Generative AI for Computational Medical XR

George Papagiannakis
ORamaVR co-founder, CEO
george@oramavr.com
&
Prof. University of Crete,
Affiliated Researcher at FORTH
Visiting Prof. University of Geneva

Overview

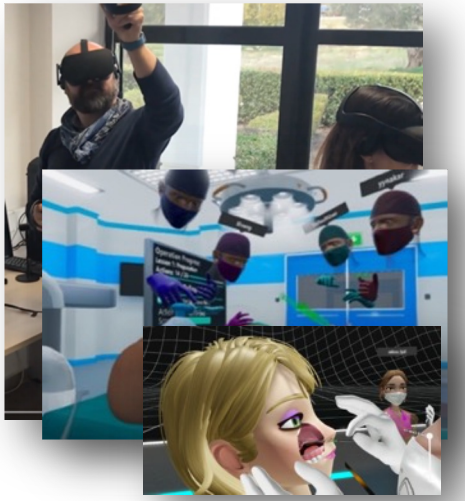
- Computational medical XR (CMXR)
- Generative AI
- Our approach

Midjourney prompt:
“a there and back again hobbit house looking from inside towards outside through the open door, cinematic, atmospheric lighting”

My Career arcs

TECHNOLOGIE Réalité et images de synthèse mêlées

LE TOURISME EN 3D EST NÉ




VHD++ Development Framework:
Towards Extendible, Component Based VR/AR Simulation Engine
Featuring Advanced Virtual Character Technologies

Michal Ponder (*), Georgo Papagiannakis (**), Tom Molet (**),
Nadia Magnenat-Thalmann (**), Daniel Thalmann (*)

(*) Virtual Reality Lab (VRlab)
Swiss Federal Institute of Technology (EPFL)
e-mail: {name.surname}@epfl.ch

(**) MIRALab,
University of Geneva
e-mail: {name.surname}@miralab.unige.ch

Abstract

This paper presents the architecture of the VHD++ real-time development framework that after several years of intensive research, design, and development effort has been released and enters its validation phase. This paper discusses the key aspects involved in architectural structure, design and practical implementation of an efficient, flexible and extendible real-time software framework based on the modern 3D game-engine design principles. This framework supports researchers and application developers with rapid, component based development of VR/AR systems featuring advanced virtual character simulation technologies. The discussion covers motivation, main concepts, survey of related work, the main functional and design requirements, design principles and key architectural elements. It concludes with the initial validation results including overview of existing VHD++ based VR/AR virtual character simulation applications

1. Introduction: The Demand

The very recent revolutionary advancements in computer graphics and in real-time virtual character simulation technology put a completely new light on the VR/AR systems and in particular on their scaled down cousins: interactive video games. In the extremely competitive environment there is only one rule to follow: deliver always newer, always faster and always more in shorter time. Chasing that continuous tough demand results in system complexity rising exponentially with the number of components and semantically distant technologies being integrated under a single interactive, real-time, audio-visual application roof. This explains the current, rapidly growing interest of both research and industry in advanced, complexity curbing, framework oriented, middleware solutions that while well established in other IT domains are just coming to life in the interactive real-time audio+visual simulation field.

Significant investments combined with intensive research and development in the core fields made the technologies, once affordable only to few research laboratories and government based institutions, now widely available. We are reaching the point where majority of researchers and developers has nearly equal access to similar technologies providing comparable price/performance ratio.

It seems that in the near future the success of a particular interactive real-time audio-visual product or service will unlikely be a function of any certain quality or the number of individual qualities involved. Instead it will be based on the way or rather the art of combining multiple qualities, relating them and letting them interplay inside one consistent and extendible framework. The complexity and the technologies that will let handle it will distinguish the successful products and services in the coming new era of interactive audio+visual applications.

Quoting Bill Radschel, former Chief Strategy Officer at Sun Microsystems, Inc.: *"The challenge over the next 10 years will not be speed or cost of performance; it will be the question of complexity"*.

2. Motivation: Curbing Complexity

2.1. Common Experience: Facing Complexity

Carrying on proprietary research activities while being at the same time involved in demanding, tightly timed, development projects targeting concrete applications is a daily reality of many research groups. Overall complexity of the resulting applications reaches the levels that one can barely handle with the methodologies currently at hand.


UNIVERSITÉ DE GENÈVE

FACULTÉ DES SCIENCES
ÉCONOMIQUES ET SOCIALES
Département de systèmes d'information
Professeur Nadia Magnenat-Thalmann

FACULTÉ DES SCIENCES
Département d'informatique
Professeur José Rolim

An Illumination Registration Model for Dynamic Virtual Humans in Mixed Reality

THÈSE

présentée à la Faculté des Sciences de l'Université de Genève

pour obtenir le grade de Docteur ès sciences, mention informatique

par
Georgios Papagiannakis
de
Crète (Grèce)

Thèse N° 3795

GENÈVE
Atelier de reproduction de la Section de physique
2006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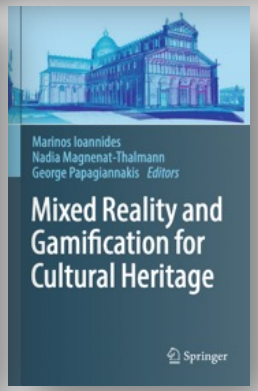
Advances in Applied Clifford Algebras

Preface for Special Issue on Geometric Algebra in Computer Science and Engineering

Dietmar Hildenbrand, Eckhard Hitzer* and George Papagiannakis


Marinos Ioannides
Nadia Magnenat-Thalmann
George Papagiannakis *Editors*

Mixed Reality and Gamification for Cultural Heritage

Springer

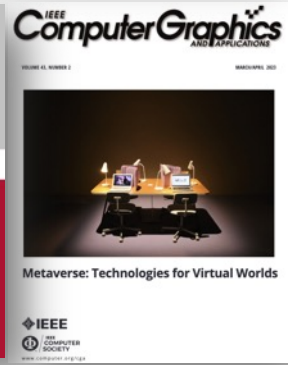

Nadia Magnenat-Thalmann · Jian Zhang · Jinman Kim · George Papagiannakis · Bin Sheng · Daniel Thalmann · Marina Gavrilova (Eds.)

LNCS 13443

Advances in Computer Graphics

39th Computer Graphics International Conference, CGI 2022
Virtual Event, September 12–16, 2022
Proceedings

Springer MOREMEDIA


IEEE Computer Graphics and Applications

Metaverse: Technologies for Virtual Worlds

IEEE COMPUTER SOCIETY

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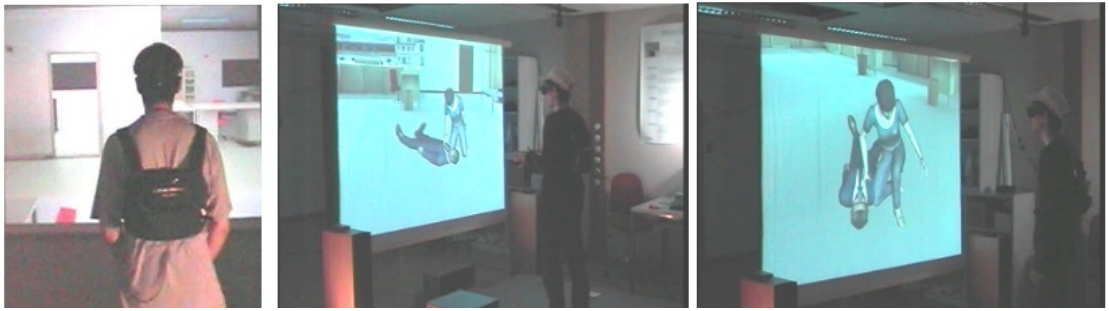
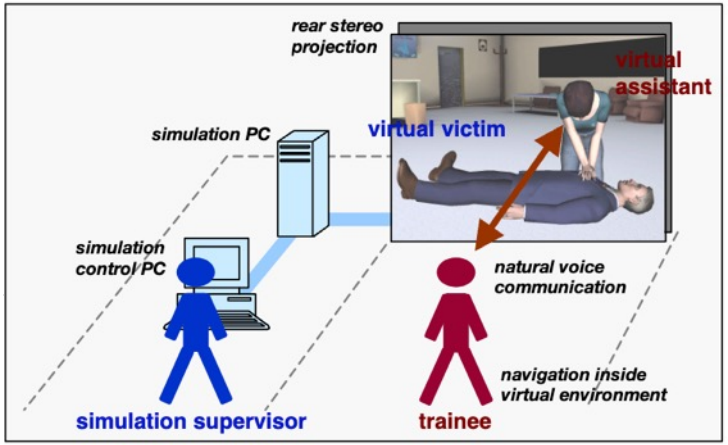
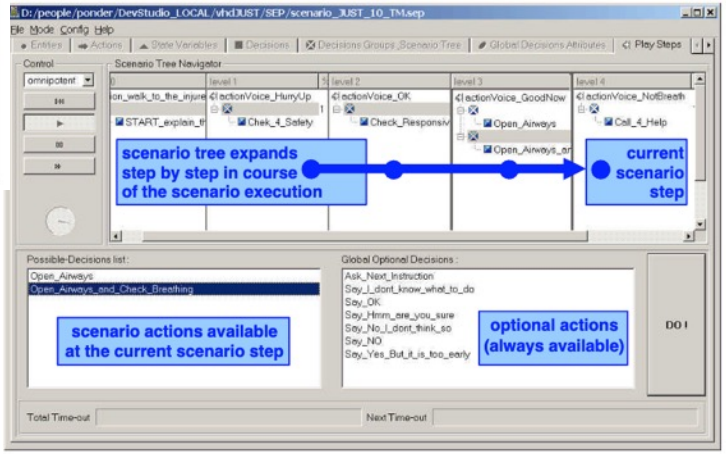
XR and Spatial computing for medical training?

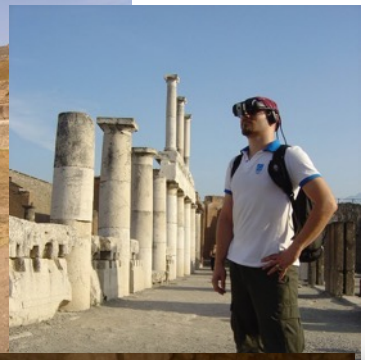






- M Ponder, B Herbelin, T Molet, S Schertenleib, B Ulicny, G Papagiannakis, N Magnenat-Thalmann, and D Thalmann. 2002. Interactive Scenario Immersion:Health Emergency Decision Training in JUST Project. Proc. Of 1st International Workshop on Virtual Reality Rehabilitation, VRMHR2002, Lausanne, (November 2002), 87–101.
- Michal Ponder, Bruno Herbelin, Tom Molet, Sebastien Schertenlieb, Branislav Ulicny, George Papagiannakis, Nadia Magnenat-Thalmann, and Daniel Thalmann. 2003. Immersive VR decision training: telling interactive stories featuring advanced virtual human simulation technologies. DOI:https://doi.org/10.1145/769953.769965

XR and Spatial computing for education?



Papagiannakis, G. *et al.* LIFEPLUS: Revival of life in ancient Pompeii. *Proc. of Virtual Systems and Multimedia, VSMM02, Gyeongju* (2002)
Papagiannakis, G. *et al.* Mixing Virtual and Real scenes in the site of ancient Pompeii. *Computer Animation and Virtual Worlds, John Wiley and Sons Ltd* 16, 11–24 (2005)

150+

Years outdated medical educational residency model: master - apprentice

18M

Medical professionals' shortage by 20230

5B

People lack access to affordable surgical and anesthesia care according to WHO

The Anatomy Lesson of Dr. Nicolaes Tulp, 1632, Rembrandt, Mauritshuis museum, The Hague, Netherlands

Spatial Computing, Medical Metaverse[1] and Digital Twins are revolutionizing healthcare and education

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1. https://ieeexplore.ieee.org/document/9940237
2. https://www.accenture.com/us-en/insights/health/digital-health-technology-vision
3. https://finance.yahoo.com/news/healthcare-metaverse-market-projected-worth-122100949.html
4. Lohre, R., Bois, A. J., Athwal, G. S. & Goel, D. P. Improved Complex Skill Acquisition by Immersive Virtual Reality Training. *J Bone Joint Surg Am* **Latest Articles**, 1–10 (2020).

Computational Medical XR

Intro

Computational medical XR[1] *is a new interdisciplinary field, bridging life sciences, with mathematics, engineering and computer science.*
It unifies ***computational science[2]*** *(scientific computing) with intelligent* ***extended reality*** *and* ***spatial computing*** *for the* ***medical*** *field.*

It integrates **computational** methods from computer **graphics**, computational **geometry**, **vision** and **deep learning** to solve hard problems in medicine and neuroscience:

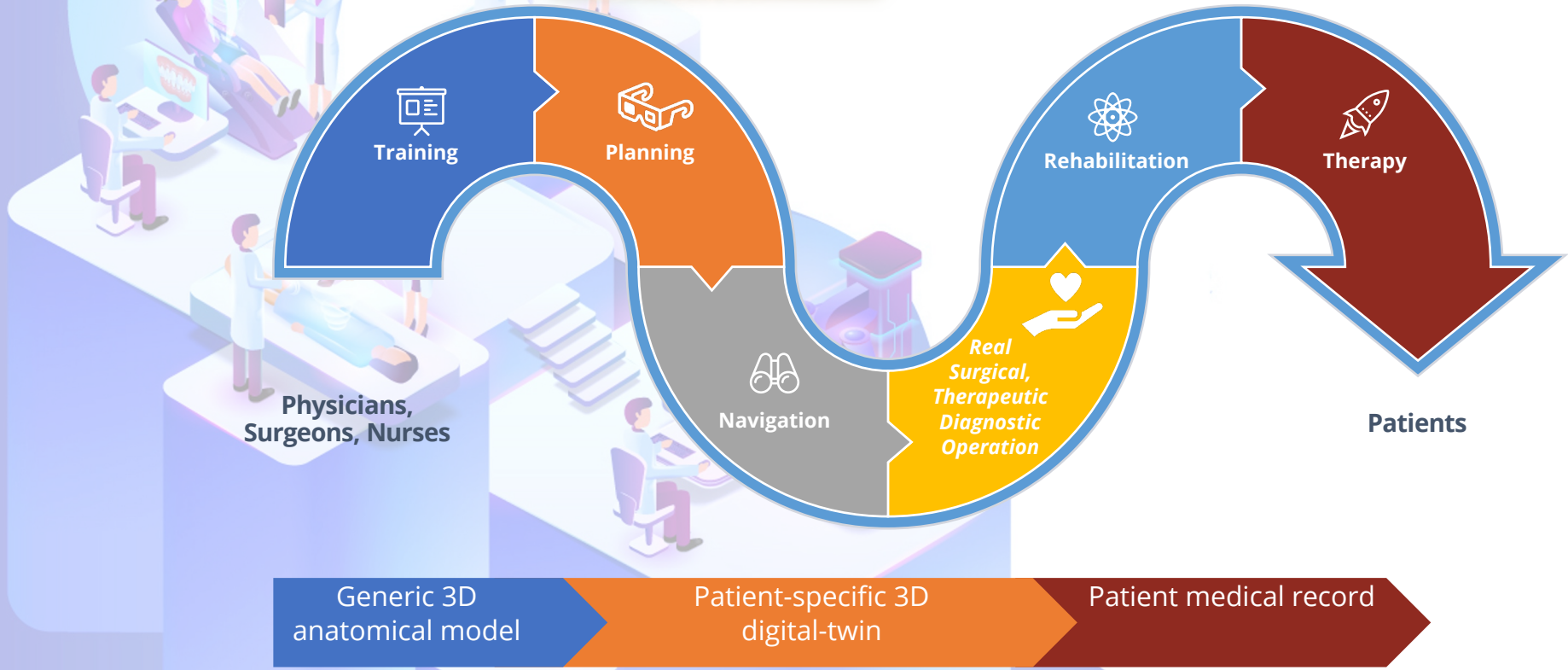
- low-code/no-code **authoring** XR platforms
- XR medical **training**
- XR surgical **planning**
- XR operative **navigation**
- XR for **rehabilitation** and **therapeutics**

[1] Papagiannakis, G., "A computational medical XR discipline", https://arxiv.org/abs/2108.04136v3, 2023
[2] D. E. Stevenson. 1994. Science, computational science, and computer science: at a crossroads. Commun. ACM 37, 12 (Dec. 1994), 85–96. DOI:https://doi.org/10.1145/198366.198386

Computational Medical XR
Overview

Frontiers SIGGRAPH 2023 talk[1]
Frontiers SIGGRAPH 2023 workshop[2]





[1] https://s2023.siggraph.org/presentation/?id=ftalk_101&sess=sess408
[2] https://s2023.siggraph.org/presentation/?id=fwork_109&sess=sess287, 2023

Why now for computational medical XR?

Stable Diffusion prompt:
"doctors and nurses with 3D VR and AR glasses in digital and real objects and environments integrated and communicating between each other based on immersive experiences"

"After **years** of **validation** and **use** by early adopters – XR medical technology is poised to move to the **mainstream**; recent changes in **access** and **cost** make XR quite **affordable**"
Dr. Walter Greenleaf,
Stanford Health Care & Virtual Human Interaction Lab

"The biggest **challenges** in **healthcare** are (1) **access**—there aren't enough enough good doctors to provide timely care to all who need it (and clinicians are leaving the field in droves due to burn out), and (2) **cost**—the cost of healthcare has skyrocketed, largely because of increasing labor costs.
AI will **solve both** of these issues."
Daisy Wolf and Vijay Pande,
https://a16z.com/2023/08/02/where-will-ai-have-the-biggest-impact-healthcare/

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Metaverse* = Internet(3D)^{AI} ⟺ XR

The Rules **

Rule #1. There is only one Metaverse.

Rule #2: The Metaverse is for everyone.

Rule #3: Nobody controls the Metaverse.

Rule #4: The Metaverse is open.

Rule #5: The Metaverse is hardware-independent.

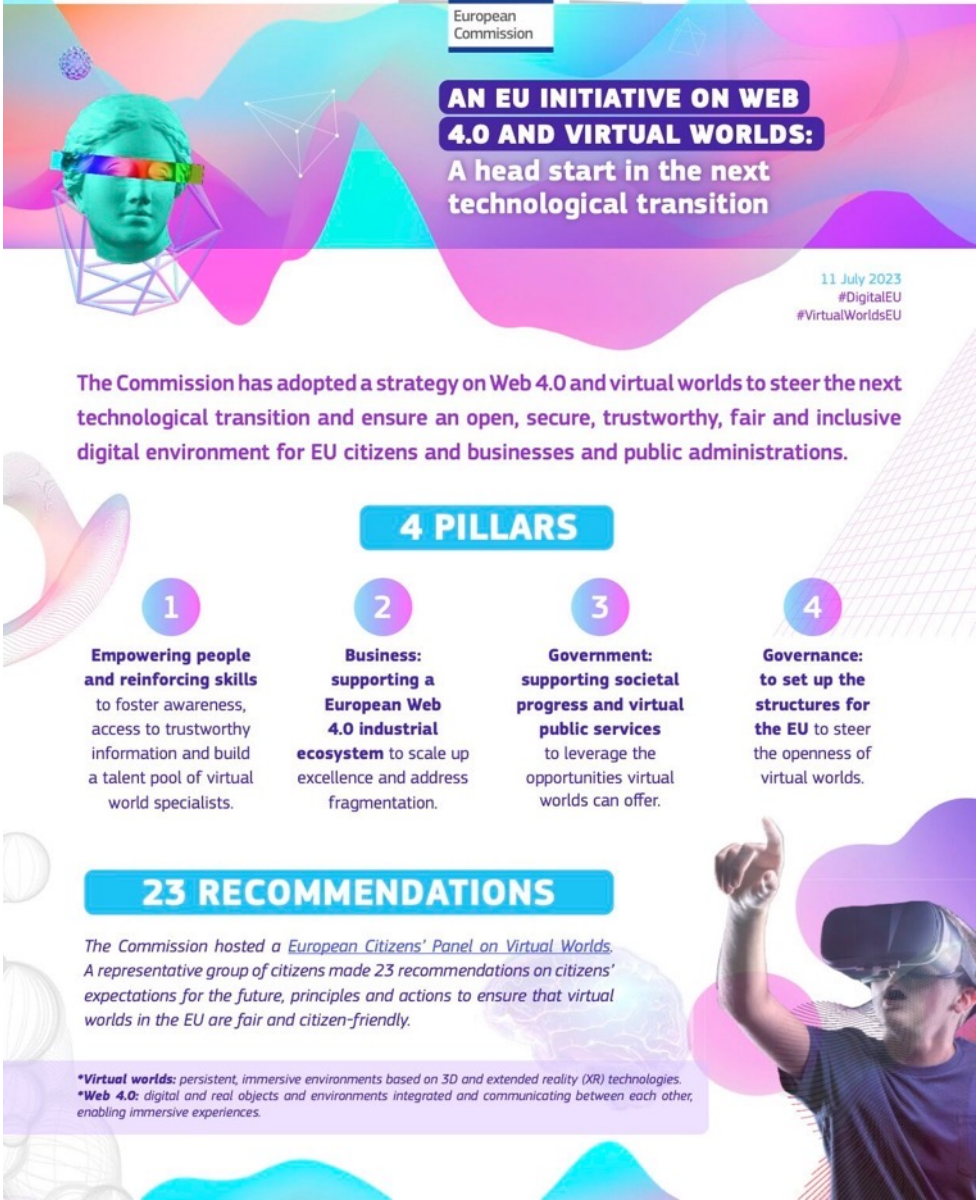
Rule #6: The Metaverse is a Network.

Rule #7: The Metaverse is the Internet.

* Source: A. Graylin, HarvardXR, April 2023

** https://medium.com/meta-verses/the-seven-rules-of-the-metaverse-7d4e06fa864c

Stable Diffusion prompt:
"a girl in VR glasses experiencing metaverse worlds"



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Virtual Worlds and **Web 4.0** *

Virtual Worlds:

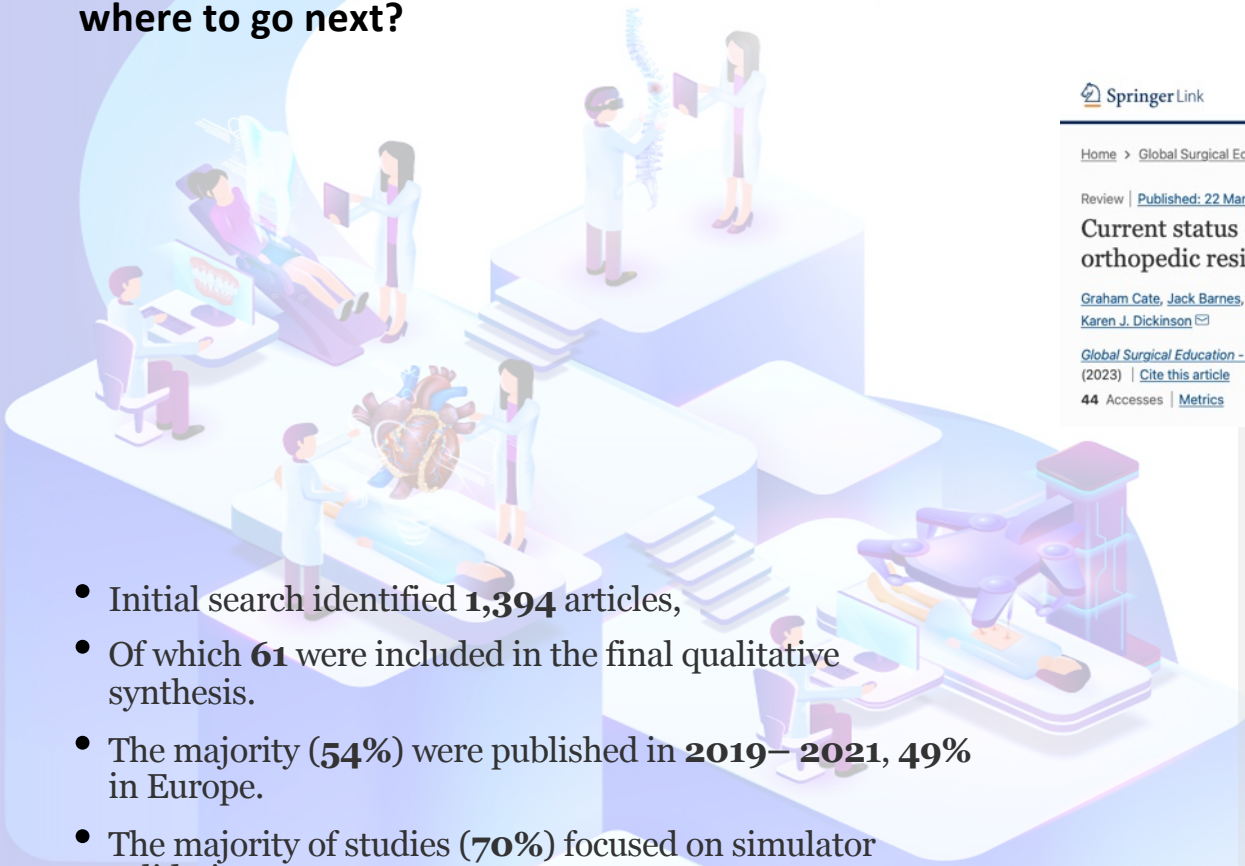
Persistent, immersive environments based on 3D and extended reality (XR) technologies

Web 4.0:

Digital and real objects and environments integrated and communicating between each other, enabling immersive experiences

* Source: https://digital-strategy.ec.europa.eu/en/library/virtual-worlds-and-web-40-factsheet

VR simulation-based training for surgical education: where to go next?



- Initial search identified **1,394** articles,
- Of which **61** were included in the final qualitative synthesis.
- The majority (**54%**) were published in **2019– 2021**, **49%** in Europe.
- The majority of studies (**70%**) focused on simulator validation.

- Cate, G., Barnes, J., Cherney, S. *et al.* Current status of virtual reality simulation education for orthopedic residents: the need for a change in focus. *Global Surg Educ* **2**, 46 (2023). https://doi.org/10.1007/s44186-023-00120-w

SpringerLink

Home › Global Surgical Education - Journal of the Association for Surgical Education › Article

Review | Published: 22 March 2023

Current status of virtual reality simulation education for orthopedic residents: the need for a change in focus

Graham Cate, Jack Barnes, Steven Cherney, Jeffrey Stambough, David Bumpass, C. Lowry Barnes & Karen J. Dickinson

Global Surgical Education - Journal of the Association for Surgical Education **2**, Article number: 46 (2023) | Cite this article

44 Accesses | Metrics

Current literature pertaining to **VR training** for orthopaedic residents is **focused on establishing validity and rarely forms part of a curriculum**. Where the focus is education, the majority are discrete educational modules and do not teach a comprehensive amalgam of orthopedic skills. This suggests **focus is needed to embed VR simulation training within formal curricula.**

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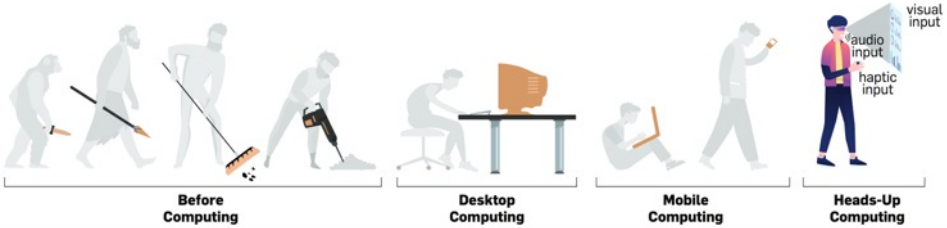

Heads-up computing*

Do our tools really complement us, or are we adjusting our natural behavior to accommodate our tools?

* Shengdong Zhao, Felicia Tan, and Katherine Fennedy. 2023. Heads-Up Computing Moving Beyond the Device-Centered Paradigm. Commun. ACM 66, 9 (September 2023), 56–63. https://doi.org/10.1145/3571722

METAVERSE GENERATION (VIRTUAL WORLDS): CODE -> LOW-CODE -> NO-CODE (GENERATIVE AI)

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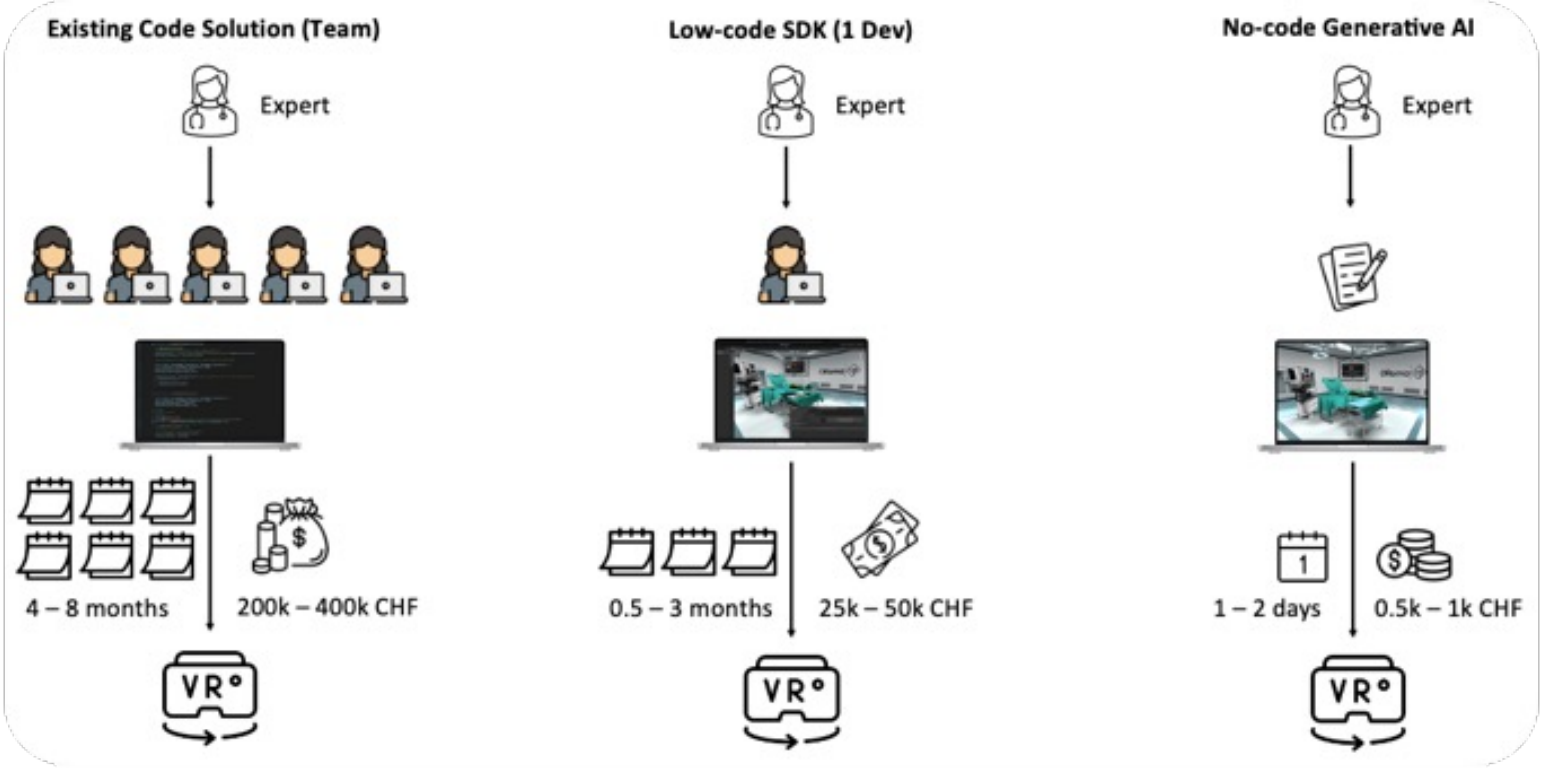

Stable Diffusion prompt:
"interacting in extended reality with a photorealistic environment of a hospital"

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XR draws on AI

"In order to get to **ultrarealistic** and **useful** 3D, there's a need to **step beyond** hardware and incorporate AI.

Even the most powerful GPU wouldn't be able to **generate** high-quality **ray-traced** 3D models in real time.

Just when Moore's Law is **expiring** and graphics as usual has run into a roadblock, AI has appeared as a **valuable** tool.

It provides us with new and powerful methods to **push** graphics forward, by being smarter about the rendering process.

We are at the **cusp** of **enormous innovation** in the 3D rendering space"

Samuel Greengard. 2023. 3D Modeling Draws on AI. Commun. ACM 66, 8 (August 2023), 15–16. https://doi.org/10.1145/3603748

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Deep learning and generative AI

"Deep learning takes **data points** and turns them into a **query-able structure** that enables **retrieval** and **interpolation** between the points.

You could think of it as a continuous **generalization** of **database** technology."

"It is categorically **different** from even the simplest of **embodied biological agents**. As in, it's an entirely different category, with no shared characteristics.

Analogies to the brain are just as misleading as when people used the same analogies to describe computers in the 1950s."

F. Chollet, Google AI

Stable Diffusion prompt:
"an explosion of colorful powder"

PA

which are the top medical VR training companies worldwide?

As of my knowledge cutoff in September 2021, several companies were making significant strides in medical VR training. They are using virtual reality to transform medical education and training, allowing healthcare professionals to practice procedures and build skills in a safe, controlled environment.

Here are some of the leading companies in the field:

1. **Osso VR**: Osso VR offers a surgical training platform that allows surgeons to practice procedures in a virtual operating room. The platform is used by medical device companies, hospitals, and educational institutions worldwide.
2. **FundamentalVR**: FundamentalVR provides a VR training platform for surgeons that combines virtual reality with haptic feedback to create a more immersive and realistic training experience. The platform allows trainees to feel the texture of virtual tissues and materials, enhancing the learning experience.
3. **Surgical Theater**: Surgical Theater offers a platform that combines VR with patient-specific imaging data to create a 360° 3D view of a patient's anatomy. This platform is used for both patient education and surgical planning.
4. **VirtaMed**: VirtaMed's VR simulators provide training in various medical specialties, including orthopedics, urology, and gynecology. The company's simulators combine high-fidelity graphics with original instruments and anatomic models for a realistic training experience.
5. **EchoPixel**: EchoPixel's technology allows medical imaging data to be displayed in 3D, making it possible for doctors to interact with patient-specific organs and tissues in an open 3D space.
6. **ORamaVR**: ORamaVR is developing a VR platform for training healthcare professionals. Their platform uses the MAGES SDK, which allows developers to create customized training scenarios.
7. **MediView XR**: MediView XR has developed an augmented reality (AR) platform for surgical navigation, providing real-time 3D holographic visualization of the patient's anatomy during surgery.

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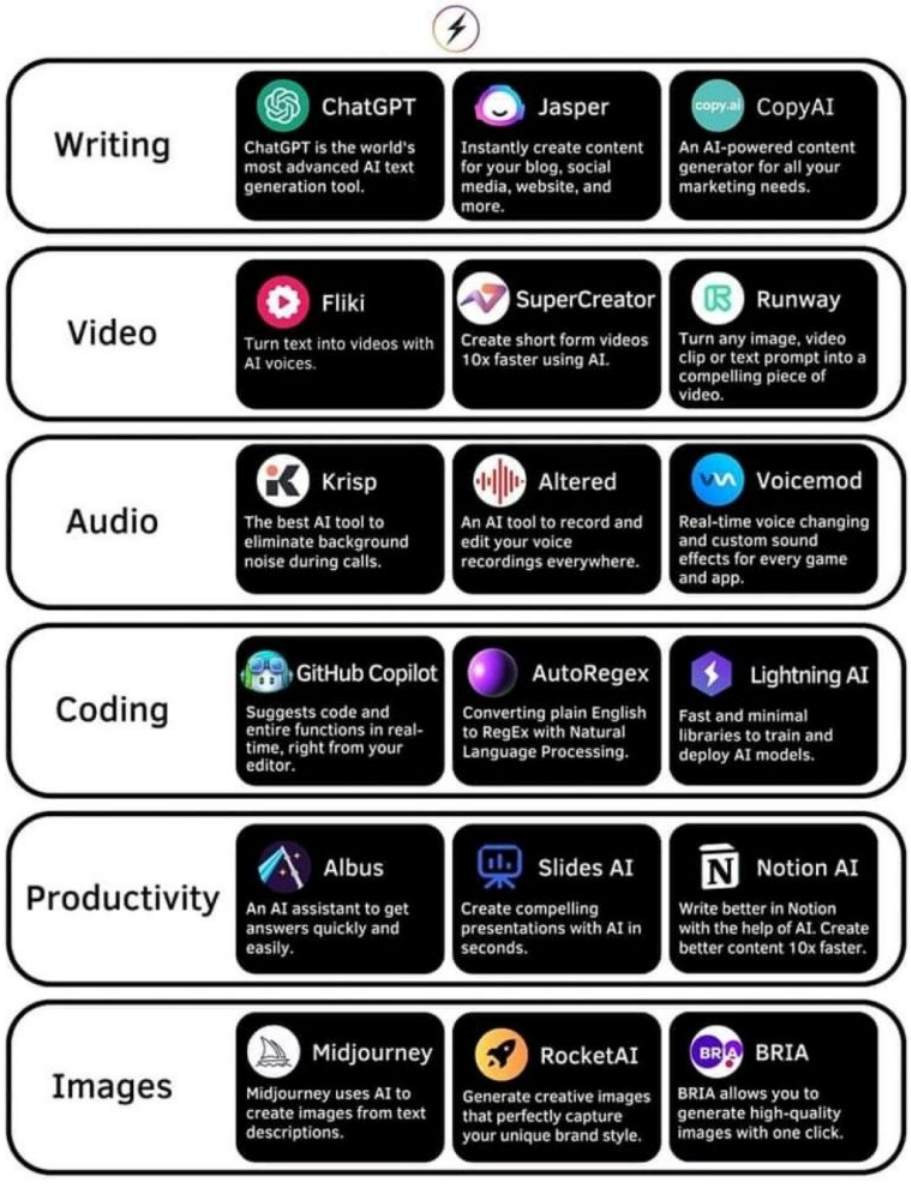
What is Generative AI?

AI models capable of generating new, open-ended and creative content:
- Text
- Images
- videos
- music
- 3D models
- 3D animations
- ....

Based on Foundational Models (Large Language models) and variations of the Transformer AI model



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Generative AI tools are increasing productivity today

https://www.linkedin.com/feed/update/urn:li:activity:7061327376017678336?utm_source=share&utm_medium=member_desktop

FINANCIAL TIMES

Artificial Intelligence

Generative AI exists because of the transformer

This is how it works

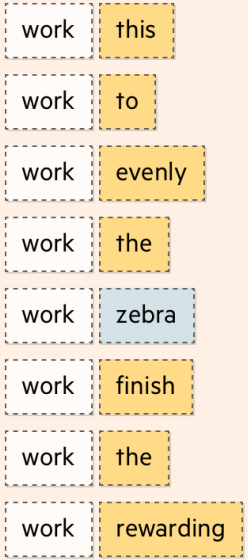
By **Visual Storytelling Team** and **Madhumita Murgia** in London SEPTEMBER 12 2023

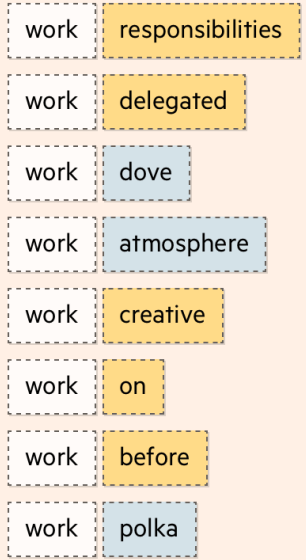
https://ig.ft.com/generative-ai/

First a block of words is broken into **tokens** — basic units that can be encoded. Tokens often represent fractions of words, but we'll turn each full word into a token.

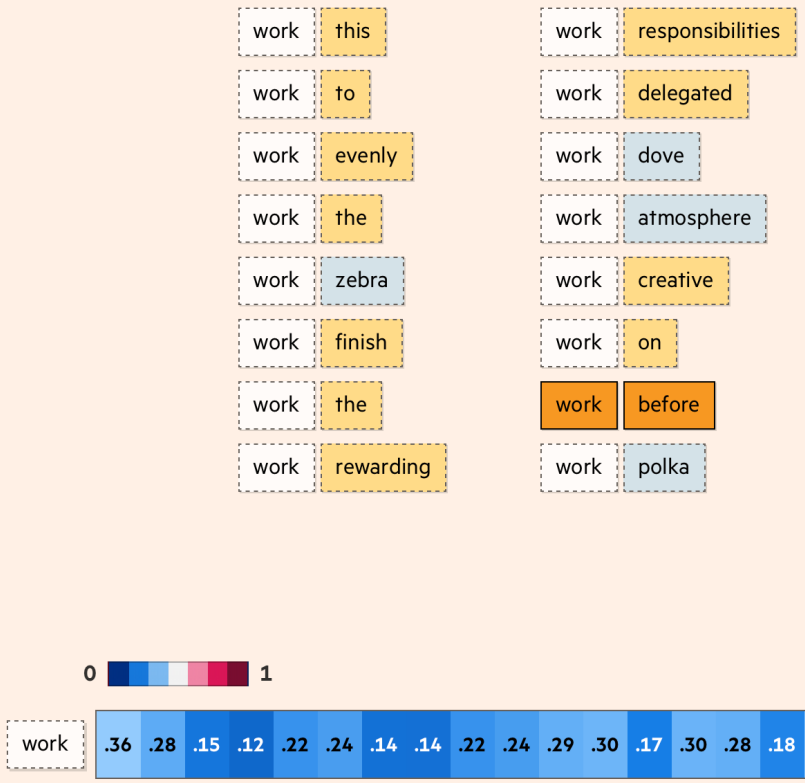
In order to grasp a word's meaning, **work** in our example, LLMs first observe it in context using enormous sets of training data, taking note of **nearby words**. These datasets are based on collating text published on the internet, with new LLMs trained using billions of words.

Eventually, we end up with a huge set of the words found **alongside** **work** in the training data, as well as those that **weren't** found near it.

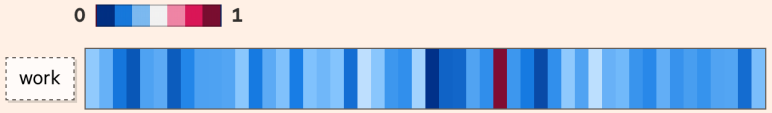




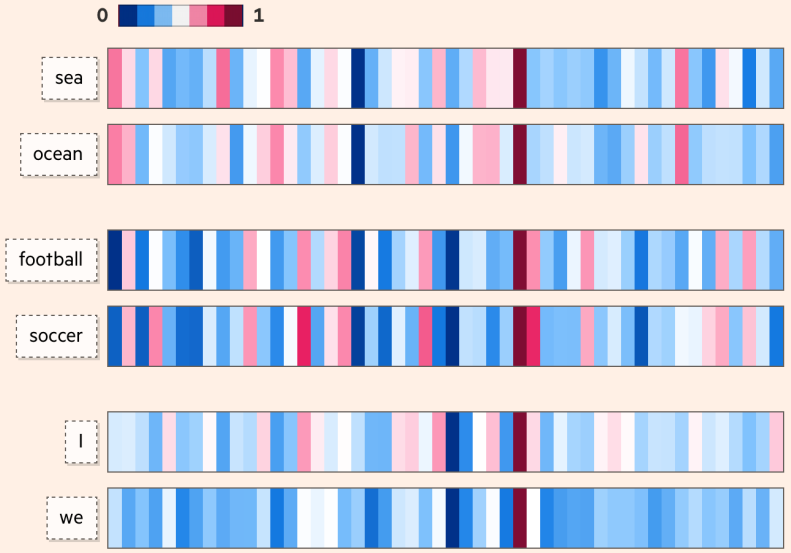
As the model **processes** this set of words, it produces a vector — or list of values — and adjusts it based on each word's proximity to **work** in the training data. This vector is known as a word embedding.



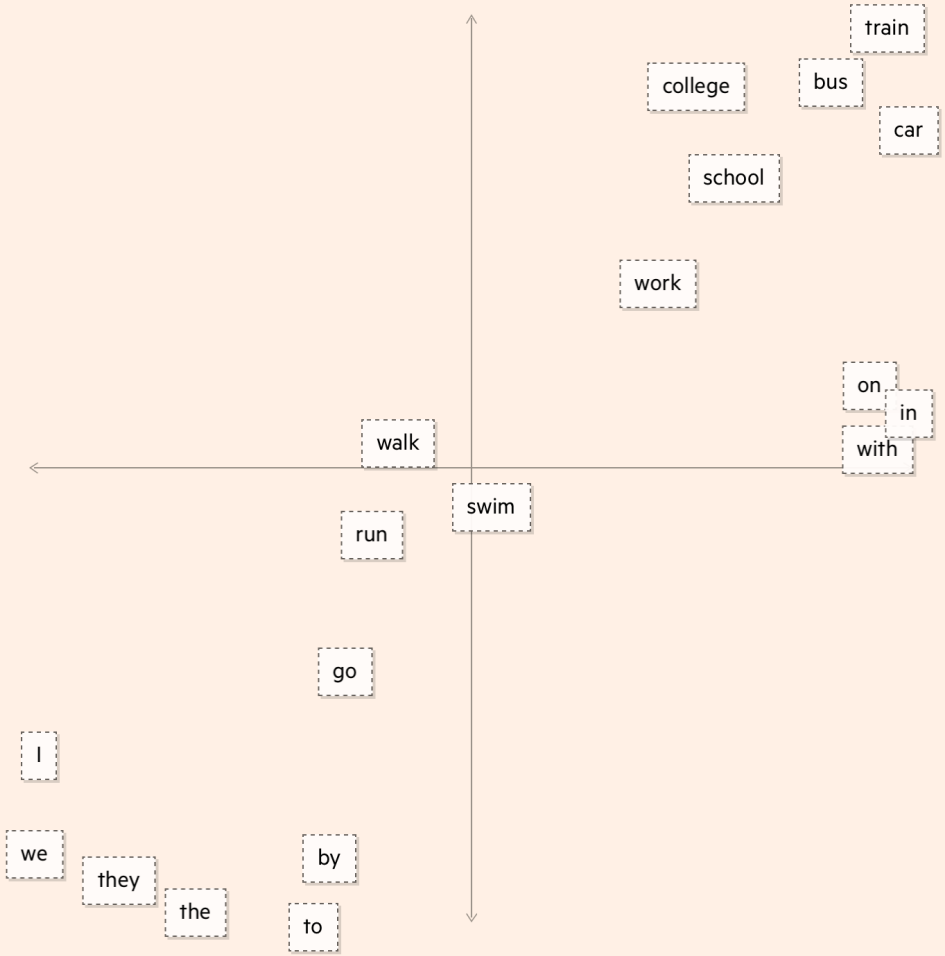
A word embedding can have hundreds of values, each representing a different aspect of a word's meaning. Just as you might describe a house by its characteristics — type, location, bedrooms, bathrooms, storeys — the values in an embedding quantify a word's linguistic features.



The way these characteristics are derived means we don't know exactly what each value represents, but words we expect to be used in comparable ways often have similar-looking embeddings.

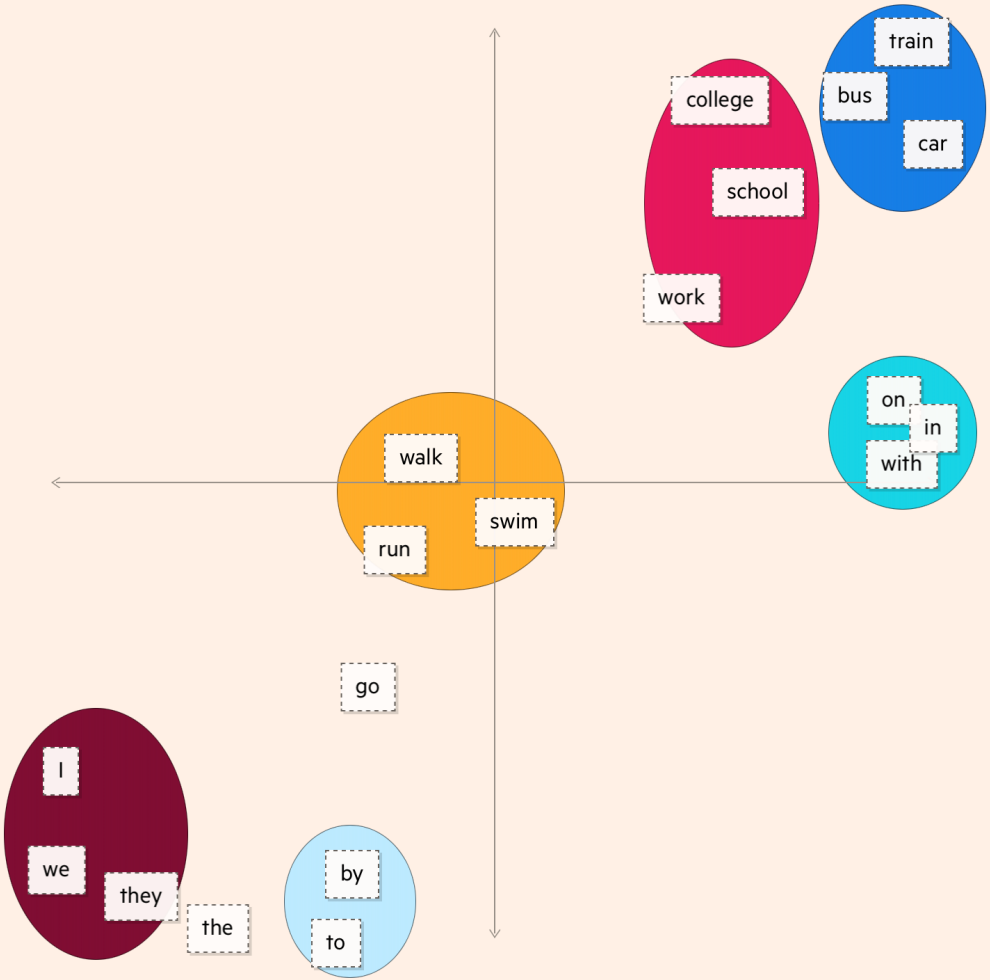


By reducing the hundreds of values each embedding represents to just two, we can see the distances between these words more clearly.



https://ig.ft.com/generative-ai/

We might spot clusters of **pronouns**, or modes of **transportation**, and being able to quantify words in this way is the first step in a model generating text.

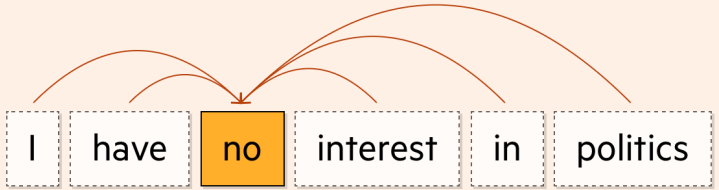


https://ig.ft.com/generative-ai/

A key concept of the transformer architecture is self-attention. This is what allows LLMs to understand relationships between words.

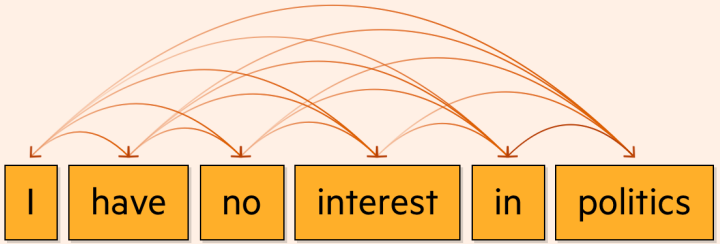
I have no interest in politics

Self-attention looks at each **token** in a body of text and decides which others are most important to understanding its meaning.

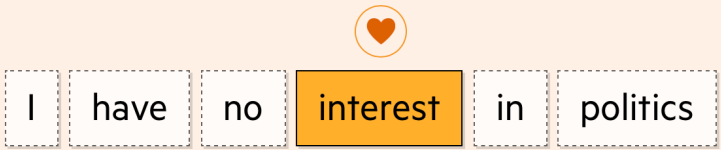


Before transformers, the state of the art AI translation methods were recurrent neural networks (RNNs), which scanned each word in a sentence and processed it sequentially.

With self-attention, the transformer computes all the words in a sentence at the same time. Capturing this context gives LLMs far more sophisticated capabilities to parse language.



In this example, assessing the whole sentence at once means the transformer is able to understand that **interest** is being used as a noun to explain an individual's take on politics.



The benefits of self-attention for language processing increase the more you scale things up. It allows LLMs to take **context** from beyond sentence boundaries, giving the model a greater understanding of how and when a word is used.

Midjourney prompt:
“a combination of brain MRI, a neural network graphic and an AR headset, cinematic, 3D”

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Generative AI in Medicine

1 **AI for Healthcare**

AI can revolutionize medical research and improve patient outcomes.

2 **Generative Models**

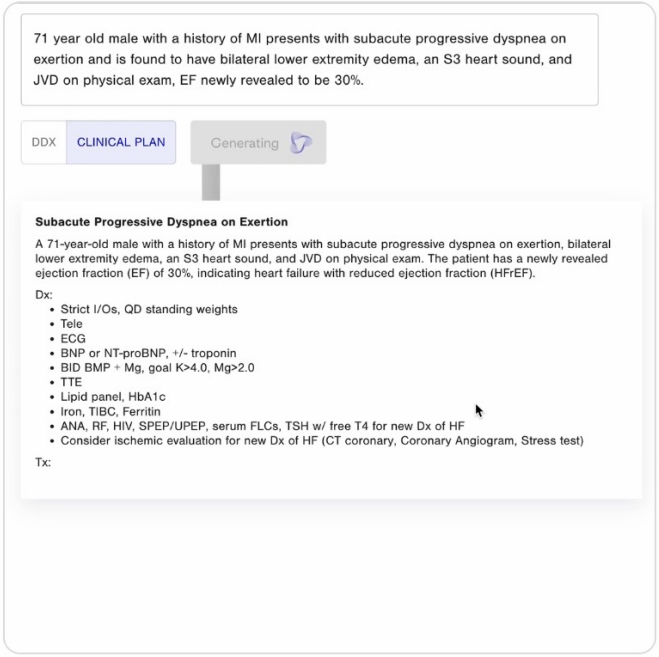
Generative AI models can generate synthetic medical data and enhance diagnostic accuracy.

3 **Deep Learning**

deep learning algorithms are used to train generative models and generate medical insights.

GLASS

Glass AI combines a large language model (LLM) with a clinical knowledge database, created and maintained by clinicians, to create DDx and Clinical Plan outputs.



https://glass.health/ai/

ORama VR

Gen AI applications in Medicine

Medical Imaging Analysis

Improve accuracy and efficiency in radiology with generative models for image reconstruction and segmentation.

Virtual Drug Trials

Accelerate drug development by simulating and predicting drug efficacy and side effects.

Disease Modeling

Create realistic disease models to study disease progression and develop personalized treatment strategies.

Clinical diagnosis

Develop personalized diagnostic and treatment strategies.

Zhavoronkov, A., Ivanenkov, Y.A., Aliper, A. *et al.* Deep learning enables rapid identification of potent DDR1 kinase inhibitors. *Nat Biotechnol* **37**, 1038–1040 (2019). https://doi.org/10.1038/s41587-019-0224-x

Advantages and Limitations of Gen AI in Medicine

Advantages

Increase efficiency, accuracy, and scalability in medical research and diagnosis.

Limitations

Address challenges related to data quality, model interpretability, costs for training-inference

Ethical Considerations and Challenges

- Privacy and security concerns in handling sensitive medical data
- Ensuring fairness and avoiding bias in AI-based medical decision making
- Transparency and explainability of generative AI models for regulatory compliance

Future Trends and Implications of Gen AI in Medicine

1

Personalized Medicine

generative AI to develop tailored treatments based on individual patient data.

2

Remote Patient Monitoring

generative AI can enable remote monitoring and telemedicine for better healthcare accessibility.

3

Collaborative AI-Doctor Partnership

harmonious collaboration between AI algorithms and medical professionals.


ORama VR
Operation Progress:
Lesson 1: Knee Incision
Actions: 0 / 68
Cut Epidermis
Operation Start
Action Time: 13.98 Sec
Score: 100%
Errors: 1

THE PROBLEM

XR training improves learning outcomes[1],
XR content creation cannot keep up with demand:

- **LENGTHY CREATION TIMES: 2 – 8 MONTHS**
- **HIGH AUTHORING COSTS[2]:**
  MIN $20K PER MINUTE
- **INFINITE NUMBER OF TRAINING EXPERIENCES**
  TO BE SIMULATED AS DIGITAL TWINS
- **LACK OF LOW/NO-CODE, CONTENT AUTHORING TOOLS**

1 https://www.sciencedirect.com/science/article/pii/S0883540319303341
and more than 55 published clinical trials since 2020 verify this fact

2 https://roundtablelearning.com/cost-of-virtual-reality-training-full-vr-2020/

THE SOLUTION

MAGES XR training low-code/no-code authoring platform*:

- **SKILLS TRANSFER, COMPETENCY ASSESSMENT**
- **SCALING TRAINING LOW-COST AND ON-DEMAND**
- **LOW-CODE XR TRAINING AUTHORING FASTER (8X), AT LOWER COST (8X)**
- **NO-CODE XR TRAINING AUTHORING IN FEW HOURS BY NON-DEVELOPERS (FORTHCOMING)**

*https://ieeexplore.ieee.org/document/10038619

THE PRODUCT
MAGES SDK

15 October 2023

We have created the best low-code, Medical XR Authoring Platform SDK:

PROPRIETARY IP WITH 5 KEY MED-XR ALGORITHMS (PATENTABLE):

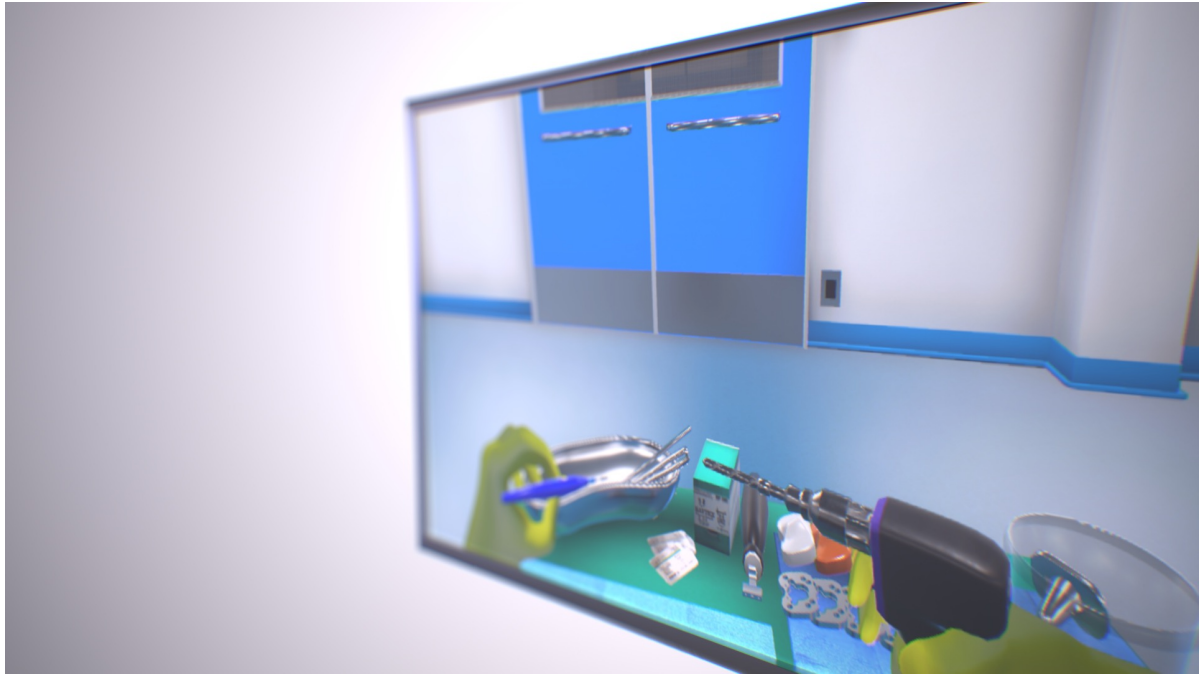
- Multiplayer soft / hard tissues
- DL-based unlimited Analytics
- Gamified VR design patterns
- Educational visual Editor
- Medical Semantic representation

XR HARDWARE AGNOSTIC & CROSS-ENGINE (UNITY, UE)

SDK-AUTHORED MED-XR APPS PROVEN IN 7 PUBLISHED CLINICAL TRIALS*

- Statistically significant improvement on sensorimotor performance of the trainees of the VR group
- Higher satisfaction and user acceptance

VIDEO →



•*https://www.sciencedirect.com/science/article/pii/S0883540319303341
•https://games.jmir.org/2021/1/e24170
•https://games.jmir.org/2021/4/e29586/
•https://doi.org/10.3389/frvir.2021.740197

METAVERSE LOW-CODE AUTHORING FRAMEWORKS

ORama VR

Numerous **authoring frameworks** have emerged to sustain the creation of VR/AR applications

Main characteristics of virtual reality authoring tools: [1]

- Virtual environment **creation**
- Manipulating and importing **3D** objects
- Interactive **human characters** development
- Artificial intelligence **automation**

"Our medical virtual-worlds **(or digital twins)** will seem fundamentally different in the future due to the incorporation of developing technology" [3]

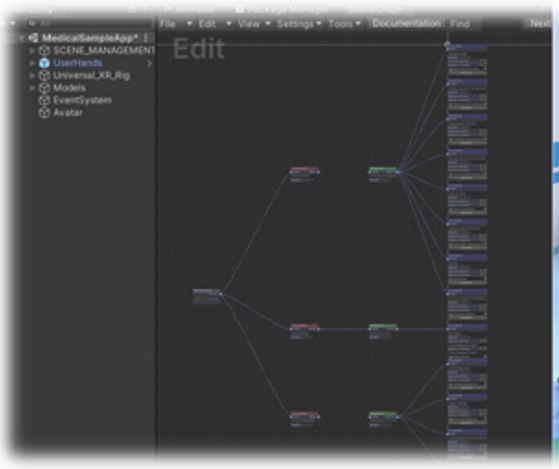
"The most evaluated metrics were **usability**, **effectiveness**, **efficiency**, and **satisfaction**." [2]

[1] Chamusca, I. L., Ferreira, C. V., Murari, T. B., Apolinario, A. L. & Winkler, I. Towards Sustainable Virtual Reality: Gathering Design Guidelines for Intuitive Authoring Tools. *Sustainability-basel* **15**, 2924 (2023)

[2] Coelho, H., Monteiro, P., Gonçalves, G., Melo, M. & Bessa, M. Authoring tools for virtual reality experiences: a systematic review. *Multimed Tools Appl* 1–24 (2022) doi:10.1007/s11042-022-12829-9

[3] Bansal, G., Rajgopal, K., Chamola, V., Xiong, Z. & Niyato, D. Healthcare in Metaverse: A Survey On Current Metaverse Applications in Healthcare. *Ieee Access* **PP**, 1–1 (2022)

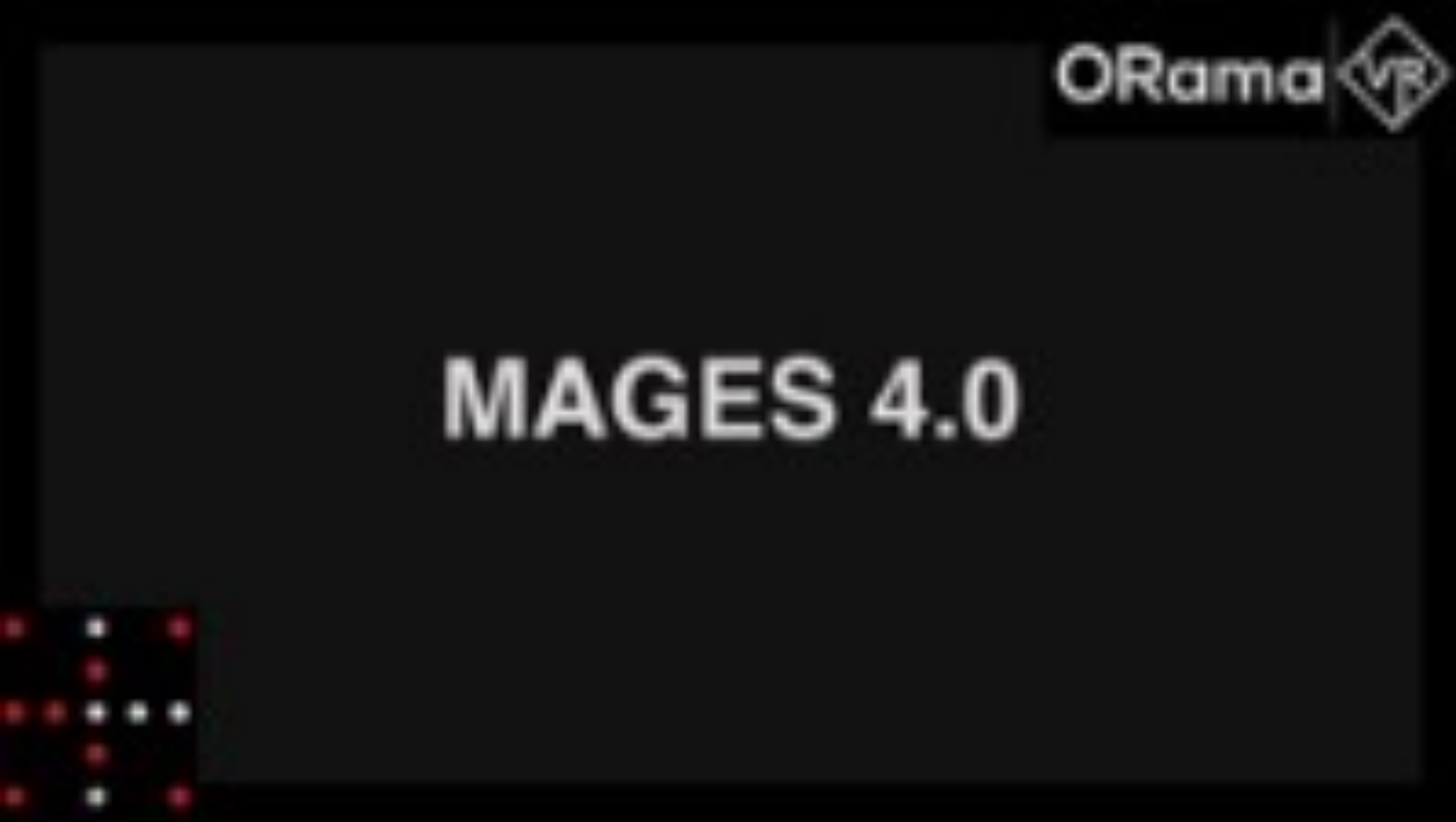
METAVERSE AUTHORING FRAMEWORKS: MAGES 4.0



MAGES 4.0 introduces

- Automations in VR design-patterns for interaction-design **Actions development**
- VR recorder to capture and replay VR sessions
- Realistic real-time **cut, tear and drill** algorithms
- AR and mobile (iOS/Android) support
- Dissected edge physics engine
- Edge-cloud **remote** visual **rendering**
- Optimized networking layer with collaboration of **AR/VR** devices
- Convolutional **neural network** automatic assessment
- New template applications (open source)

P. Zikas *et al*., "**MAGES 4.0: Accelerating the World's Transition to VR Training and Democratizing the Authoring of the Medical Metaverse**," in *IEEE Computer Graphics and Applications*, vol. 43, no. 2, pp. 43-56, 1 March-April 2023, doi: 10.1109/MCG.2023.3242686.



MAGES 4.0: Accelerating the world's transition to medical VR training

ORama VR

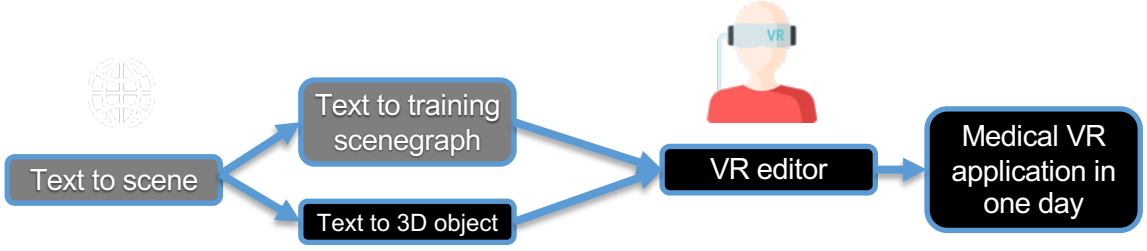
One more thing

What about

no-code generative-AI for medical XR training?

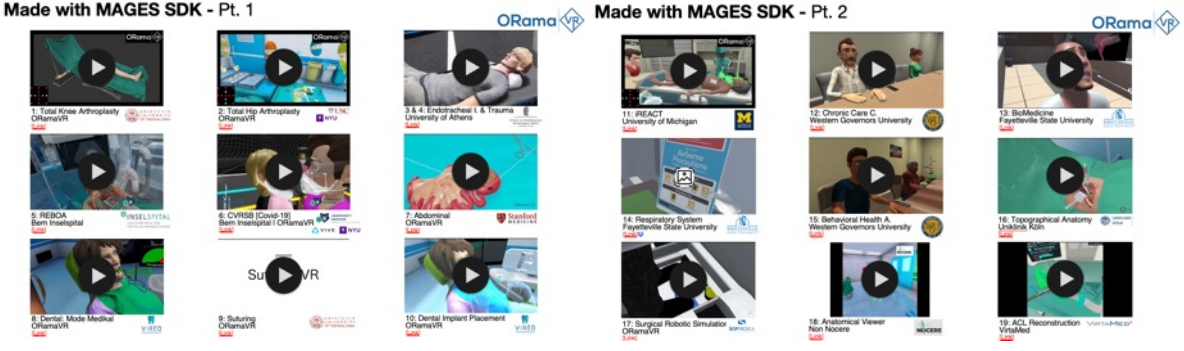
OMEN-E: Open MEdical Neural metaversE

MAGES OMEN-E No-code platform
(*Generative-AI based, no developer needed*)



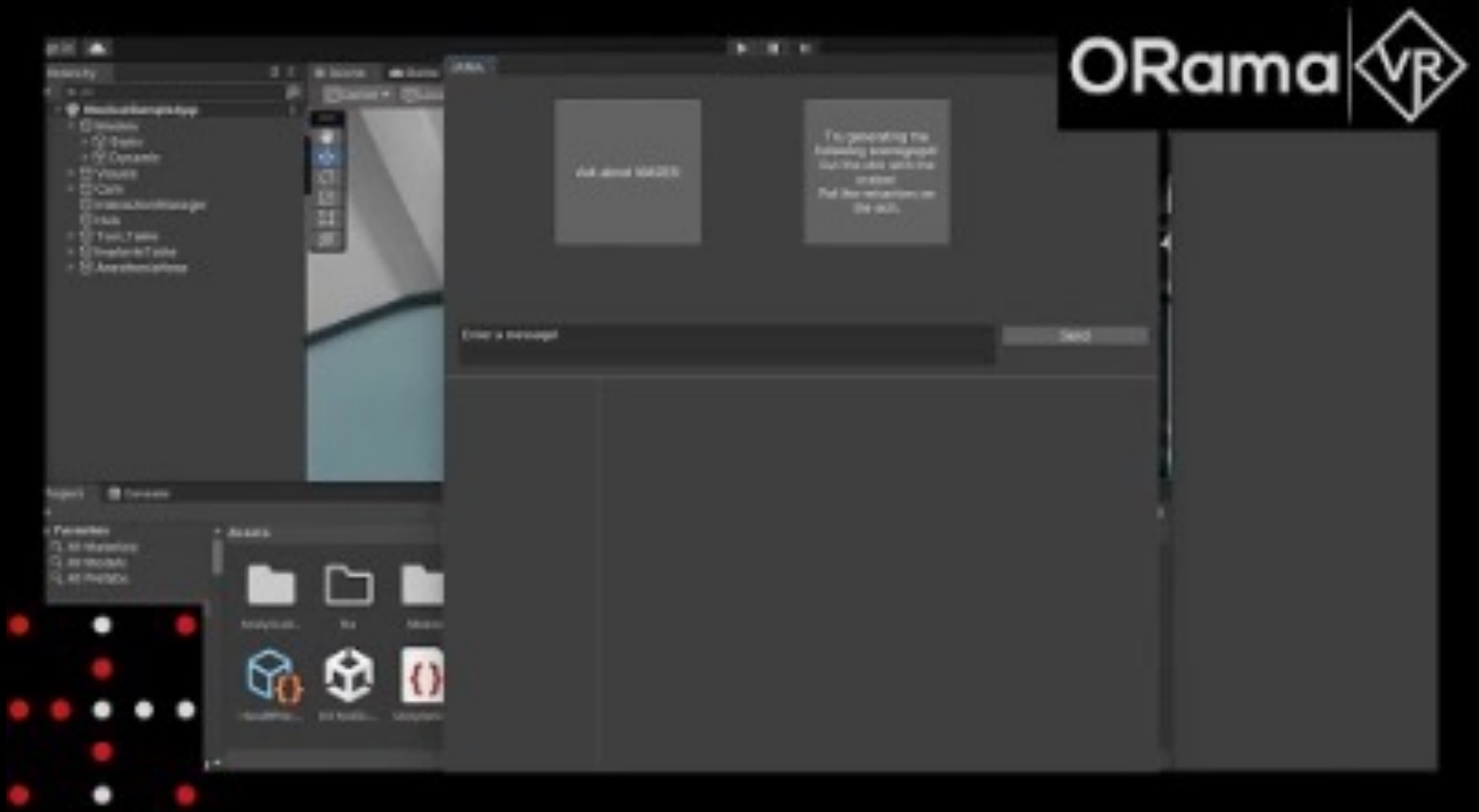
MAGES SDK NXT Low-code platform*
(*support all VR/AR/mobile h/w devices, 1 developer needed*)

MAGES SIM template Library (*reach 100 sims as medical VR apps*)



*https://ieeexplore.ieee.org/document/10038619

JARIA – MAGES SDK NXT (5.0)



One really last thing

```
# general imports
# import openai and dependencies
import os
import openai
openai.api_key = os.getenv("OPENAI_API_KEY")
openai.Model.list()
```

```
import textwrap
# ask ChatGPT via its API and get a response
response = openai.ChatCompletion.create(
model = "gpt-3.5-turbo",
messages=[{"role":"system", "content": "You are a helpful assistant."},
{"role":"user", "content": "Can you say 80 words to inspire the audience of 5th Annual Virtual Reality and Healthcare Europe
Symposium about generative AI in medicine?
"},]
)
chatReply = response['choices'][0]['message']['content']
print(textwrap.fill(chatReply, width=100))
```

```
…Ladies and gentlemen, welcome to the 5th Annual Virtual Reality and Healthcare Europe Symposium.

Today, we delve into the exciting realm of generative AI in medicine.

Imagine a world where computers aid in medical diagnosis, drug discovery, medical training and
personalized treatment plans.

With generative AI, we can unlock endless possibilities. By combining the power of virtual
reality and healthcare, we can revolutionize patient care and improve outcomes.

Let us embrace this technology, harness its potential, and together, shape a future where
generative AI drives us towards a healthier, more compassionate world!
```

Swiss Accelerator innovation project supported by

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Confederazione Svizzera
Confederaziun svizra

Swiss Confederation

Innosuisse – Swiss Innovation Agency

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Greece 2.0
NATIONAL RECOVERY AND RESILIENCE PLAN

fidal field trials beyond 5G

5G-EPICENTRE

Dr. George Papagiannakis
Prof. University of Crete,
Affiliated Researcher at FORTH
Visiting Prof. University of Geneva
&
ORamaVR co-founder, CEO
george@oramavr.com

FORTH Foundation for Research & Technology - Hellas

ORama VR

UNIVERSITÉ DE GENÈVE

Let's accelerate world's transition to computational medical XR and Gen AI!