# Rumo ao Metaverso

## Definições e Oportundiades


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# Medialab - IC

# O Metaverso vai acontecer???

# Premissa 1: como interagimos com o mundo digital


# Premissa 2: Eles já existem e lidamos com eles a muito tempo...


# Premissa 3: Precisamos (muito) deles...

# Digital Twins (ou “serious metaverse”)

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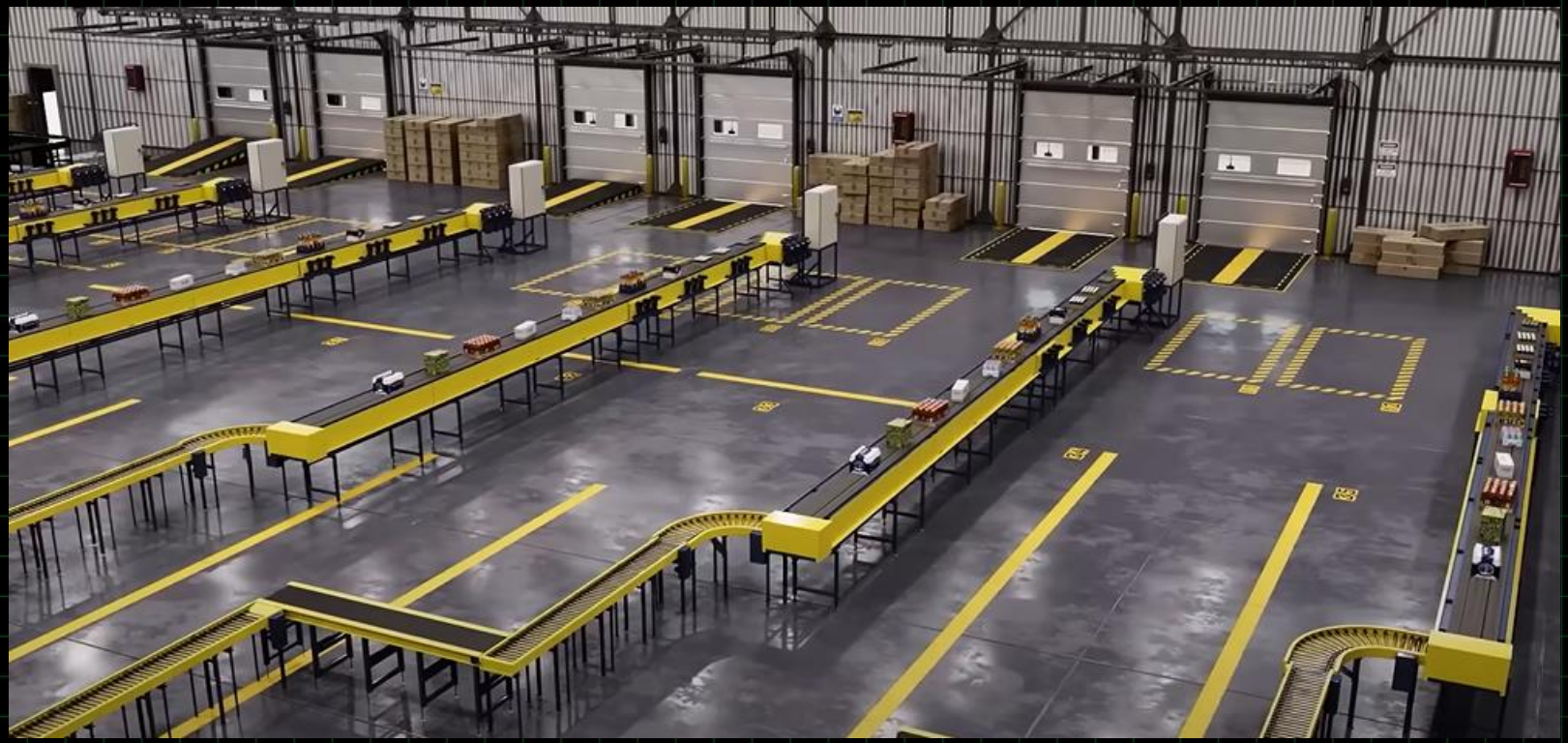
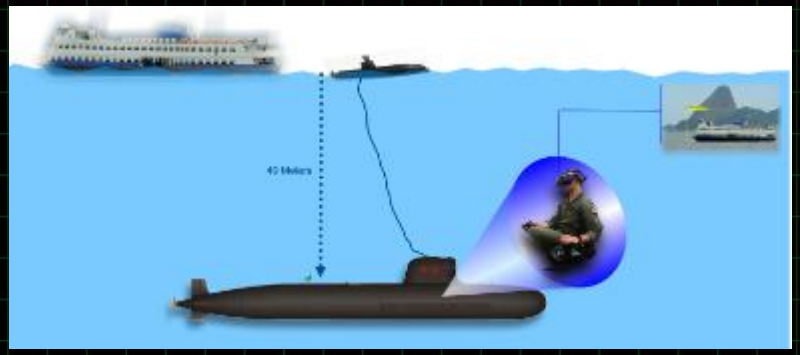
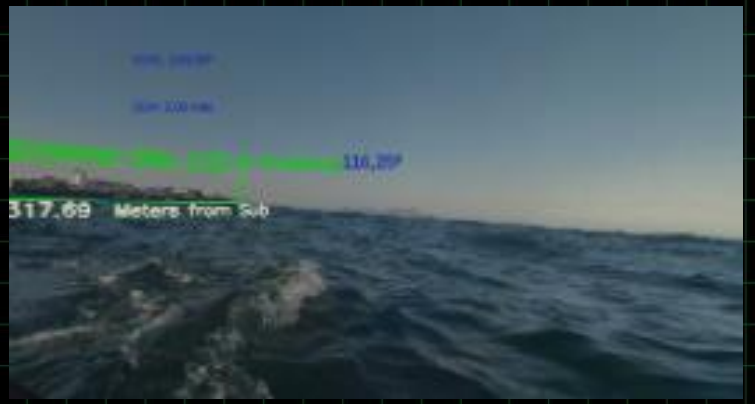


https://www.youtube.com/watch?v=39ubNuxnrK8

# Fboat e lancha autonoma

# Visão computacional

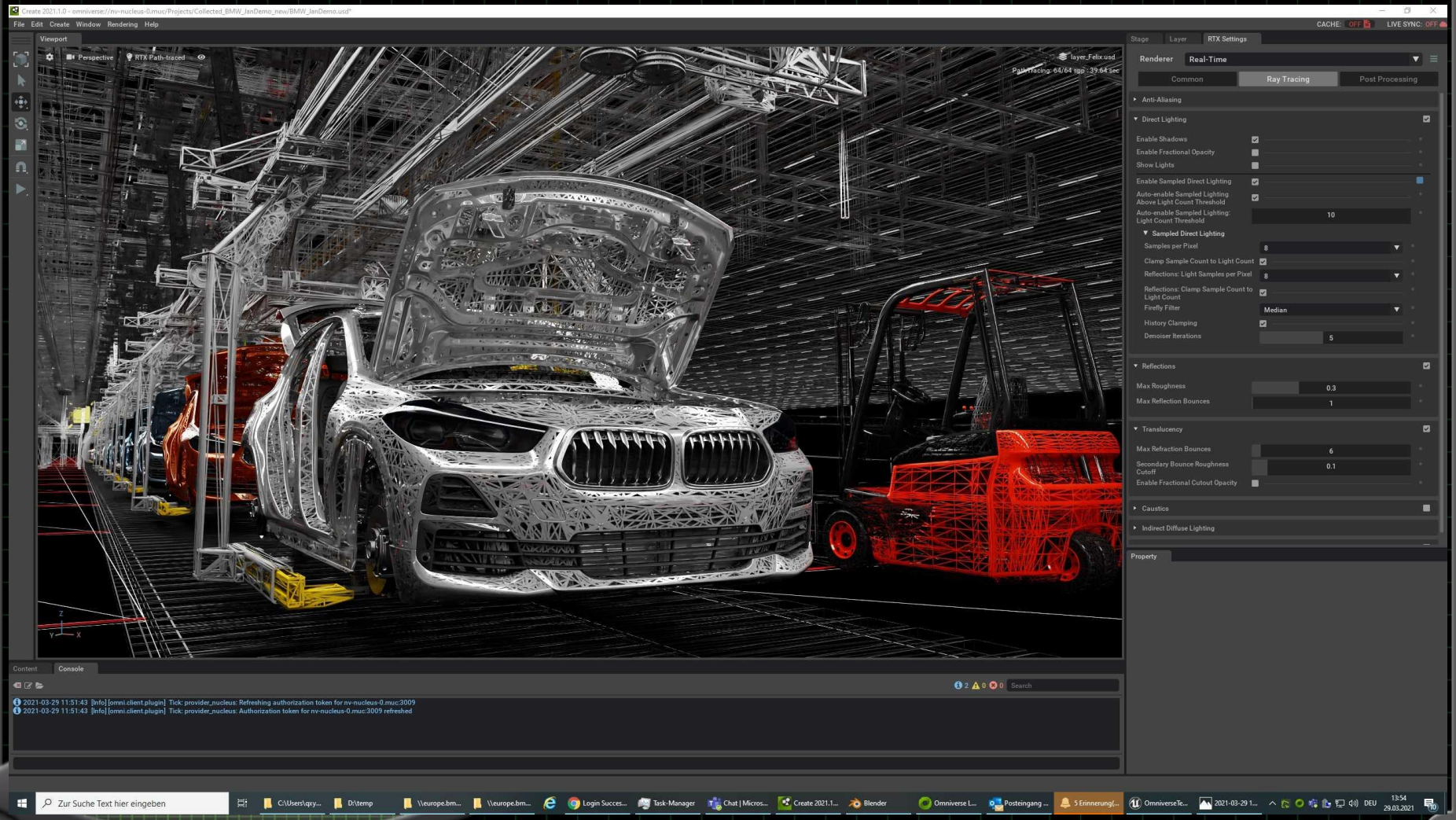





# Visão computacional

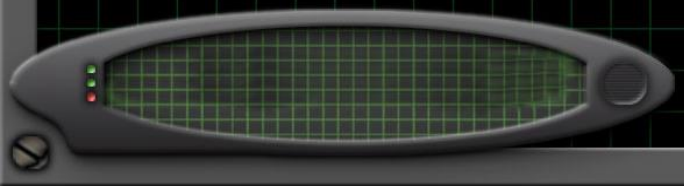


# NVIDIA Omniverse




Unity
Produtos
Soluções
Aprendizado
Mais
Comece
FERRAMENTAS PARA ARTISTAS
Ferramentas e conteúdo da Weta Digital
Unity e Weta Digital estão democratizando a mais completa cadeia de ferramentas para criação, simulação e renderização em 3D já criada.

# Em resumo...



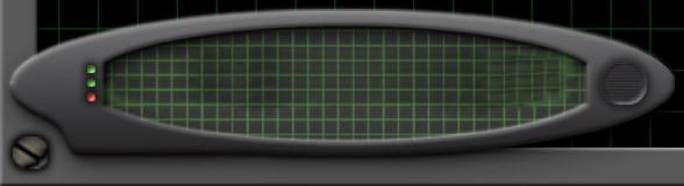
# Metaverso = $\sum_{k=0}^{n} X$

Onde X:

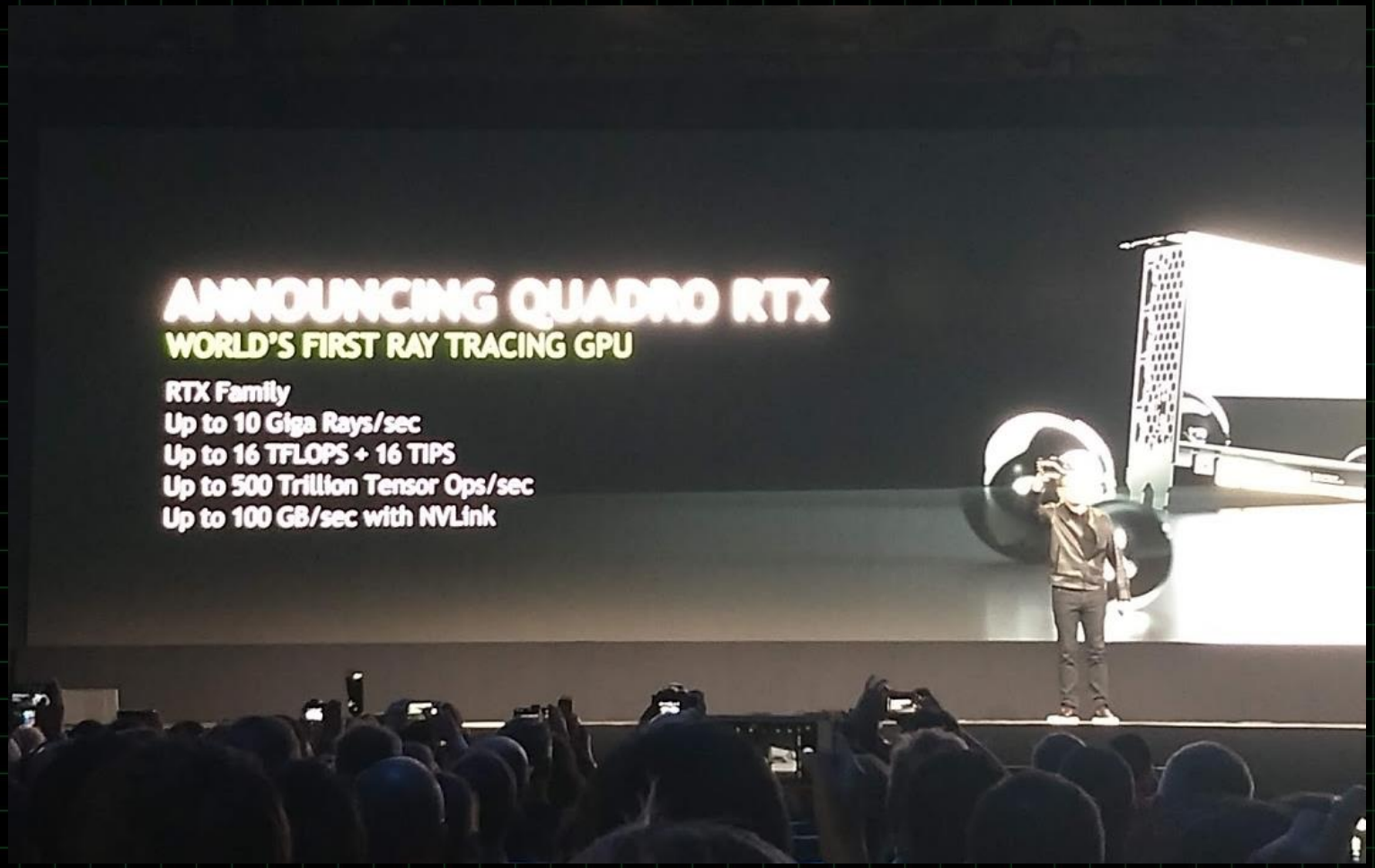
| | | | |
|---|---|---|---|
| Visualization | Management | Economy | Content Generation |
| Socialization | Authoring | Processing | ... |

***O Metaverso não existe...***
***Existem muitos metaversos...***
***INTEGRAÇÃO***

# Desafios técnicos...



# Real Time Ray Tracing

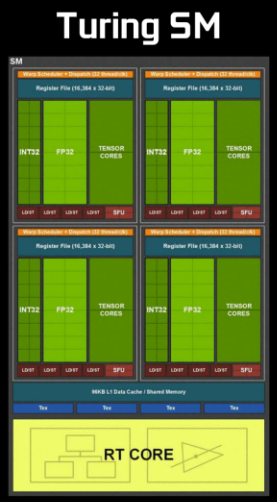


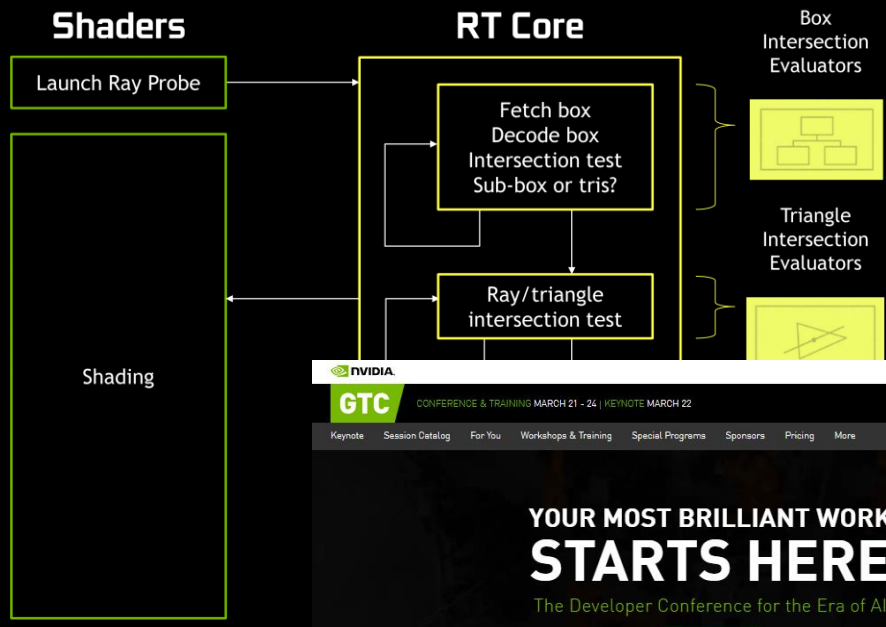

Courtesy of Peter Sivi/Motionland

# RTX Pipeline

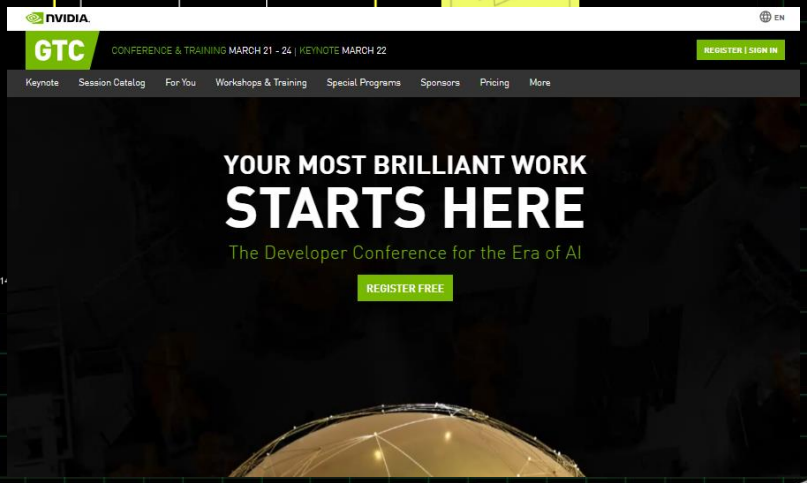
## TURING RAY TRACING WITH RT CORES

Hardware Acceleration Replaces Software Emulation




THIS PRESENTATION IS EMBARGOED UNTIL SEPTEMBER 1



# Displays em alta resolução

**Importance of Retina Display**

**Retina Display requires 16K!**

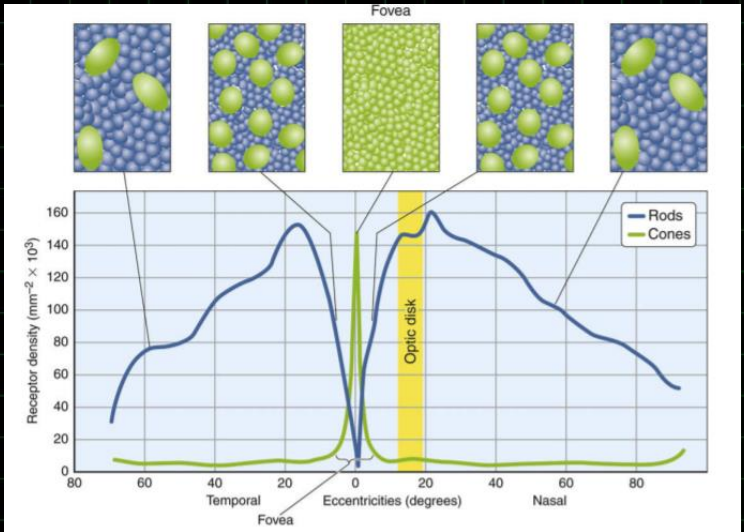
- **Full HD 2K → 1980 x 1080 = 2,07 Mpixels/Frame**
- **Ultra HD 4K → 8,29 Mpixels/Frame**
- **Nuclear HD 16K → 132,7 Mpixels/Frame**

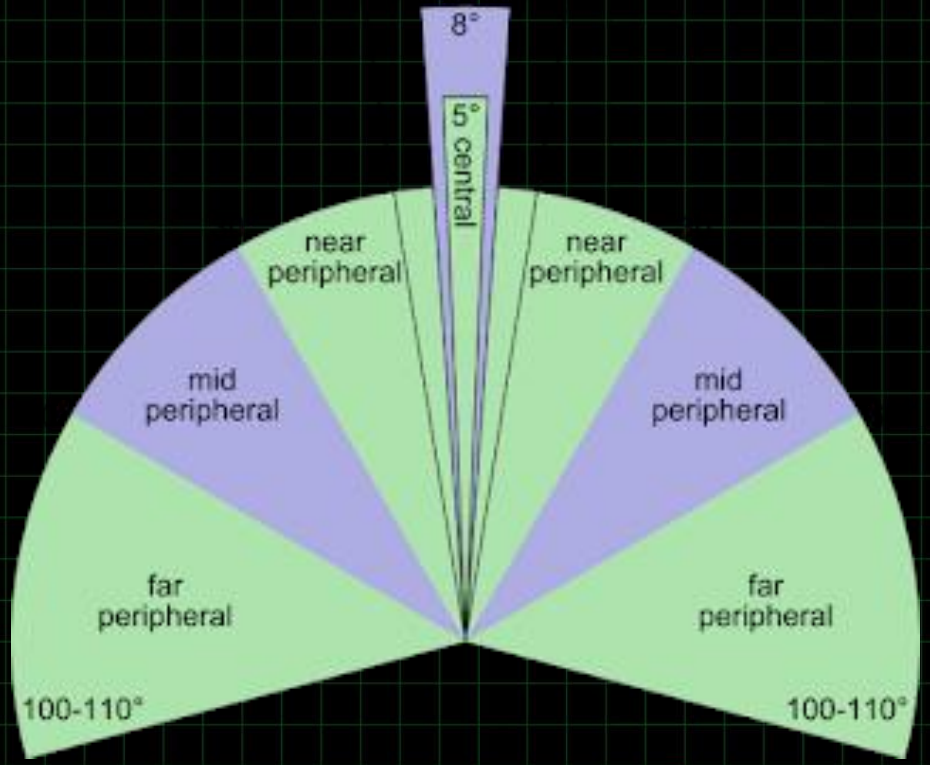
**64 times more pixels than Full HD displays**

Oculus Quest 2: (1832 x 1920 per eye)

**Iphone Retina display: 2532 x 1170**

# Foveated rendering



# Cybersickness

# Cybersickness identification


**2021:**

**Porcino, T.**, Bernardini, F., Rodrigues, E. O., Silva, A., Clua, E., and Trevisan, D. **A symbolic machine learning approach for cybersickness potential-cause estimation.** In *International Conference on Entertainment Computing*. 2021. Springer.

**Porcino, T.**, Trevisan, D., and Clua, E**. A cybersickness review: causes, strategies, and classification methods.** *Journal on Interactive Systems*, 12(1):269–282. 2021. SBC

**Porcino, T.**, Rodrigues, E. O., Bernardini, F., Trevisan, D., and Clua, E. **Identifying cybersickness causes in virtual reality games using symbolic machine learning algorithms.** *Entertainment Computing*, page 100473. 2021. Springer.

**2020:**

**Porcino, T.**, Rodrigues, E. O., Silva, A., Clua, E., and Trevisan, D. **Using the gameplay and user data to predict and identify causes of cybersickness manifestation in virtual reality games.** In *2020 IEEE 8th International Conference on Serious Games and Applications for Health (SeGAH)* , pages 1–8. IEEE.

**Porcino, T.**, Trevisan, D., and Clua, E. **Minimizing cybersickness in head-mounted display systems: causes and strategies review.** In *2020 22nd Symposium on Virtual and Augmented Reality (SVR)*, pages 154–163. IEEE.

**2017:**

**Porcino, T.** M., Clua, E., Trevisan, D., Vasconcelos, C. N., and Valente, L. (2017). **Minimizing cybersickness in head-mounted display systems: design guidelines and applications.** In *Serious Games and Applications for Health (SeGAH), 2017 IEEE 5th International Conference on* , pages 1–6. IEEE.

# Cybersickness Prediction

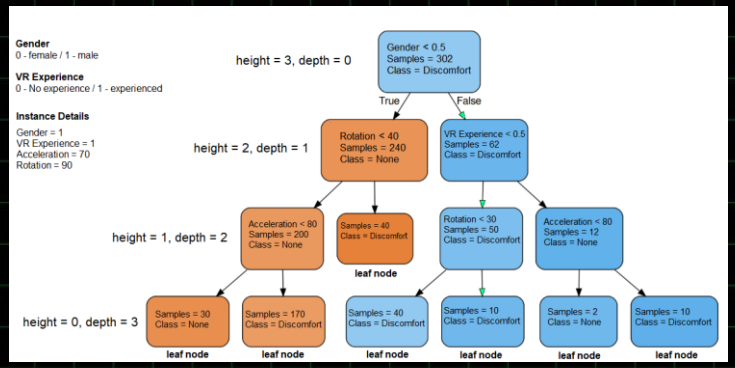
## Procedure

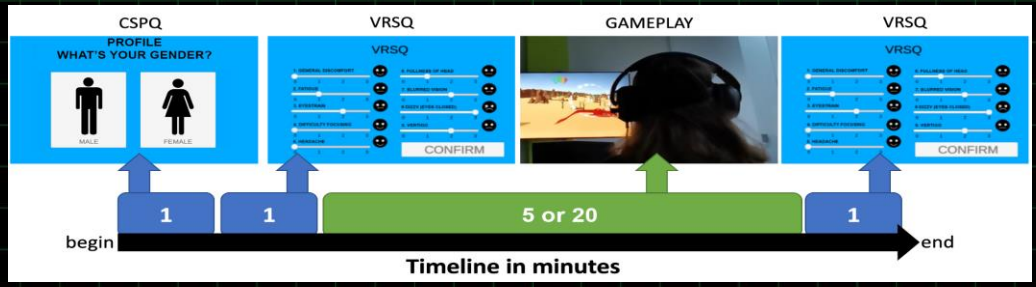
**Data Collection Protocols**

Content: 2 VR games using Unity 3D Engine.
Hardware: 2 types of HMDs (HTC Vive and Oculus Rift)
Participants: 88 (19 females) divided in 6 protocols.
Dataset: During the protocols, the dataset and the software content was evolved to final stage. After all phases we considered 37 valid user.

**Symbolic Machine Learning Approach**

We use symbolic machine learning to analyse and identify one or more causes of discomfort, which is user and context specific. In other words, the approach described in this manuscript is not a general rule for recognizing the presence of discomfort as previously approached in the current literature.

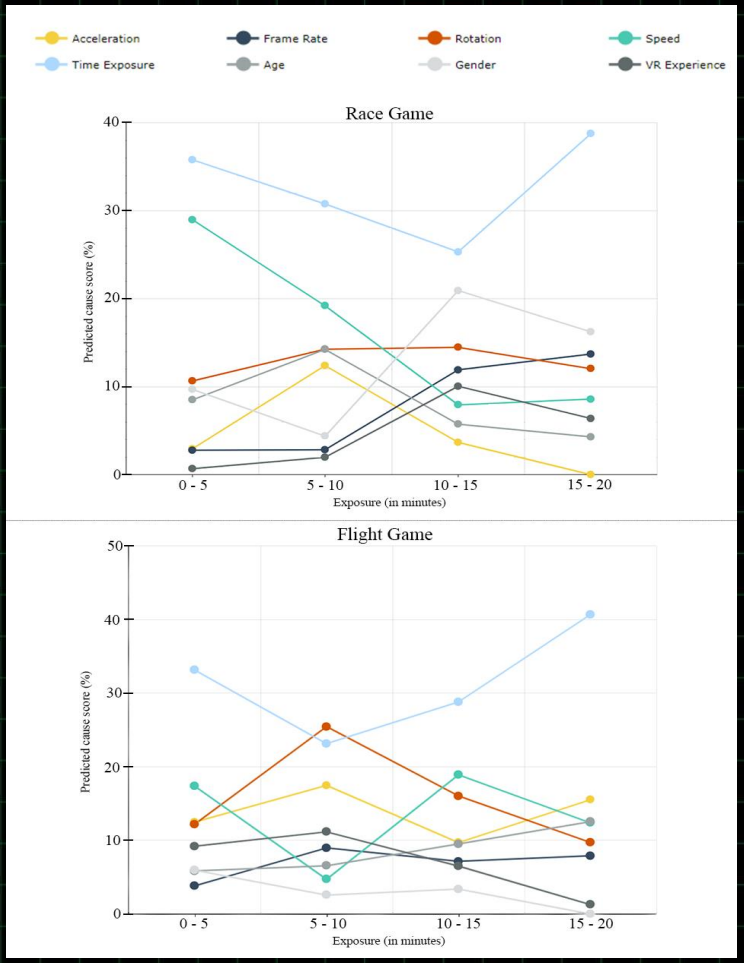


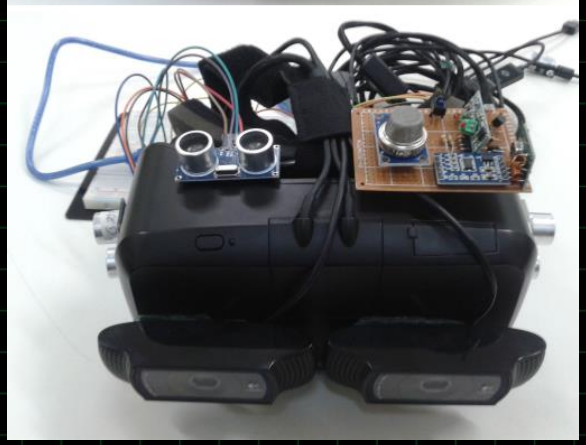
# Cybersickness Prediction

Random Forest feature ranking (identification of cybersickness causes) for the race (A) and flight game (B) for P5 subjects.

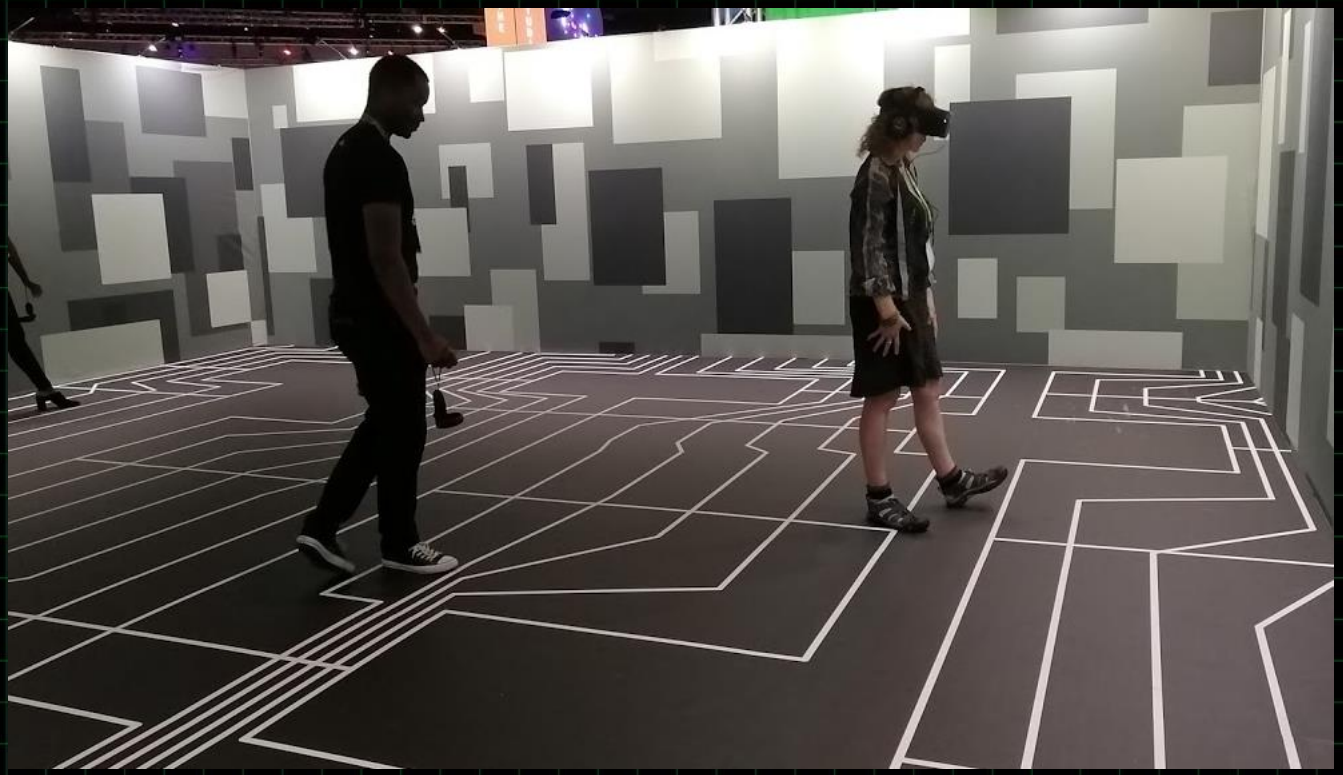

Race and flight game potential-cause score ranking along with different exposure moments for the P6 subjects.



# Tracking



# Endless Walk



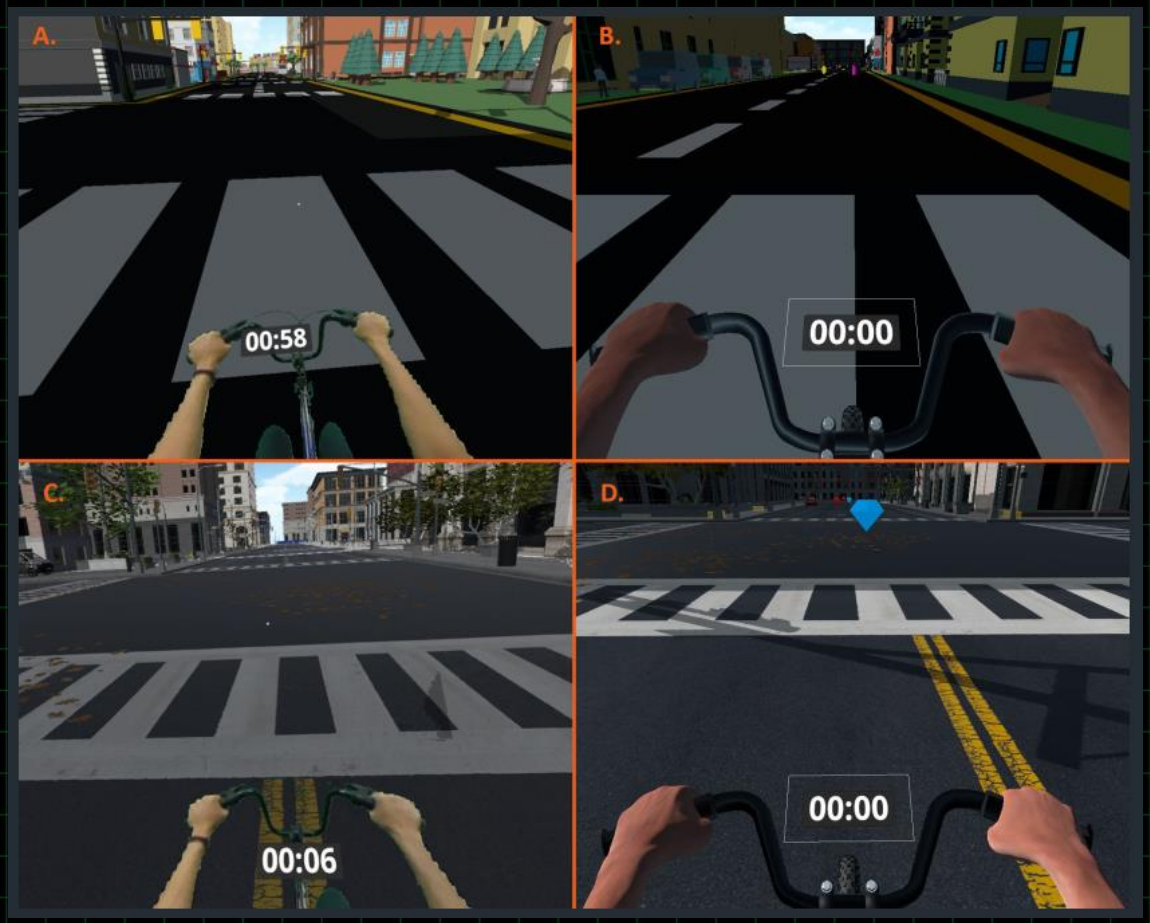
# Presence Platform Interaction SDK and Tracked Keyboard Now Available

Written by: Oculus VR • Feb 1, 2022

At Connect 2021, we introduced Presence Platform—a broad range of machine perception and AI capabilities that allow you to build more realistic mixed reality, interaction, and voice experiences that seamlessly blend virtual content in a user's physical world. Since then, we've followed that introduction with releases of Spatial Anchors Experimental, Voice SDK, and Passthrough, and we're now excited to add to our growing list of mixed reality capabilities with Interaction SDK Experimental.

## Interaction SDK

# Hand Tracking

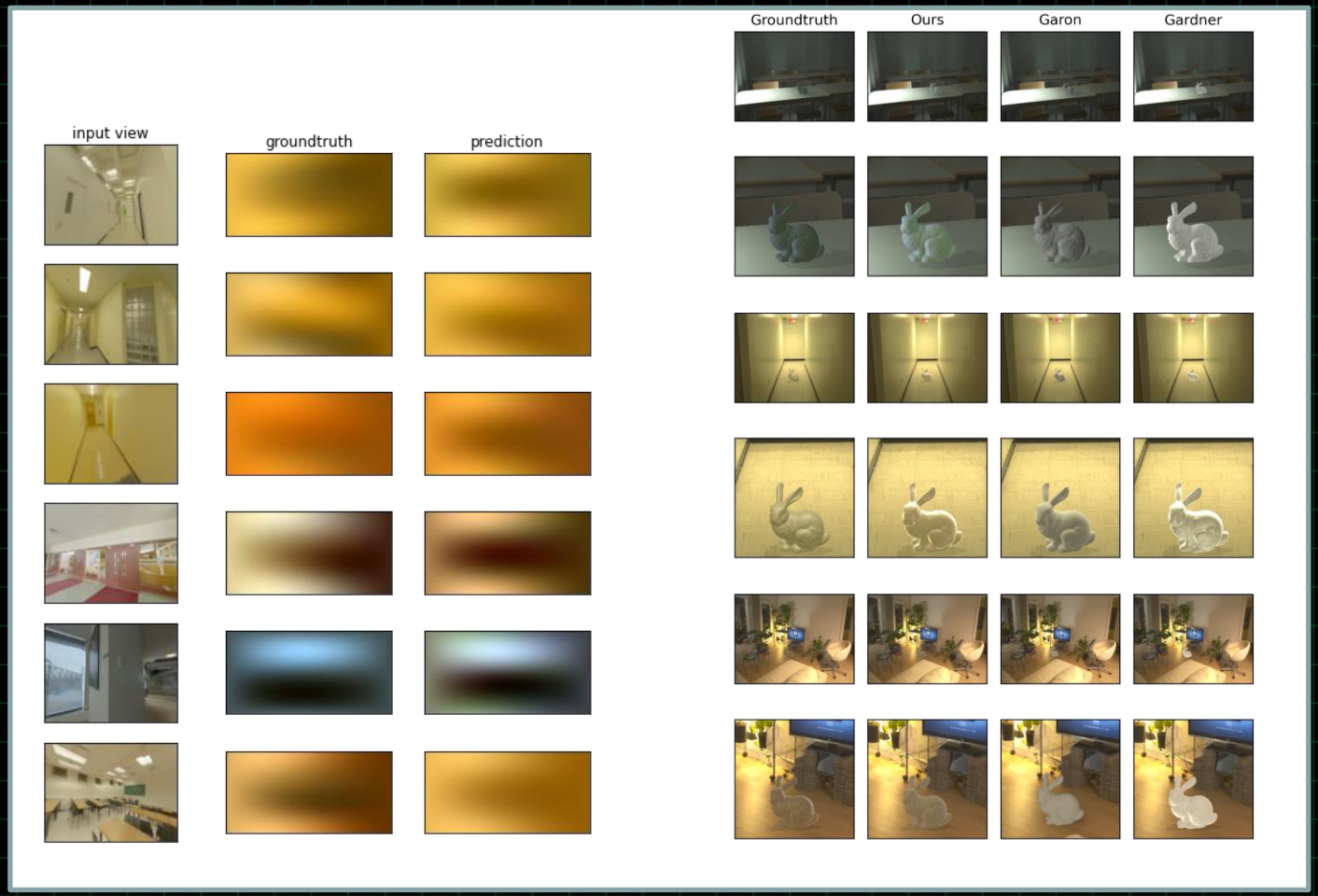



OLIVEIRA, W. ; TIZUKA, M. ; Clua, Esteban ; SALGADO, L. ; TREVISAN, D. Virtual and Real Body Representation in Mixed Reality: An Analysis of Self-presence and Immersive Environments. Proceedings of the XVIII International Conference on Entertainment Computing (ICEC 2019), 2019. p. 42-54

# Illumination Matching

# Deep Learning Environment Lighting

- High quality lighting
- Fast (real time)
- Low estimation error
- Easy to use (9 SH lighting coefficients)
- One AI model for all applications
- Does not require scene setup
- Does not require user`s intervention




MARQUES, Bruno Augusto Dorta; CLUA, Esteban Walter Gonzalez Clua; VASCONCELOS, Cristina Nader. Deep spherical harmonics light probe estimator for mixed reality games. **Computers & Graphics**, v. 76, p. 96-106, 2018.

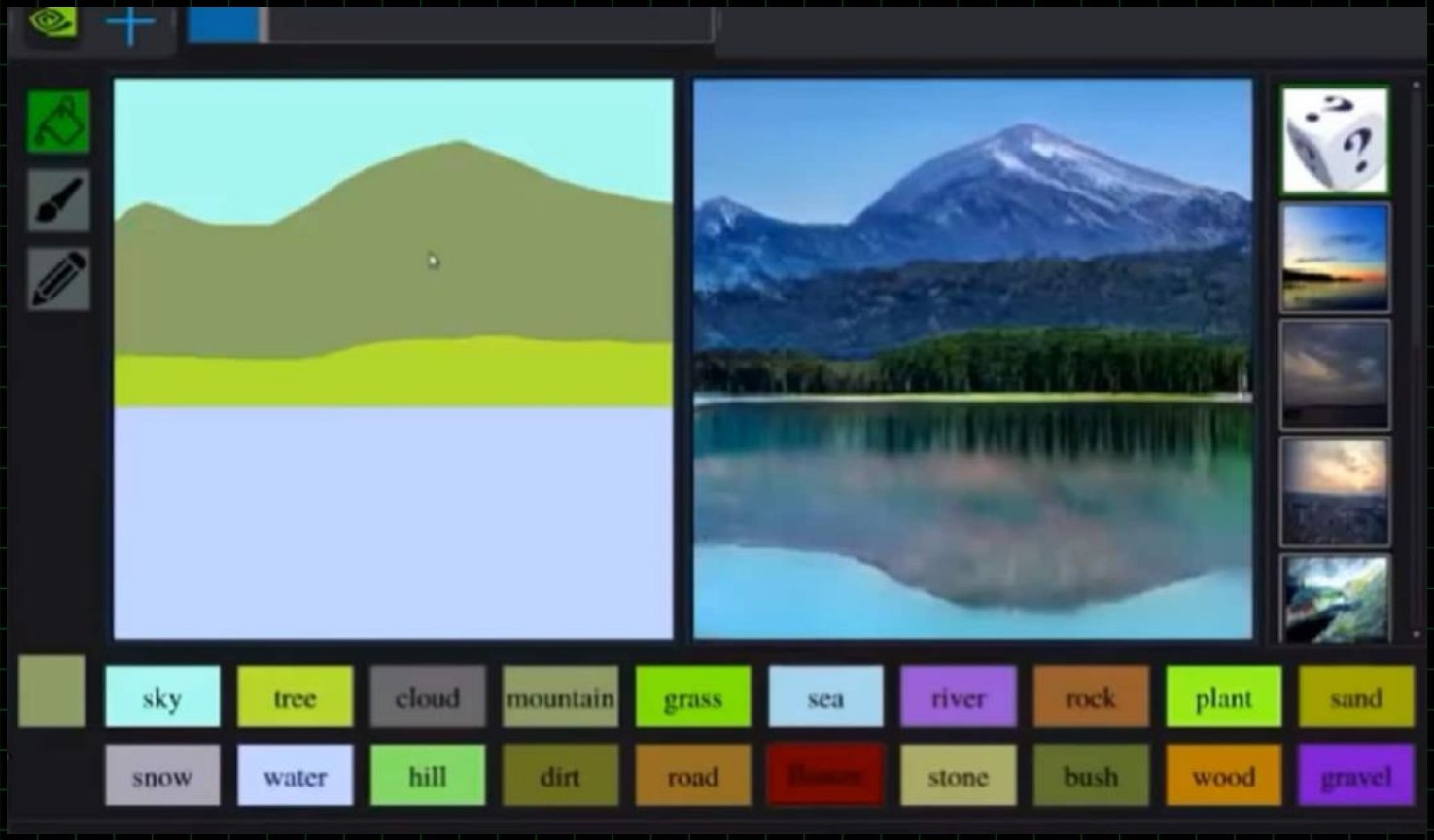
# Wearables


Oculus
Development Kit

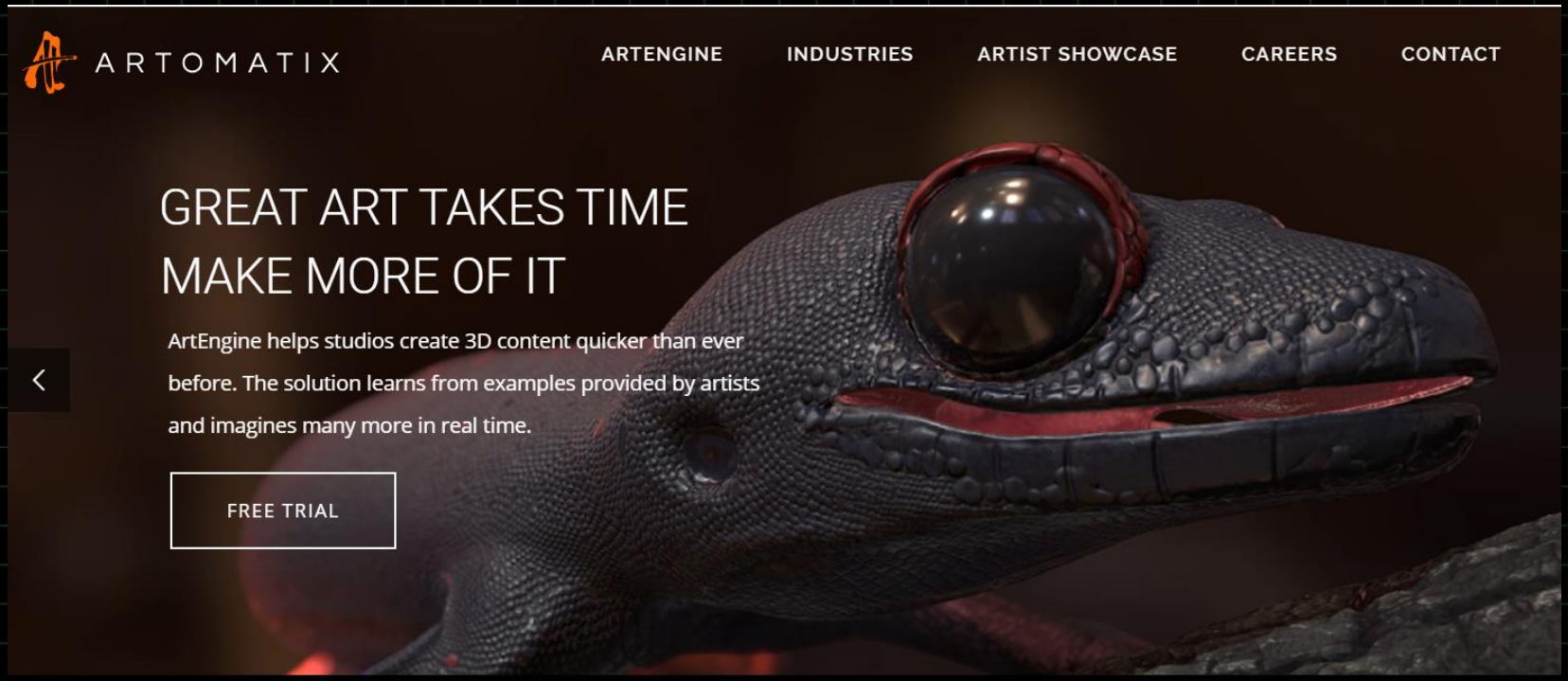
# Inclusive devices

# Deep Learning and World creation

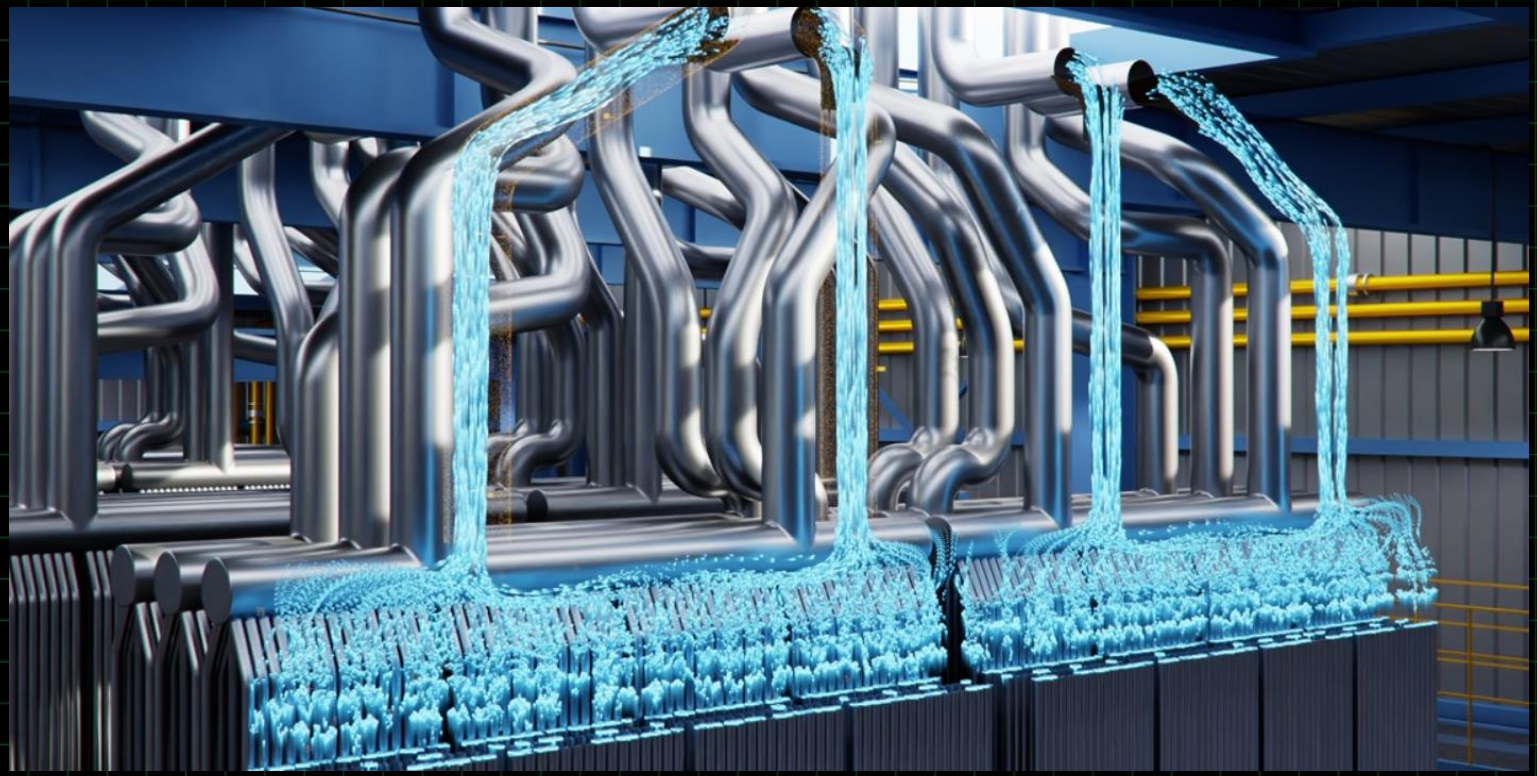
https://www.nvidia.com/en-us/research/ai-playground/



# Deep Learning and Characters Creation



# Physics & ML



https://developer.nvidia.com/modulus

# Analytics

MELO, SIDNEY ARAUJO ; PAES, ALINE ; Clua, Esteban ; KOHWALTER, TROY C. ; Murta, Leonardo . Detecting long-range cause-effect relationships in game provenance graphs with graph-based representation learning. ENTERTAINMENT COMPUTING, v. 32, p. 100318-100337, 2019