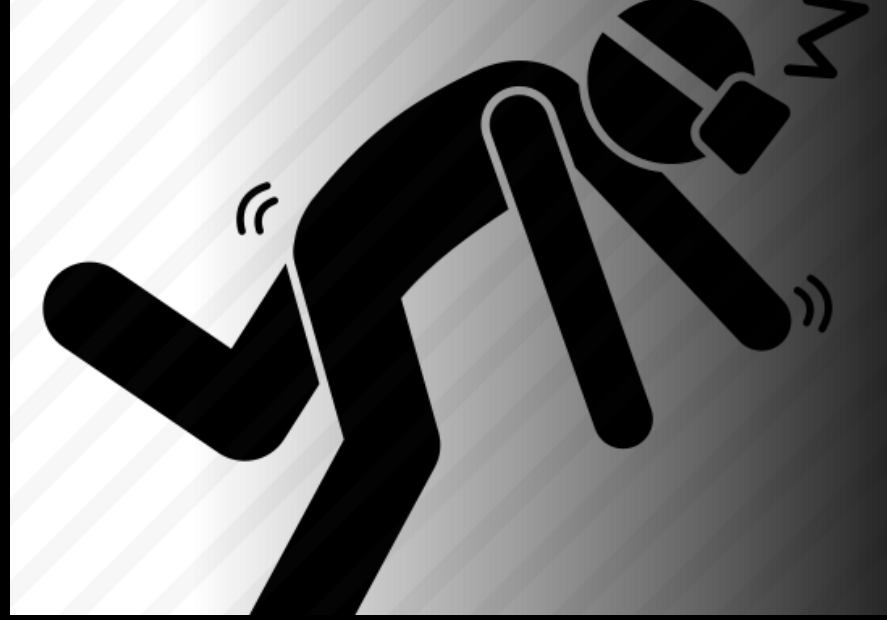
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An immersive digital platform where users interact in real time through avatars in a shared virtual space.

- VR Chat,
- Rec Room
- Altspace VR
- High Fidelity
- Meta Horizon
- Mozilla Hubs



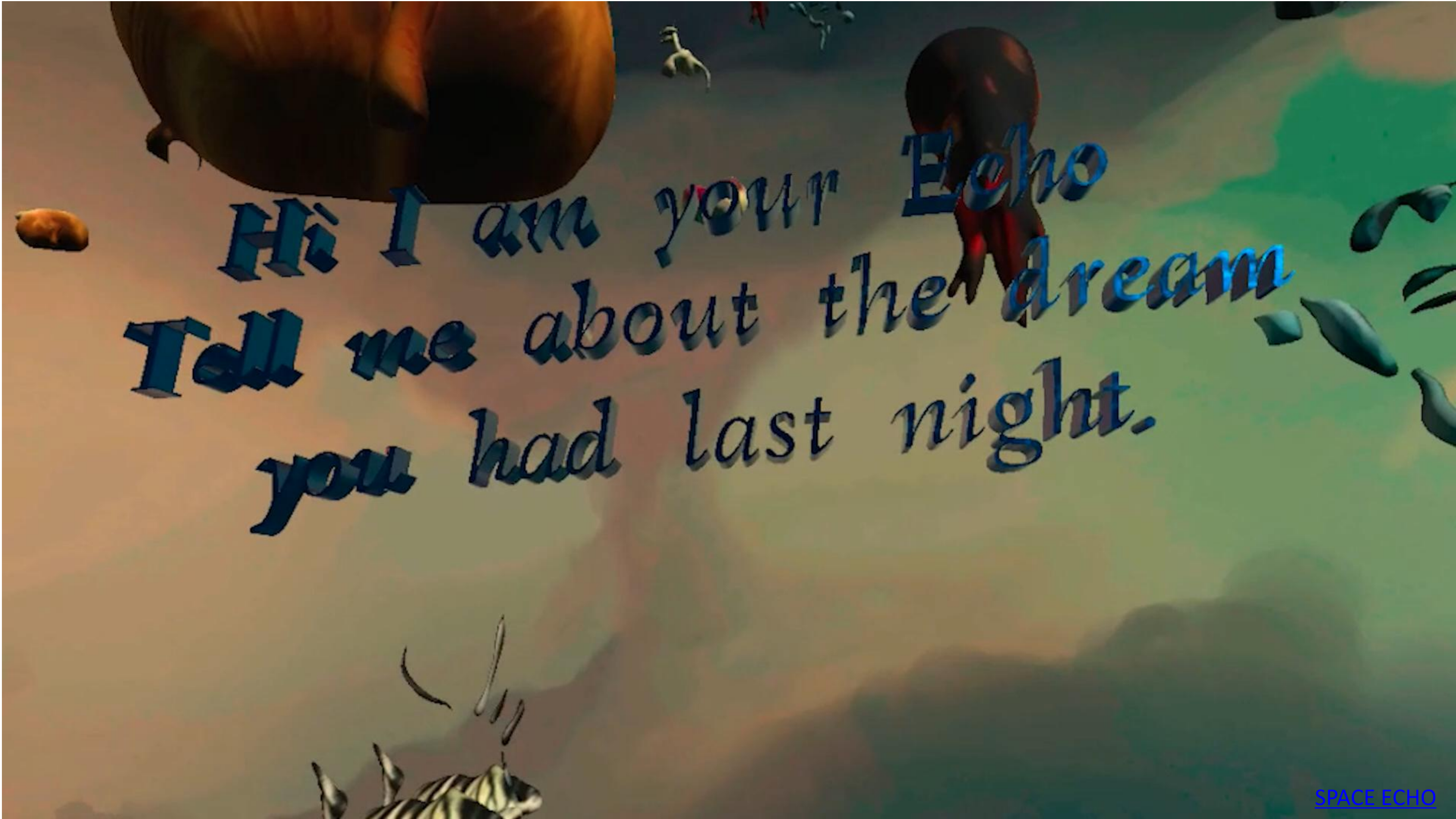


# The Gray Area Between Reality and VR

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- Lack of eye contact
- Lack of subtle facial expression
- Noise distraction
- Heaviness of the HMD
- Limited graphics

A surreal, dreamlike landscape. In the upper left, a large, glowing orange sphere hangs in the sky. To its right, a red, alien-like creature with a bulbous head and thin limbs stands on a light-colored ground. The sky is a mix of light blue and green, with various floating objects: a small orange fruit, a white bird-like creature, and several dark, teardrop-shaped objects. The overall atmosphere is ethereal and otherworldly.

Hi I am your Echo  
Tell me about the dream  
you had last night.

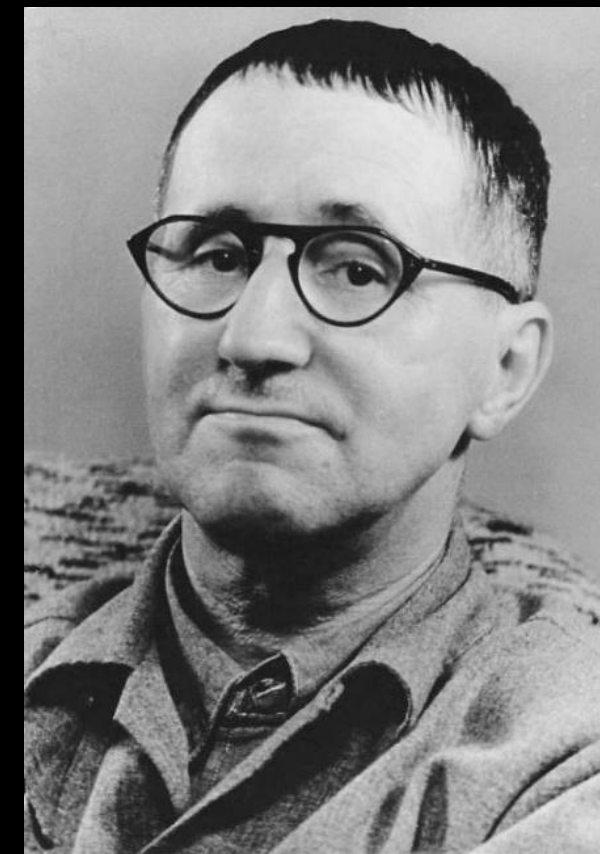
# DISTANCING EFFECT VERFREMUNGSEFFEKT

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By interrupting immersion, the audience can distance themselves from the play and it enables them to reflect on social issues.

ex) Experimental stage settings, innovative acting methods, and direction

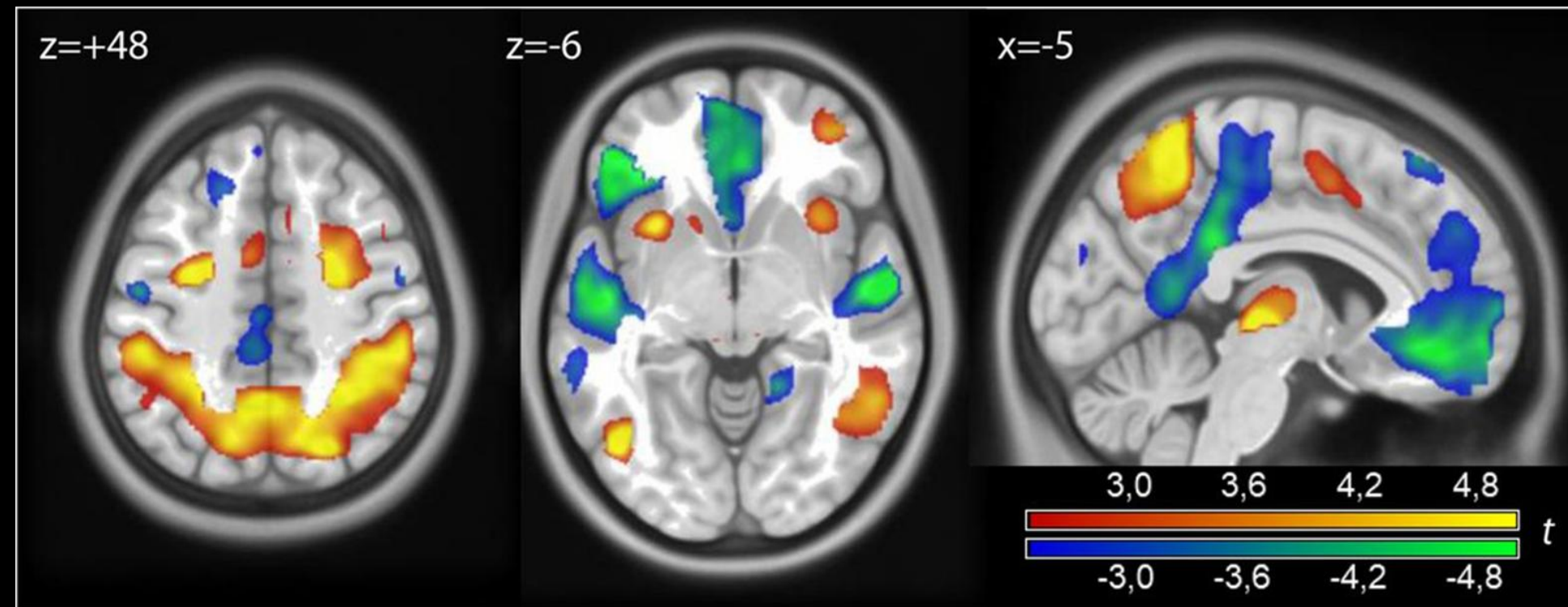
Breaking immersion == Critical view on society



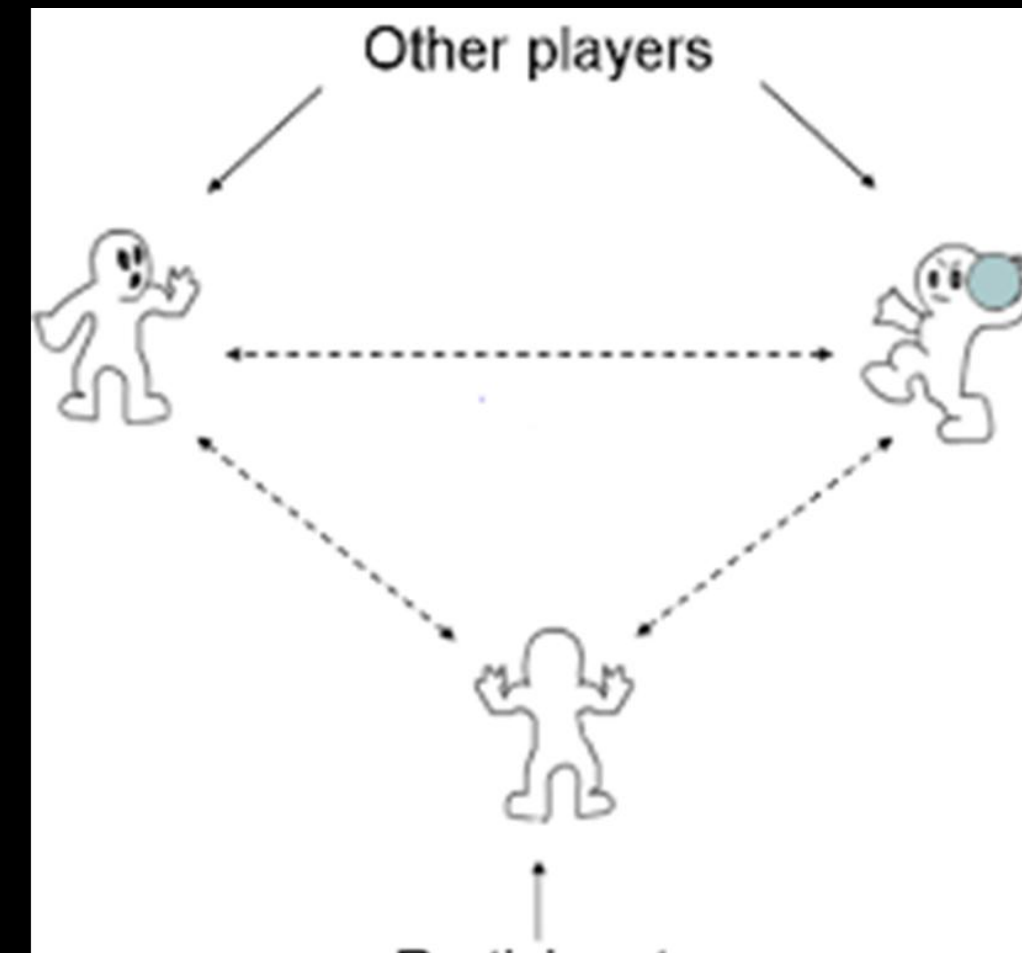
Bertolt Brecht

# CYBER BALL EXPERIMENT

Social rejection in virtual reality = Psychological pain



CINGULATE CORTEX ASSOCIATED WITH PAIN PERCEPTION



Williams, K. D., Cheung, C. K. T., & Choi, W. (2000). CyberOstracism: Effects of being ignored over the Internet. *Journal of Personality and Social Psychology*, 79, 748-762.

# Motivation & Theoretical Background

# RESEARCH QUESTION

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Can **intentional communication barriers** in social VR help

- (1) increase users' **desire to connect**, and
- (2) foster **meta-reflection on communication**?

# HYPOTHESIS

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Intentional disruption in communication inside a social VR

app can foster **deeper connection** and provoke

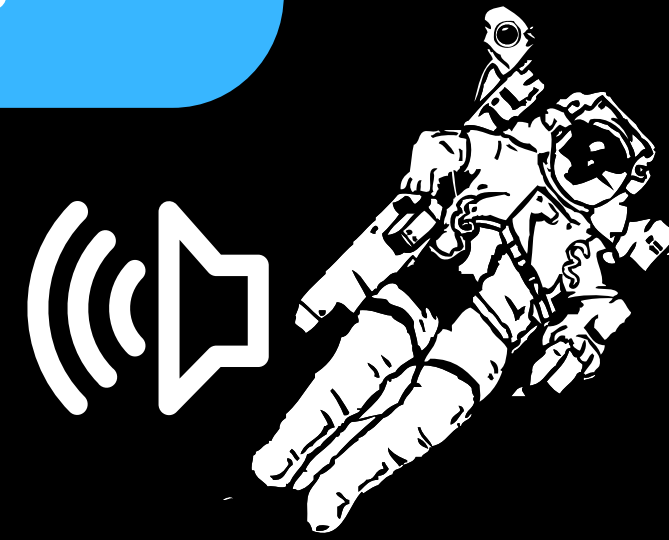
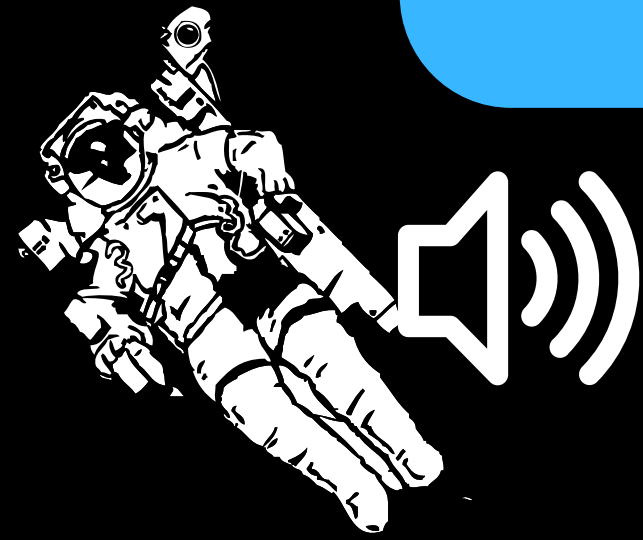
**meta-reflection** on the communication.

# SPACE ECHO 2.0

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	Controller powered	Voice powered
Locomotion style	Press trigger button	Speak
Direction	Forward	Backward
Key Mechanism	Smooth navigation Voice	Voice-powered reverse Speak → Move backward → Forced distance

WHAT IS YOUR  
FAVORITE  
MEMORY?



SPEAK

MOVE

COLLIDE  
TRIGGER  
QUESTION

ANSWER

QUESTION  
DISSAPERS

CONCLUSION 질문  
리스트, 어떤 식의  
질문이 있었나?

*Design disconnection to foster connection.*

어떤 질적 질문을  
하였는가?

*Design disconnection to foster connection.*

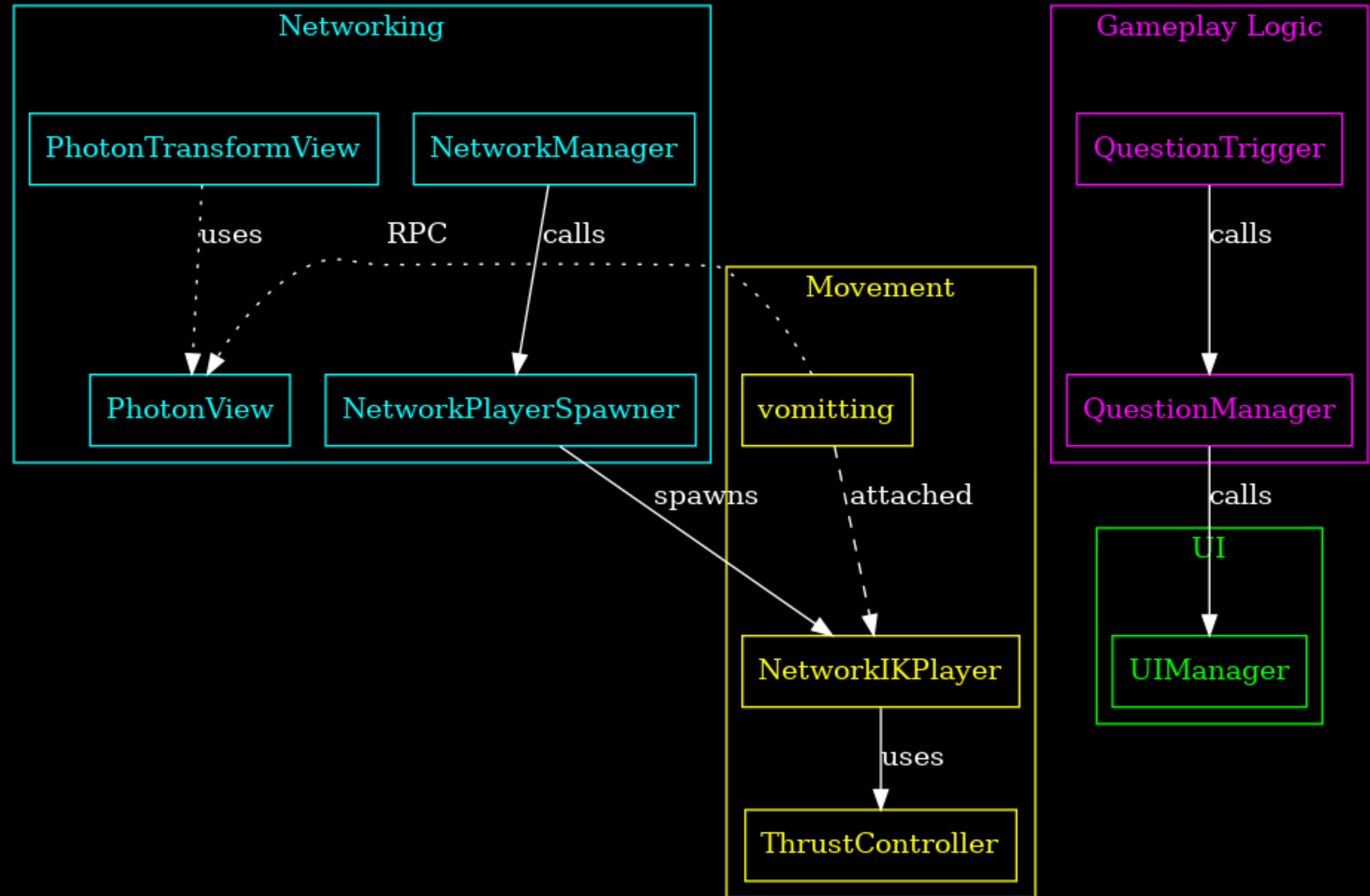
# TECHNICAL IMPLEMENTATIONS

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- Meta Quest 2 VR
- Unity + C#
- Photon PUN (real-time sync)
- Speech to text Api+ 3D text renderer (Tiny Giant Studio)
- Oculus SDK + OpenXR for input

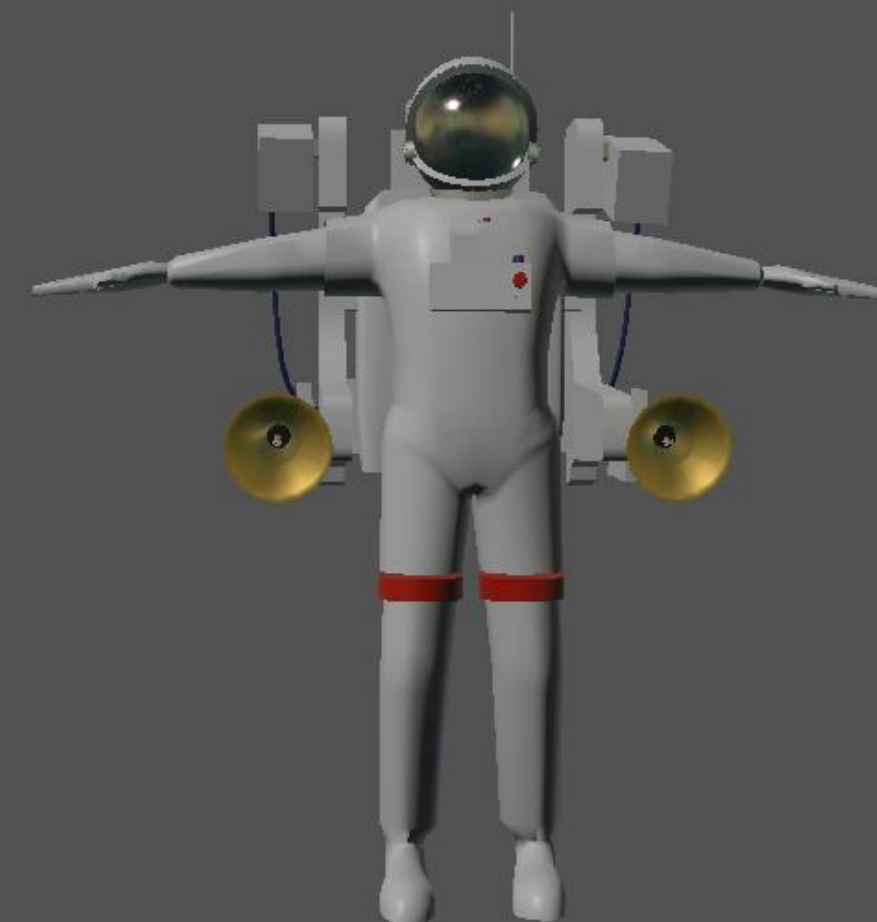
# Motivation & Theoretical Background

# SYSTEM DESIGN



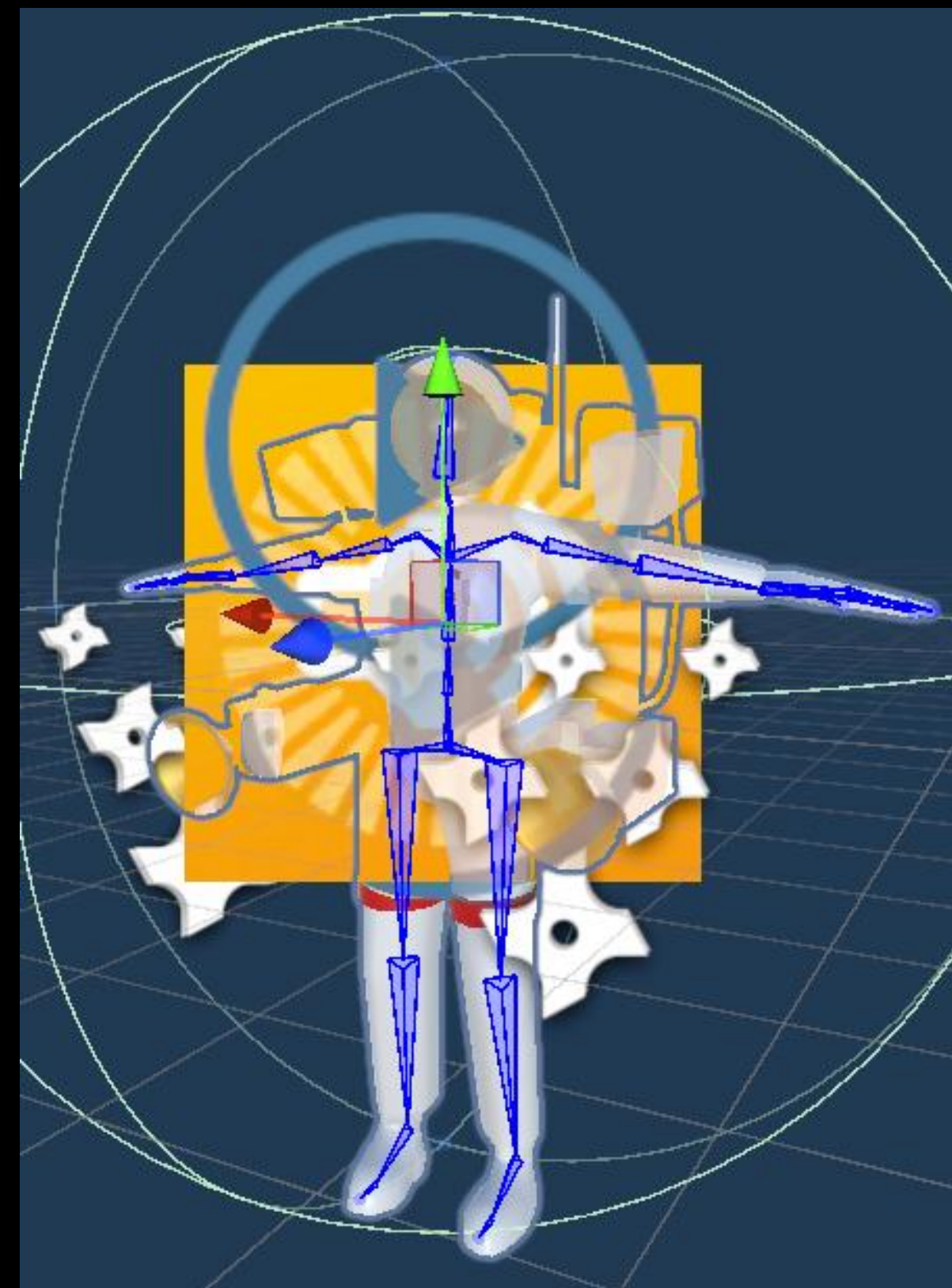
# CHARACTER DESIGN

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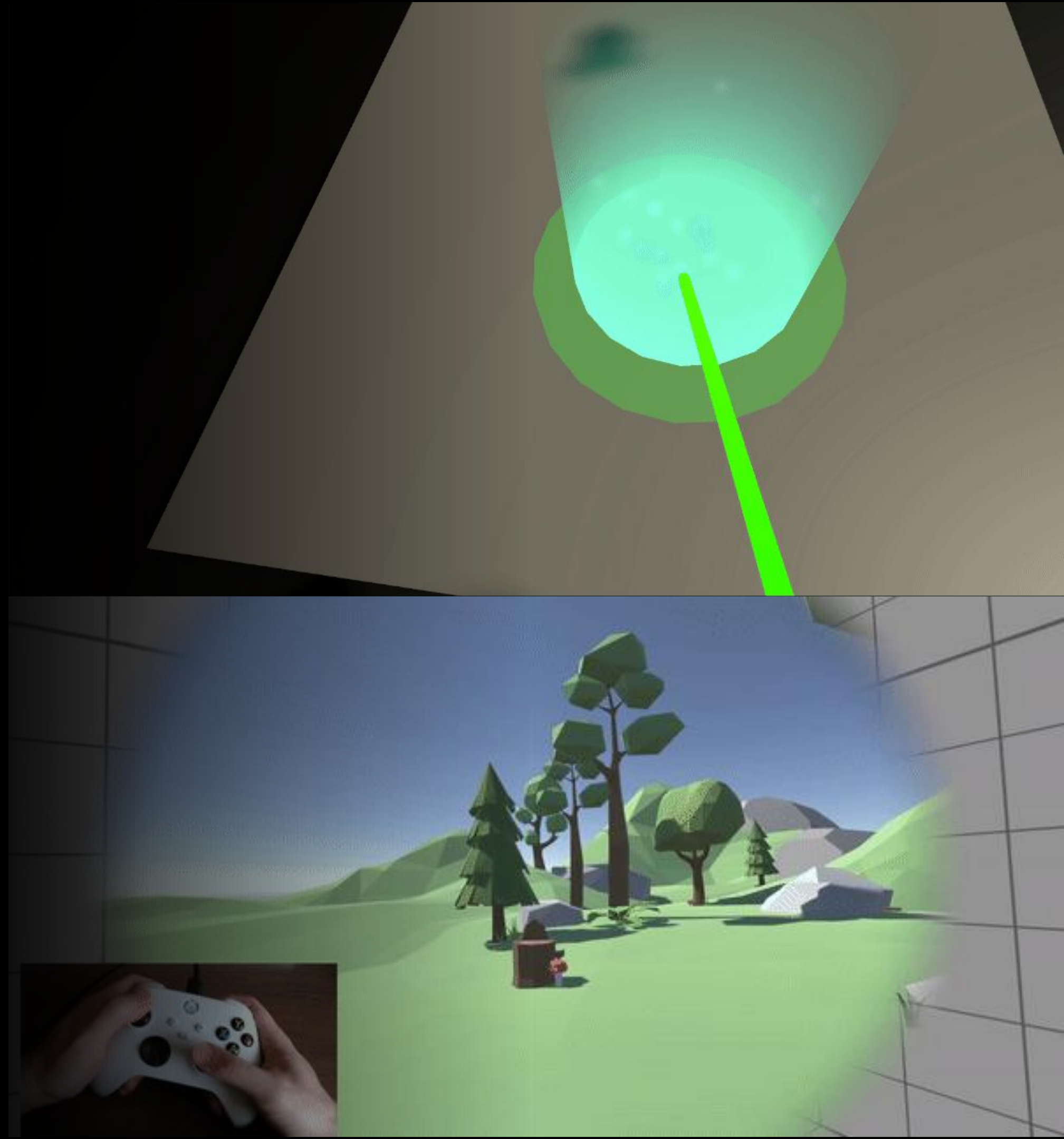
# CHARACTER MAPPING

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# AVATAR LOCOMOTION

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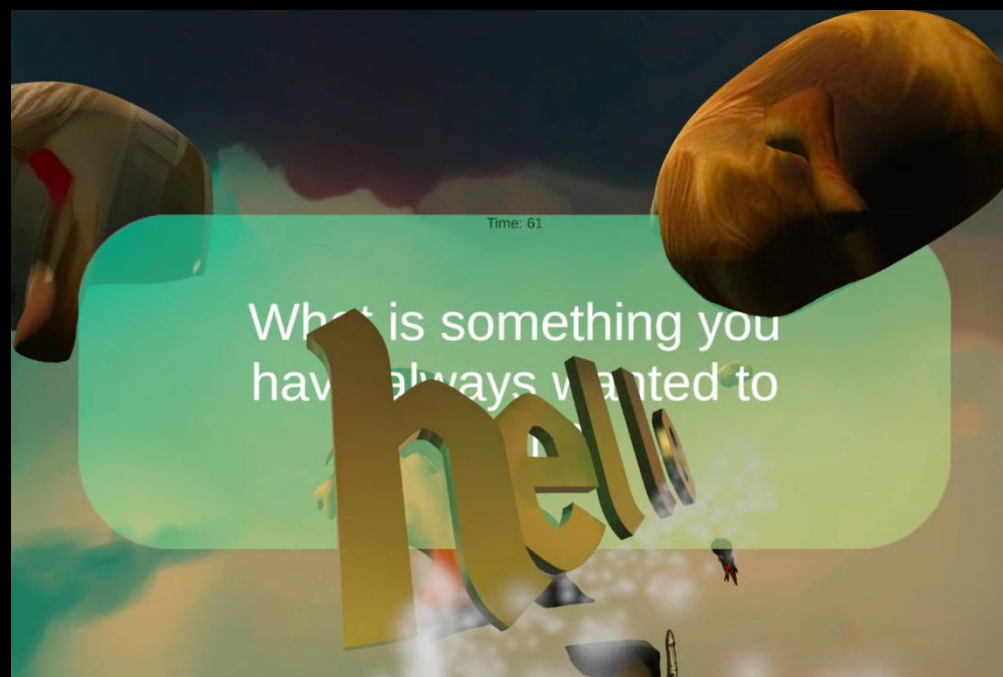
# REVERSE JETPACK SYSTEM

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# SPEECH TO TEXT TRAIL SYSTEM

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MULTIPLAYER  
NETWORK  
ENVIRONMENT

---

PLUS



photon

PUN

2

MULTIPLAYER



# QUESTION UI SYSTEM

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▼ # ✓ Question Manager (Script) ⓘ ↗ ⋮

Script

Question UI Panel

Question Text

Timer Text

▼ Questions 10

Element 0	Speak to move. You can only move in t
Element 1	What is one of your favorite places in t
Element 2	What has been the highlight of your we
Element 3	What are people usually surprised to fir
Element 4	What is your greatest struggle right no
Element 5	What is one moment in time you will ne
Element 6	What is one of your greatest motivator
Element 7	What is the most adventurous thing yo
Element 8	What is your most treasured memory?
Element 9	What does friendship mean to you?

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# REWARD PARTICLE EFFECT

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ECHO  
AND  
NARCISSUS

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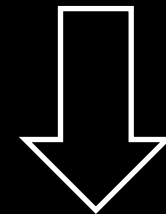
# SPATIAL DESIGN

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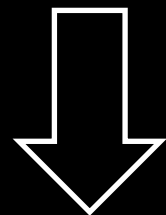


# TEXT GENERATION / TEXT TO SPEECH

ORIGINAL ECHO & NARCISSUS STORY



AI GENERATED STORY



AI GENERATED AUDIO

TextSynth Home Playground Documentation Pricing Technology Login Sign Up

**Text Completion** Text completion using large language models. More information is available in the [documentation](#).

Translation  
Text to Image  
Chat  
Voice Chat  
Speech to Text  
Text to Speech

Type a text and let the neural network complete it. Each try returns a different randomly chosen completion.

Model:  top-k:  top-p:  temperature:  max tokens:  stop at:

Select an example

Tiresias' fame of prophecy was spread through all the cities of Aonia, for his unerring answers unto all who listened to his words.

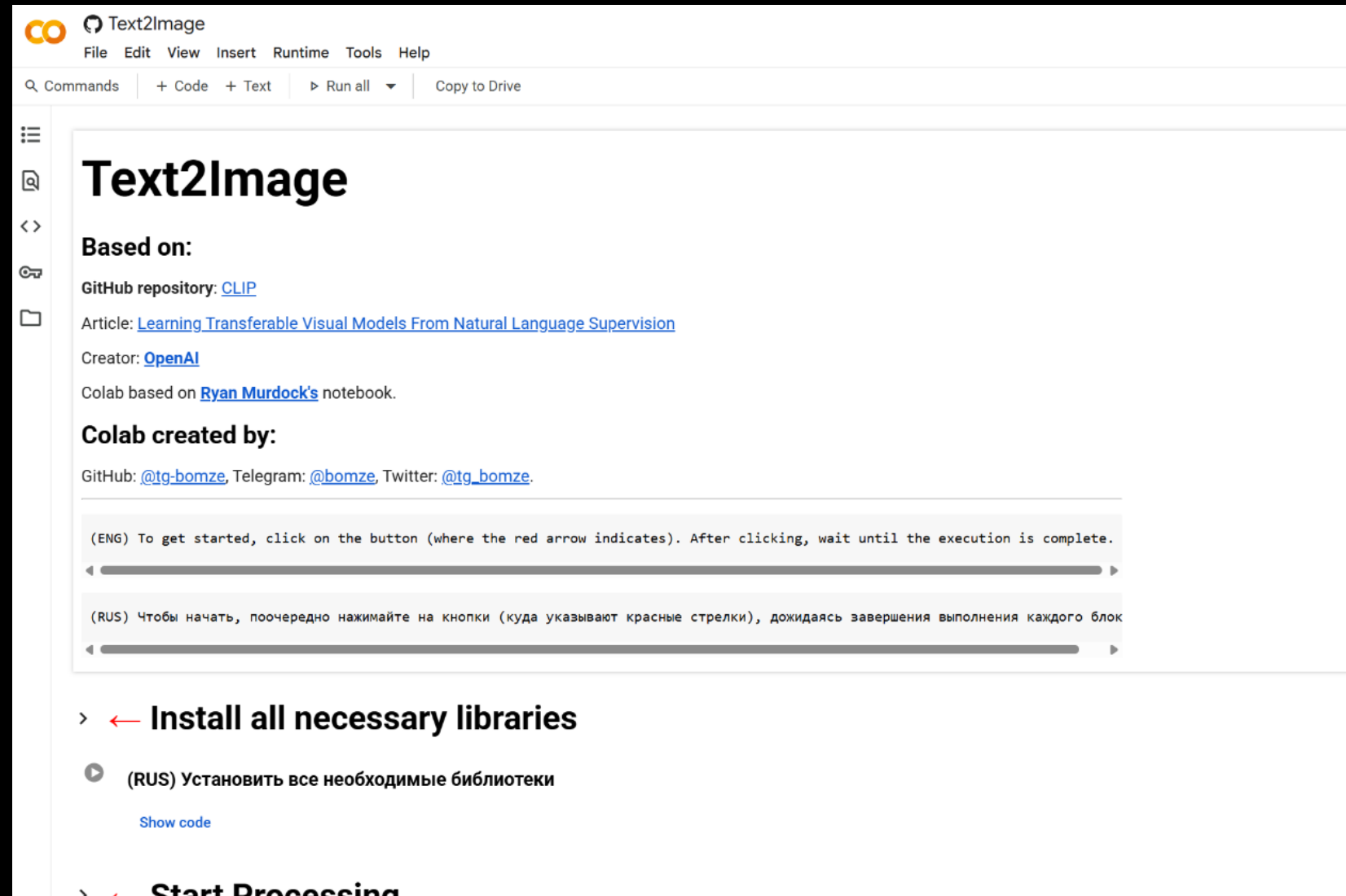
[Generate another](#) [More](#)

**Completed Text:**

**Tiresias' fame of prophecy was spread through all the cities of Aonia, for his unerring answers unto all who listened to his words.** And many were the folk who made the journey to Aonia, in order that they might learn from his lips the counsels that were right for them. And many too were the folk who made the journey from afar to sit with the prophet, and to listen to his utterances, that they might behold him and his wisdom. For the fame of his prophecy was made great throughout the land by the many things that he had said that were proven true. But when Oedipus went forth to war, and after he was returned to Thebes, the city mourned because of his misfortunes, and because the king was gone from the kingdom. And while Oedipus had been blind from anger, many of the folk of Thebes had thought that the blinding was rightly-done. Then Tiresias said: O Thebans, do not be deceived in this

# AI IMAGE GENERATION/ TEXT TO IMAGE

CLIP+BigGAN Text2Image by Ryan Murdock



The screenshot shows a Google Colab notebook interface for 'Text2Image'. The notebook title is 'Text2Image'. Below the title, it lists the following information:

- Based on:**
  - GitHub repository: [CLIP](#)
  - Article: [Learning Transferable Visual Models From Natural Language Supervision](#)
  - Creator: [OpenAI](#)
  - Colab based on [Ryan Murdock's](#) notebook.
- Colab created by:**
  - GitHub: [@tg-bomze](#), Telegram: [@bomze](#), Twitter: [@tg\\_bomze](#).

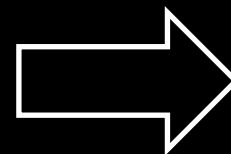
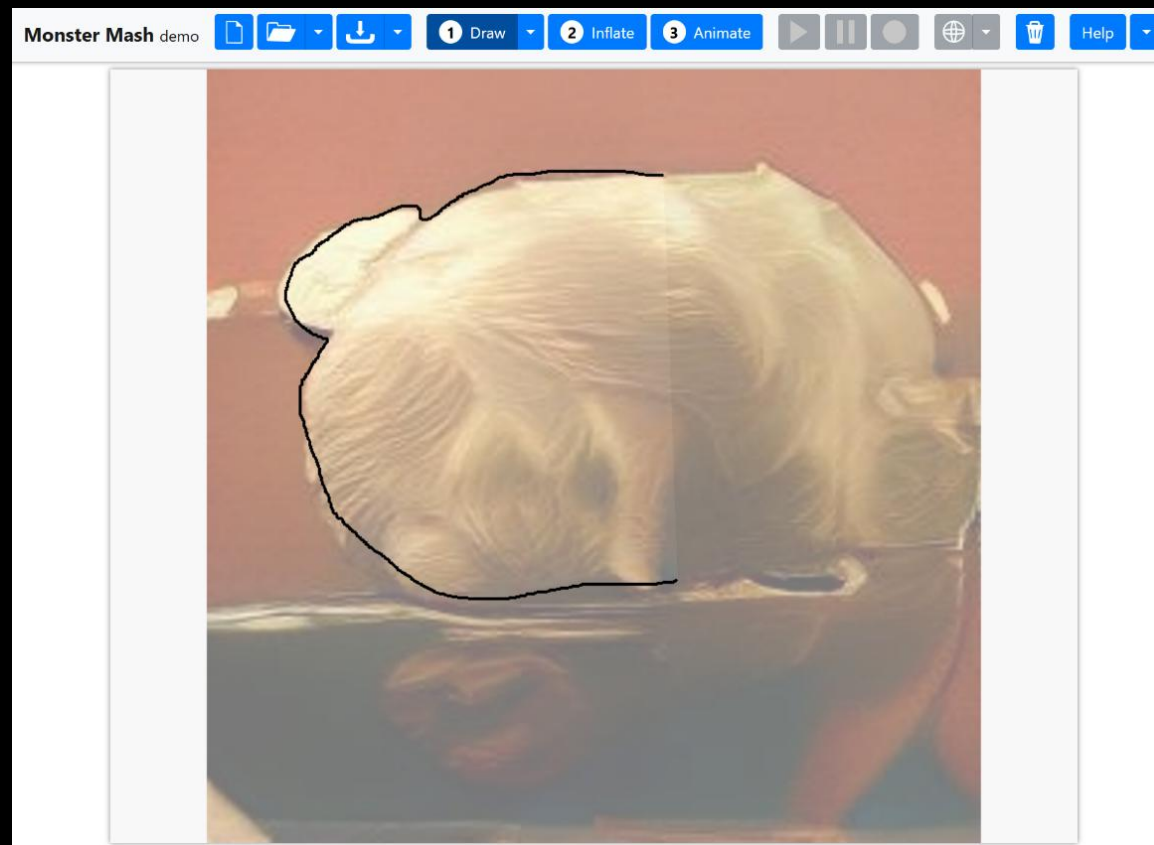
Below this information, there are two code blocks with instructions:

- (ENG) To get started, click on the button (where the red arrow indicates). After clicking, wait until the execution is complete.
- (RUS) Чтобы начать, поочередно нажимайте на кнопки (куда указывают красные стрелки), дожидаясь завершения выполнения каждого блок

At the bottom, there is a section titled 'Install all necessary libraries' with a sub-section '(RUS) Установить все необходимые библиотеки' and a 'Show code' link.



# AI 3D OBJECT GENERATION IMAGE TO 3D MODEL



MONSTER MASH

# DEVELOPMENT CHALLENGES

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## **Synchronization Issue**

- Synchronizing avatar position, hand movements, and head tracking across clients was difficult.
- The problem was that different parts of the avatar would sometimes appear misaligned or delayed on other players' screens.

## **Solution**

- Used Photon RPC (Remote Procedure Call).
- Allows a function called on one client to be executed on all others.
- Ensures consistent and real-time representation of movements for all players.

# DEVELOPMENT CHALLENGES

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## **Text Trail Rendering Issue**

- 3D text trails did not appear letter by letter.
- Entire sentences would appear all at once after speaking.
- Texts were often overlapping in the same location.

## **Solution**

- Built a coroutine-based queue system to control the timing of character output.
- Adjusted output intervals dynamically based on the player's movement speed.

# SPACE ECHO 2.0 USER STUDY



# SPACE ECHO 2.0

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## Study design

- Mixed-method
- Within-subjects design

## Participants

- N = 30 (25 analyzed)
- Age: 20s–30s
- Diverse gender identities

## Conditions

- Controller-powered  
vs Voice-powered (Reverse Jetpack)
- Condition order randomized

## Data Collected

- Qualitative: Post-experiment interviews

# DISCOMFORT SPARKS STRATEGY

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*"...since we both were really **thinking about how difficult it was** to find each other. We were actually able to **talk more like friends rather than strangers**. So I think that is something that take our mind off the conversation." (P22)*

*"**Teamwork** and using **hand signals** to tell others to talk or stop." (P3)*

*"I tried **different ways to talk** and then I spent some time **to find a way to move**. Like, for example, if I put a request in this way, it would move backward or forward." (P27)*

*"I tried **different volume** to get close to my partner." (P11)*

# DIVERGING OUTCOMES

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"I was able to have a **good personal level conversation** with my partner since we both were more focused on the difficulties, **we forgot for a second that we were strangers**. That wouldn't have happened if we were in the real world." (P24)

"It was a **strange interaction** and trying to figure it out together **broke the ice**. We had to try harder to collide, which meant we **had to cooperate more**." (P7)

"The **obstacle made me more motivated** to find my partner. We started **working as a team**." (P24)

"I was **more focused on turning around**, trying to run into her, and then looking in another direction... I needed to be careful of what I say and how long of a sentence I'm forming. So it was kind of... **uncomfortable**." (P8)

**I did not want to continue the conversation** because talking would cause me to move away..." (P19)

"I think we were **struggling** a lot and I think that lack of connection ended up making me feel **tired and fatigued and not really wanting to engage**." (P23)

# REFLECTIONS ON COMMUNICATION

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*"I think make me more appreciate on the actual experience since we are hard to get to each other in the reversed experience." (P17)*

*"Yes, because it shows how talking to people may make you become more distant from them, both positionally (virtual) and in a communicative sense..." (P6)*

*"It's a really nice metaphor of digital communication where we don't really see each other... we are all strangers and things get lost in space..." (P7)*

# LIMITATIONS

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- Measurement limitation :
  - **Small-scale qualitative study** – Only 30 participants, limited generalizability
  - **No quantitative measures** (e.g., for presence, connectedness, or frustration) were collected
- Scope limitation :
  - Findings **tied to two specific prototypes**( Apnea and Space Echo)
- Uncontrolled Individual Differences :
  - **relationship intimacy** (acquainted vs strangers)
  - **personality traits** (challenge tolerance, stress sensitivity)
  - **VR experience level**

# FUTURE WORKS

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## Behavioral Data Collection

- Eye tracking
- Speech Volume
  - Proximity

## Comparative Experiments of Disruption

- Varying types of disruption mechanisms

## Cross Field Application Exploration

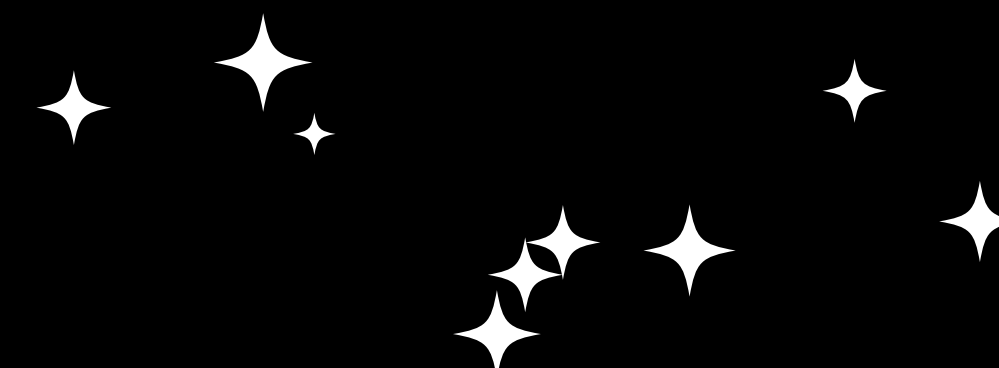
- Games
- Remote learning
- Mental health

# CONCLUSION

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*Design disconnection to foster connection.*

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# FINDINGS

# Thank you

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