Building Smart Sustainable Cities in the Metaverse: Opportunities and Challenges

Dr. Christina Yan Zhang
CEO and Founder
The Metaverse Institute
4 May 2023

STI FORUM
Science, Technology & Innovation for the Sustainable Development Goals

WORLD ECONOMIC FORUM
"Right now, we are facing a man-made disaster of global scale. Our greatest threat in thousands of years. Climate change."
David Attenborough
Broadcaster and naturalist

Metaverse

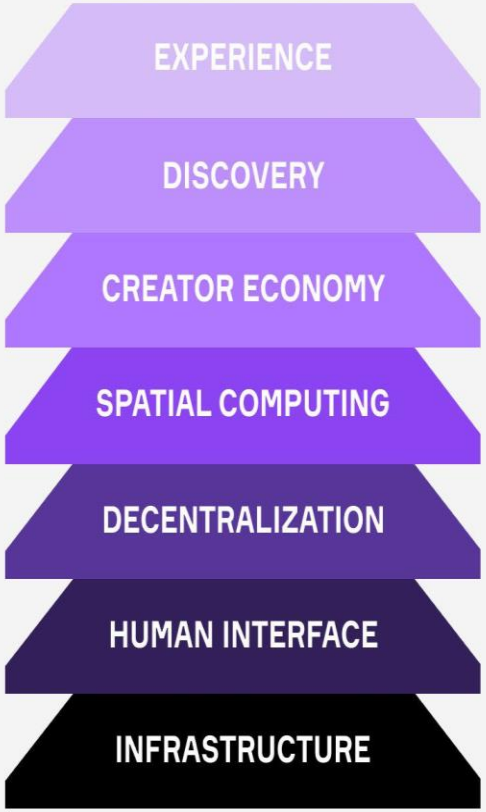
The New Reality

What is the Metaverse and its history?

TIMELINE OF THE METAVERSE

- 1992 — Metaverse coined in Snow Crash by science fiction writer Neal Stephenson
- 1995 — CyberTown
- 2002 — Digital twins
- 2003 — Second Life
- 2006 — Roblox
- 2009 — Bitcoin and blockchain
- 2010 — First prototype of the Oculus Rift VR headset
- 2011 — Ready Player One by writer Ernest Cline | Minecraft
- 2012 — First known NFT
- 2015 — Ethereum | Smart contracts
- 2016 — Pokémon Go
- 2017 — Decentraland
- 2018 — Axie Infinity, NFT-based game
- 2020 — First concerts in the metaverse
- 2021 — Facebook rebrands to Meta Platforms Inc. (Meta)
- 2022 — Microsoft acquired video game maker Activision Blizzard | H&M store in the metaverse

The Seven Layers of the Metaverse



EXPERIENCE	Games, Social, Esports, Theater, Shopping
DISCOVERY	Ad Netwoarks, Social Curation, Ratings, Stores, Agents
CREATOR ECONOMY	Design Tools, Asset Markets, Workflow, Commerce
SPATIAL COMPUTING	3D Engines, VR/AR/XR, Multitasking UI, Geospatial Mapping
DECENTRALIZATION	Edge Computing, AI Agents, Microservices, Bclockchain
HUMAN INTERFACE	Mobile, Smartglasses, Wearables, Haptic, Gestures, Voice, Neural
INFRASTRUCTURE	5G, WiFi 6, 6G, Cloud, 7nm to 1.4nm, MEMS, GPUs, Materials

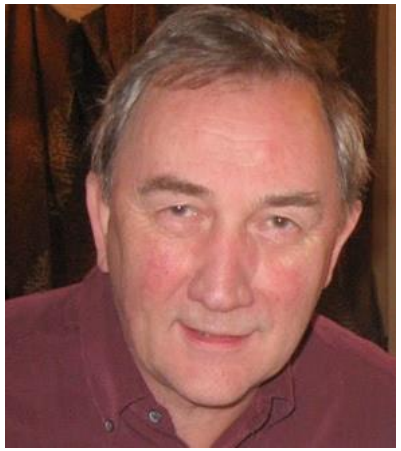
Courtesy: Jon Radoff / Building The Metaverse

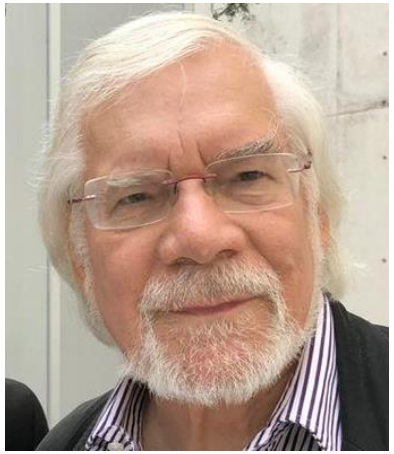
My Academic and Professional Work on The Metaverse since 2006

Loughborough University

1ST IN THE UK FOR COMMUNICATION AND MEDIA

THE TIMES/ SUNDAY TIMES GOOD UNIVERSITY GUIDE 2021





The Use of Second Life as a Tool for Higher Education Internationalisation

by

Yan Zhang

A research dissertation submitted in partial fulfilment of the requirements of the award of the degree of Master of Arts Of Loughborough University

September 2007

Supervisor: Prof. Graham Murdock
School of Social Sciences

The Use of Massively Multiplayer Online Games to Augment Early-Stage Design Process in Construction

by

Christina Yan Zhang

A Doctoral Thesis submitted in partial fulfilment of the requirements for the award of Doctor of Philosophy of Loughborough University

April 2012

©Christina Yan Zhang, 2012

Prof. Michael Pickering

Emeritus Professor of Media and Cultural Analysis

- The UK's Arts and Humanity Research Council Peer Review College(2002-2012)
- Reviews Editor for the European Journal of Communication
- Editorial board of Memory Studies and the Folk Music Journal
- Founding member of the Communications and Media Studies course

Prof. Graham Murdock

Professor Emeritus of Culture &Economy

- World renowned founding expert in critical political economy of culture and communications
- Vice President of the International Association of Media and Communciation Research (IAMCR) (2016-2020)
- Member of the European Science Foundation's Expert Panel of Research Proposal Evaluators
- Founding member of the Communications and Media Studies course

Prof. Peter Golding

Emeritus Professor of Sociology

- World renowned founding expert in critical political economy of culture and communications
- Pro-Vice-Chancellor (Research & Innovation) at Northumbria University (2009-2014)
- Pro-Vice-Chancellor (Research) at Loughborough University (2006-2009)
- Chair of the communications, media and cultural studies sub-panel for 2008, 2014 REF(Research Exercise Framework).
- Chair of the Higher Education Funding Council for England Media Studies Advisory Committee.

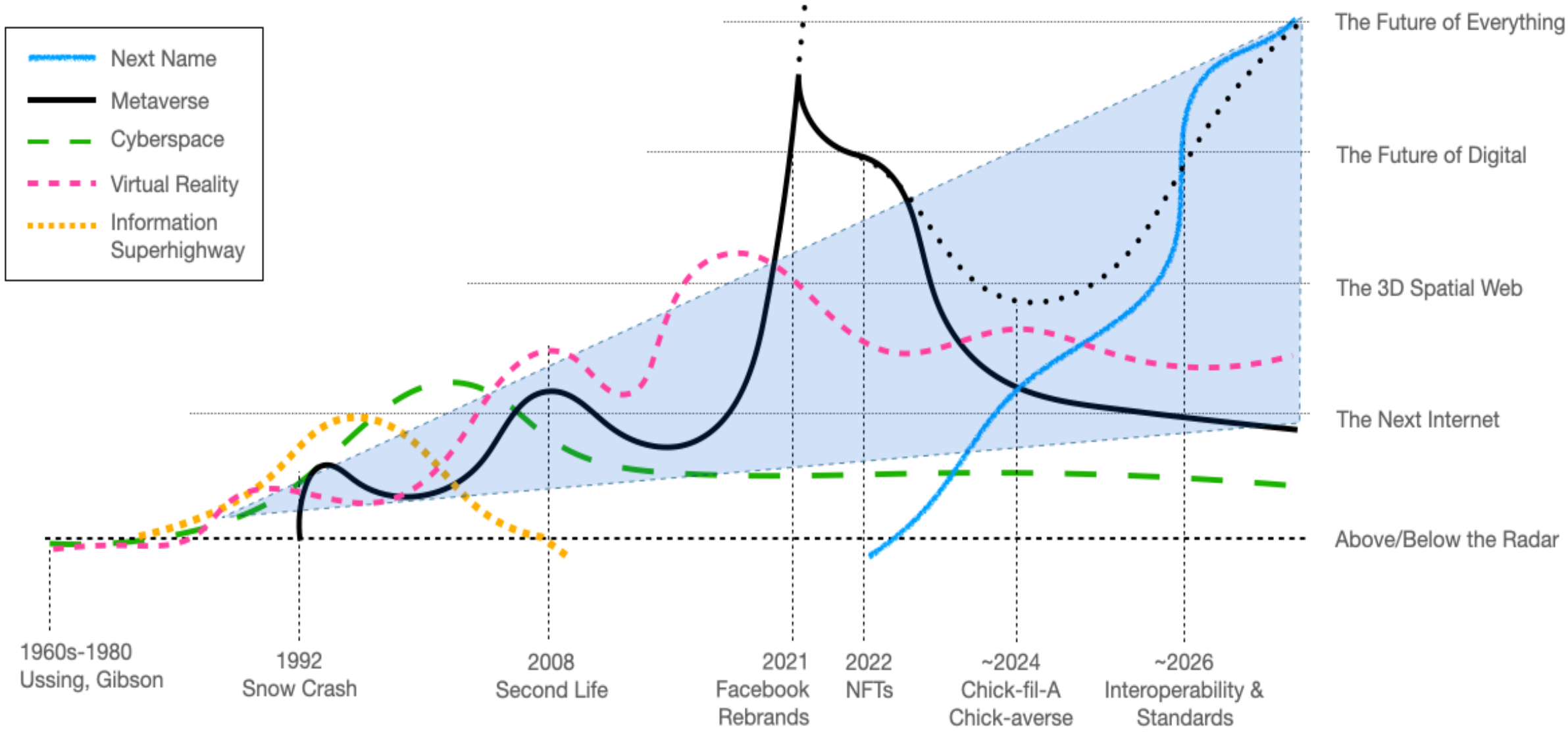
Dame Shirley Pearce DBE

Emeritus Professor of Health Psychology

- Vice-Chancellor of Loughborough University 2006-2012
- The inaugural Chair of the College of Policing (the first professional body for policing) 2013-2016
- Chair of Governors of the London School of Economics and Political Science 2016-2020
- Board member at the Higher Education Funding Council for England (HEFCE) 2009 -2015
- Previous Board member of University of Cambridge, the Healthcare Commission and Health Education England

2021 onwards- Second Wave for Mass Adoption of the Metaverse

The Metaverse Hype Cycle



Source: Avi Bar-Zeev / RealityPrime

Metaverse for
Smart Cities

$500 bn NEOM Project in Saudi Arabia

First-of-a-kind, cognitive digital twin metaverse platform, where the physical truly merges with the virtual, to create unique immersive mixed-reality experiences. For example, you could attend a meeting, wherever you are, either as a real-life robot, an augmented reality avatar, or a hologram. It will look, feel and sound as if you're actually there

7 CORE FEATURES

Dynamic digital twin:
Live cognitive virtual versions of real-world cities/architectures/ spaces

Gamified experience:
Built-in exploration and entertainment features

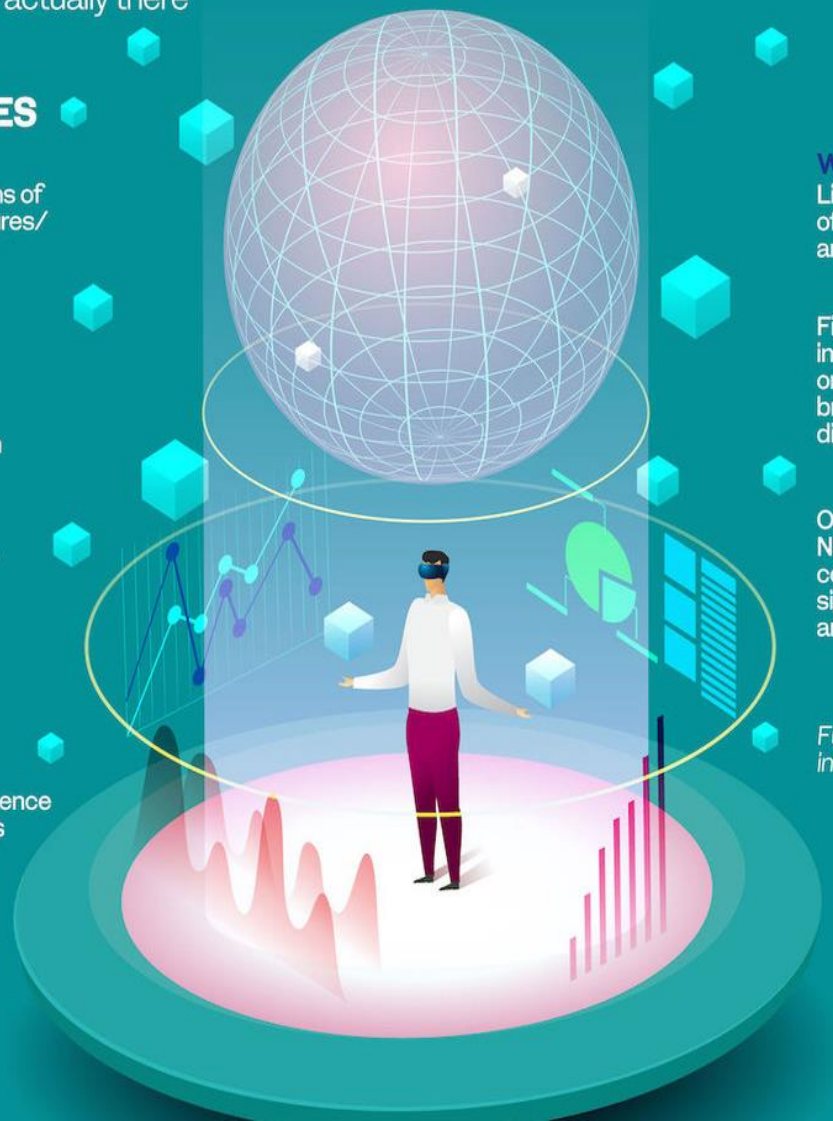
Real-time translation:
Instant language translation built into the experience

Social platform:
Matching profiles of people and fostering interaction

Digital marketplace:
Built-in crypto and NFT digital assets platform

Immersive mixed reality:
Enabling simultaneous presence in physical and digital worlds

Humanoid robotic avatars:
Use and interact with humanoid robotic avatars

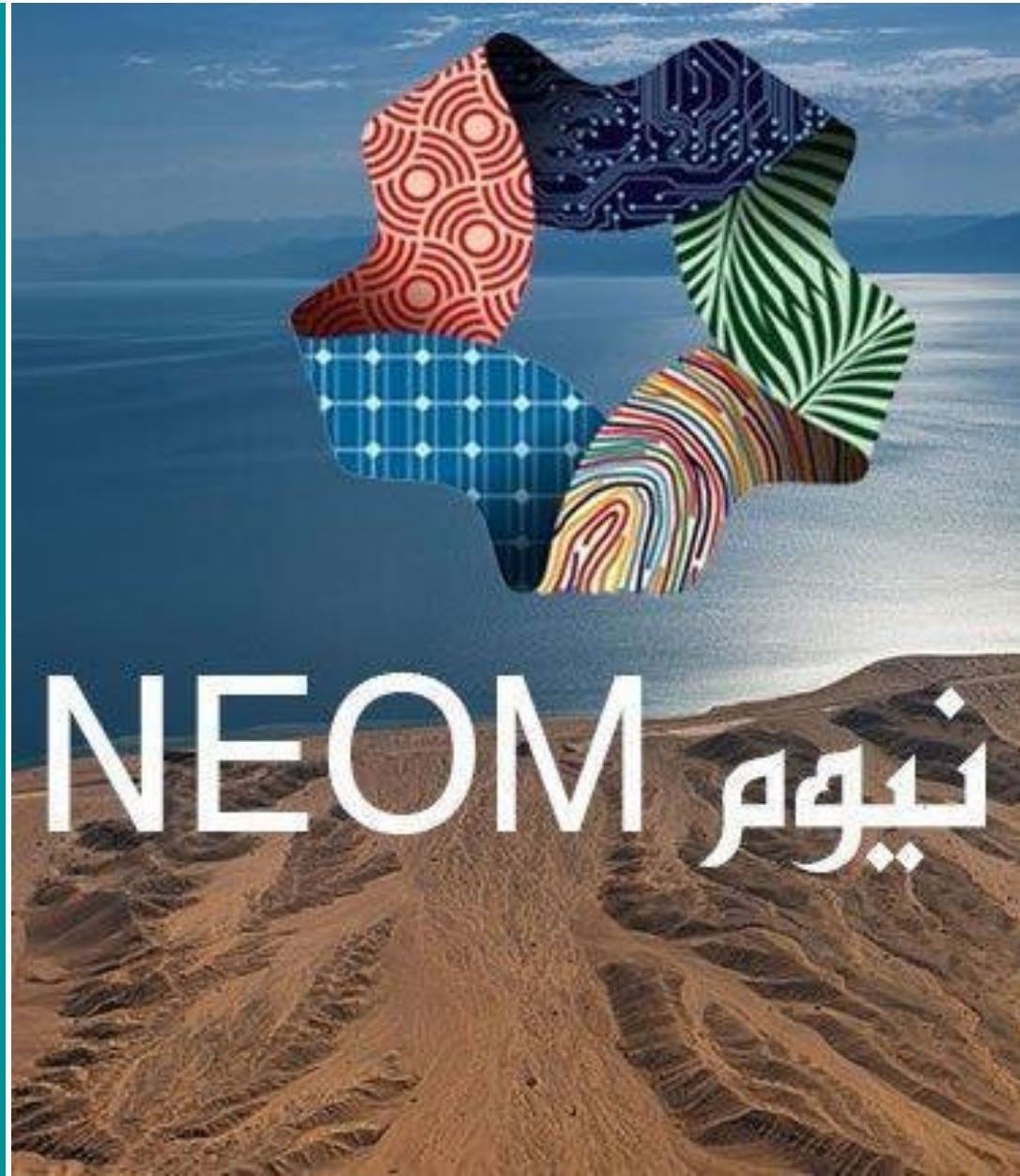


What makes XVRS unique?
Live cognitive virtual versions of real-worldcities/ architectures/ spaces

First-of-kind metaverse to include all seven features into one scalable platform, that bridges physical and digital environments

Only metaverse with access to NEOM architectures, cities and communities, while it also has significant real estate assets and investment

Further news to be announced in 2022



Existing Metaverses Applications for Smart Cities

Digital twin enhances Shanghai's transportation system

2022-09-06

The Huangpu River, airports, ports, as well as construction sites in Shanghai have been incorporated into the city's digital-twin world of the local transportation system, according to the Shanghai Urban Operation and Management Center.

Featuring artificial reality, embodied and tangible interaction, as well as artificial intelligence technologies, the Huangpu River cruise tour now has developed its digital version, Shanghai Jiushi Group, operator of the Huangpu River cruise tour services, revealed.

In this digital world, tourists can travel through time and space between today's Bund and old Shanghai online, it added.

A screen shot of the digital-twin Huangpu River.

The "digital twin" concept refers to a virtual platform or model that accurately reflects the real-time physical objects and system in the real world. This means that every element and object in the city can be found in its digital reflection in a digital system by simple clicks on a screen.

It is also a response to China's 14th Five-Year Plan (2021-2025), which has listed digital twin construction as an important part of improving the city's management capacity.

Santa Monica Is Using the Metaverse to Gamify Its Shopping District

Decerry Donato - Dec 13 2021

Last week, the app FlickPlay announced it was partnering with Santa Monica (which is where the company is based) so that it would become the first U.S. city to have access to the metaverse through its app.

After all the Facebook hype, I wanted to find out what the metaverse looked like and why a city would sign on.

So, standing on the bustling corner of Santa Monica Blvd and 3rd Street, I scanned FlickPlay's interactive map on my phone in search of tokens.

Nextech AR says City of London picks its spatial mapping technology for Metaverse launch

The company has kicked off its technology at Harmony at London Wall Place in London powered by its ARway spatial mapping technology and software development kit

In August 2021, Nextech announced its acquisition of ARway, a leader in spatial computer mapping

Nextech AR Solutions Corp. (CSE:NTAR, OTCQB:NEXCF, NEO:NTAR) has announced the launch of its "mini-metaverse" at Harmony at London Wall Place in London.

The company said the City of London Metaverse is powered by its ARway spatial mapping technology and software development kit (SDK).

Harmony at London Wall Place has been co-commissioned by Culture Mile and Brookfield Properties. It incorporates a series of location-anchored augmented reality artworks, bringing London to life with visuals and music from Guildhall School of Music & Drama and London Symphony Orchestra.

READ: Nextech AR launches '3D Rooms' for

OTCMarkets

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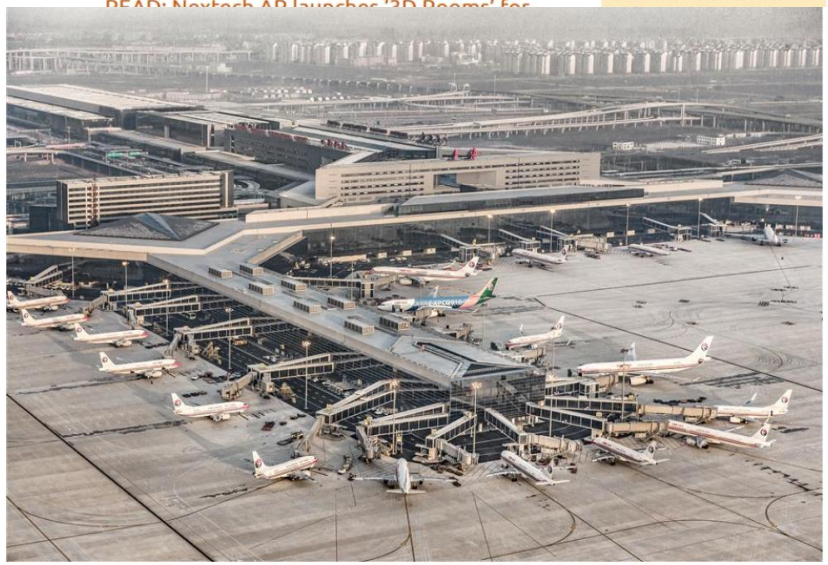

Shanghai's airports have applied the digital twin technology to operate flights

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Home » News & Publications » News » ASCE Features NYC Digital Twin Research By UTC Partners at Columbia

A three-year project at Columbia University is building Digital Twins of intersections, roadways, and other key infrastructure in New York City to monitor and map traffic flow throughout the city. Using Digital Twins can help researchers and officials simulate traffic and congestion conditions and test potential mitigation strategies in a virtual environment.

Dr. Sharon Di and her team have been working on a National Science Foundation project, "Hybrid Twins for Urban Transportation: From Intersections to Citywide Management," where they are developing a virtual replica, or digital twin, of New York City for traffic management and monitoring.

The Digital Twin continuously learns and dynamically updates itself as the city traffic environment changes in real time. This innovative technology can help traffic managers to monitor traffic patterns as they happen and quickly come up with adaptive management strategies.

Her research on this project was recently featured in the American Society of Civil Engineers' "Civil Engineering Source" — ASCE's news and information hub focused on delivering important industry developments in the civil engineering profession. Read the full story here.

"We plan to implement adaptive traffic signal control, learned from real-time traffic data collected from Internet of Things sensors, to coordinate traffic lights along a corridor and a subregion to move traffic more efficiently with fewer stops," Dr. Di said in the article.

An associate professor of Civil Engineering and Engineering Mechanics at Columbia University and an affiliated researcher at the Center for Advanced Infrastructure and Transportation (CAIT), Dr. Di studies travel behavior and transportation systems, both of which are being transformed by emerging communications and sensing technologies. Her research helps transportation planners and managers maximize efficiency and sustainability across their systems.

Her research team includes Qiang Du, Ph.D., a professor of applied mathematics, and Zoran Kostic, Ph.D., and Gil Zussman, Ph.D., both professors of electrical engineering at Columbia. The project is being funded by a $1.2 million grant from the National Science Foundation and the U.S. Department of Transportation's Federal Highway Administration.

As part of the Digital Twin project, researchers are also using Columbia's COSMOS, the only beyond-5G testbed in New York City, to get real-time traffic data, leveraging Cosmos's rich sensor data and deep computational capabilities.

Columbia, and other universities including Rutgers, recently received a separate $26 million NSF grant to develop an engineering research center for smart streetscapes. As part of this project, the DataCity Smart Mobility Testing Ground at Rutgers CAIT, the COSMOS testbed at Columbia, and other innovative facilities will be engaged to develop mobility tools and solutions.

Digital Twins will help traffic managers monitor transportation patterns and congestion as they happen, and develop solutions.

Existing Metaverses Applications for Smart Cities

About

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Dubai and Abu Dhabi Dubbed the World's First 'Metaverse Cities'

by Nathan Gore September 6, 2022

***Metaverse Holdings** has unveiled Dubai and Abu Dhabi as the first global cities within a global metaverse launch. The Emirates will be the first 'utilised' hub within the first virtual world that replicates real-life experiences and places*

The **Government of Dubai** recently formed the Higher Committee for Future Technology and Digital Economy to oversee the city's push to become a leading global hub for metaverse technology adoption.

The environment will match authentic real-life events and locations, with a Beta version expected to go live in the fourth quarter of 2022.

Users globally will be able to experience Dubai and Abu Dhabi's greatest attractions and landmarks alongside real world utilities from the comfort of their homes – merging the physical and digital world.

According to Metarverse, following its Beta phase it will release further key locations across the Emirates with a focus 'on creating virtual spaces that are visually, topographically, and geometrically scaled to recreate the most realistic feeling in the Dubai and Abu Dhabi metaverse, with space for endless, interconnected virtual communities using virtual reality (VR) headsets, augmented reality (AR) glasses, smartphone apps and other

Web3

South Korea Launches Metaverse Replica of Seoul

As part of a three-year effort to expand its public services, Metaverse Seoul will allow users to take their avatars to tax offices, access youth counseling and read e-books.

By Cam Thompson Jan 17, 2023 at 3:43 p.m. GMT Updated Jan 17, 2023 at 5:16 p.m. GMT

Metaverse Seoul (opengov.seoul.go.kr)

CONSENSUS 2023 by CoinDesk

Join the most important conversation in crypto and Web3 taking place in Austin, Texas, April 26-28.

Secure Your Seat

South Korea is bringing Seoul to the metaverse, launching a virtual replica of the capital city with a goal of improving its public services, Forkast reported Monday.

Known as Metaverse Seoul, the virtual world is estimated to be completed by 2026. The initial stage invites citizens to use avatars to get their tax questions answered, access youth counseling, find support for small businesses and even read e-books.

In future stages, the virtual world will expand to real estate and foreign investor services, incorporating augmented reality to manage municipal infrastructure. It also plans to introduce blockchain technologies including cryptocurrency.

South Korea has been expanding its metaverse initiatives as a part of its "Digital New Deal" political initiative. In February 2022, the nation announced plans to earmark about $200 million to fund metaverse projects, giving out grants to universities and companies to help expand their technologies. The Bank of Korea also reportedly completed a test of central bank digital currencies in November.

BTC $
ETH $
BNB $
XRP $
BUSD $

September 12, 2022

Singapore's Digital Twin of Entire Country

The world's biggest digital twin.

Singapore-based company VIZZIO Technologies "cloned" all of Singapore to create the world's biggest digital twin of an entire nation. The 1:1 scale model of 3D Singapore was created in two weeks and is divided into 1 square meter titles, totaling 728,000,000 tiles.

Digital twins are a virtual replication of the physical world. They collect information and data via tools like sensors and drones which are then combined with advanced analytics, machine learning, and artificial intelligence.

Singapore's Digital Twin

Before VIZZIO created the world's largest digital twin, Singapore funded a $73 million, data-rich digital replica of the nation called Virtual Singapore in 2014 as a part of its Smart Nation effort. Virtual Singapore, powered by the 3DEXPERIENCE PLATFORM, used images and data to allow users to visualize how the city will be developed and evolve in response to population growth, new

Wellington Digital Twin

The Wellington City twin uses smart city technologies, with real-time data to provide:

- Transportation statistics for bus, rail, ferry, bike and car
- Air traffic visualisations
- Cycle sensor data including how many trips were made in a time period, direction of travel, and which streets cyclists travel on
- Car park availability

THE WAY FORWARD

QUANTUM COMPUTING

Quantum Computing will unleash the true potential of the metaverse

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Luke Lango's *Hypergrowth Investing* Meet Luke Lango

Quantum Computing Will Be Bigger Than the Discovery of Fire!

Quantum computing is the most underrated, most transformational technological breakthrough since the internet

1d ago · By Luke Lango, InvestorPlace Senior Investment Analyst

- Haim Israel, head of global thematic investing research at Bank of America, believes quantum computing is "a revolution for humanity bigger than fire, bigger than the wheel."
- Scientists at leading tech companies have started to figure out how to harness the power of quantum mechanics to make a new generation of super quantum computers — infinitely faster and more powerful than even today's fastest supercomputers.
- Google has built a quantum computer that's about 158 million times faster than the world's fastest supercomputer.
- Quantum computing could allow us to create a million-mile EV rather soon. And through material simulation and battery optimization modeling, it'd also dramatically reduce the costs of EV manufacturing.

SPECIAL PRESENTATION: The $5 Stock That Could Make Apple the Next EV Giant

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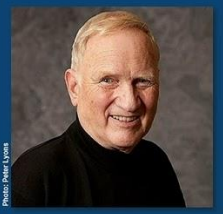
THE ROYAL SWEDISH ACADEMY OF SCIENCES

Alain Aspect

Université Paris-Saclay & École Polytechnique, France



John F. Clauser

J.F. Clauser & Assoc., USA

Anton Zeilinger

University of Vienna, Austria

"för experiment med sammanflätade fotoner som påvisat brott mot Bell-olikheter och banat väg för kvantinformationsvetenskap"

"for experiments with entangled photons, establishing the violation of Bell inequalities and pioneering quantum information science"

#nobelprize

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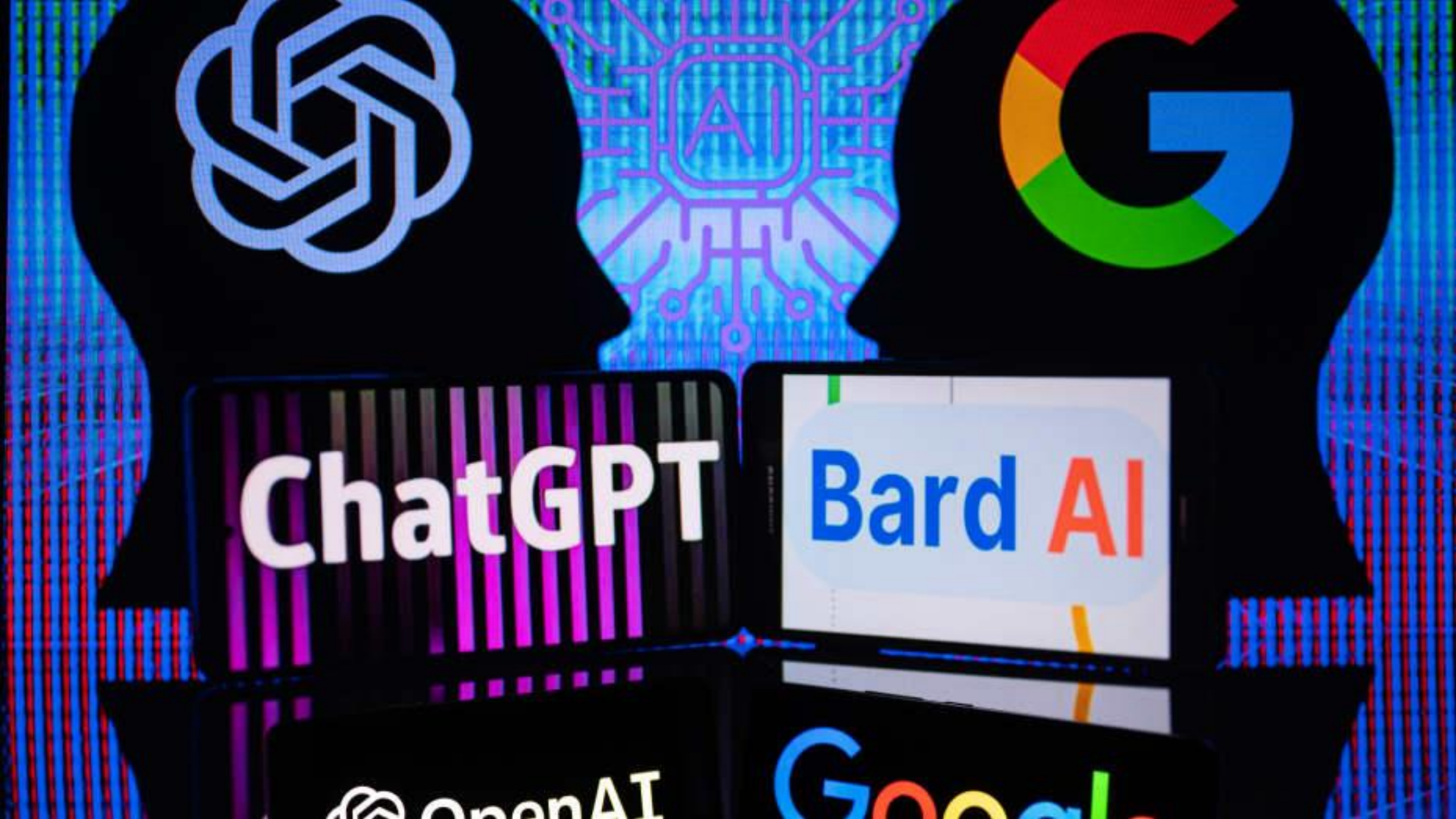
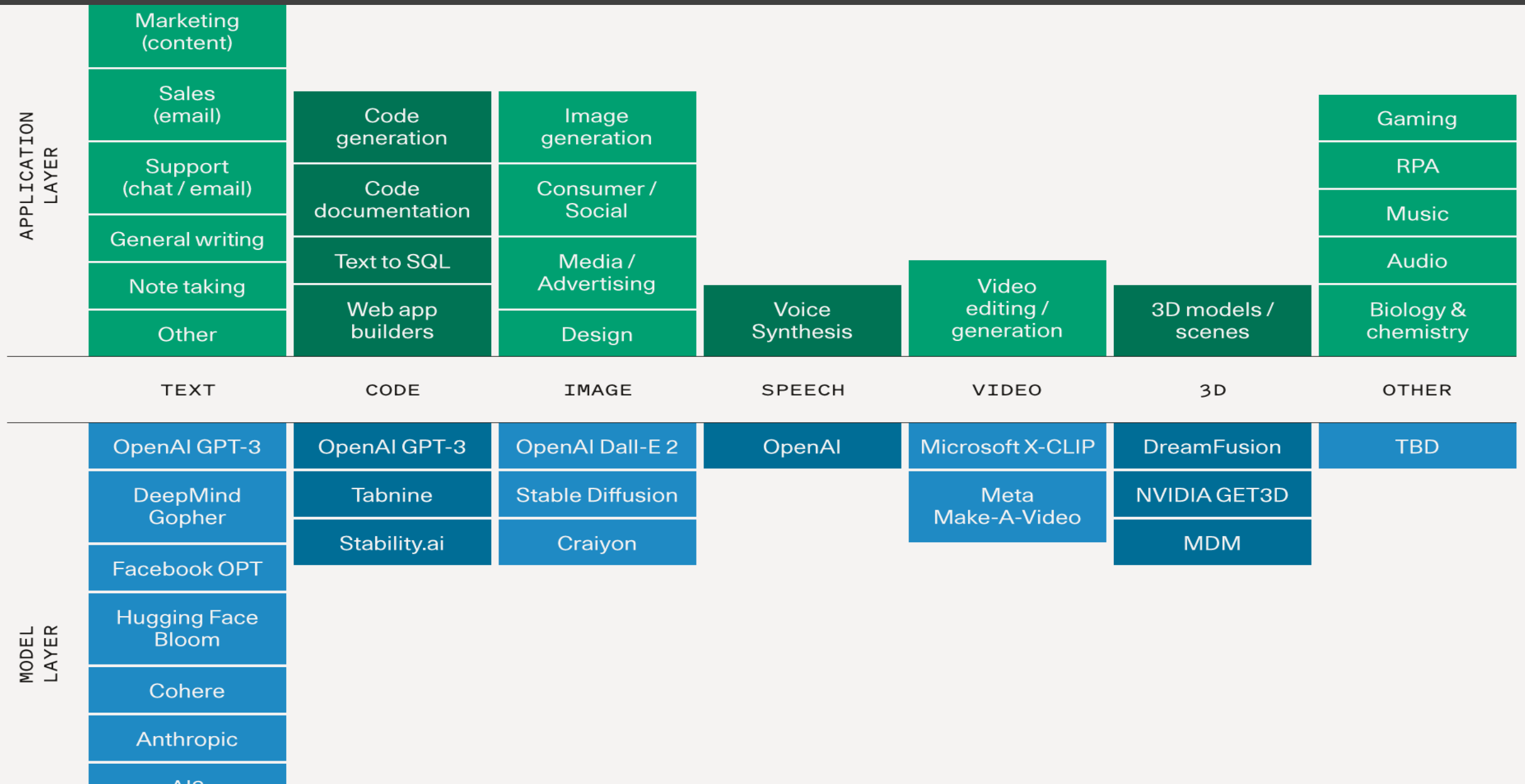
#QuantumComputing #Davos2022

Davos 2022: Quantum Computing is Closer Than You Think.


ChatGPT
Bard AI
OpenAI
Google

The Generative AI Application Landscape



Google VS NVDIA: Generative AI- Text to High-Resolution 3D

DreamFusion: Text-to-3D using 2D Diffusion

Ben Poole
Google Research

Ajay Jain
UC Berkeley

Jonathan T. Barron
Google Research

Ben Mildenhall
Google Research

Paper | Project | Gallery

Abstract

Recent breakthroughs in text-to-image synthesis have been driven by diffusion models trained on billions of image-text pairs. Adapting this approach to 3D synthesis would require large-scale datasets of labeled 3D assets and efficient architectures for denoising 3D data, neither of which currently exist. In this work, we circumvent these limitations by using a pretrained 2D text-to-image diffusion model to perform text-to-3D synthesis. We introduce a loss based on probability density distillation that enables the use of a 2D diffusion model as a prior for optimization of a parametric image generator. Using this loss in a DeepDream-like procedure, we optimize a randomly-initialized 3D model (a Neural Radiance Field, or NeRF) via gradient descent such that its 2D renderings from random angles achieve a low loss. The resulting 3D model of the given text can be viewed from any angle, relit by arbitrary illumination, or composited into any 3D environment. Our approach requires no 3D training data and no modifications to the image diffusion model, demonstrating the effectiveness of pretrained image diffusion models as priors.

Magic3D: High-Resolution Text-to-3D Content Creation

Chen-Hsuan Lin* Jun Gao* Luming Tang* Towaki Takikawa* Xiaohui Zeng*
Xun Huang Karsten Kreis Sanja Fidler† Ming-Yu Liu† Tsung-Yi Lin

*† : equal contributions

NVIDIA Corporation

IEEE Conference on Computer Vision and Pattern Recognition (**CVPR**), 2023
HIGHLIGHT

Paper (arXiv)

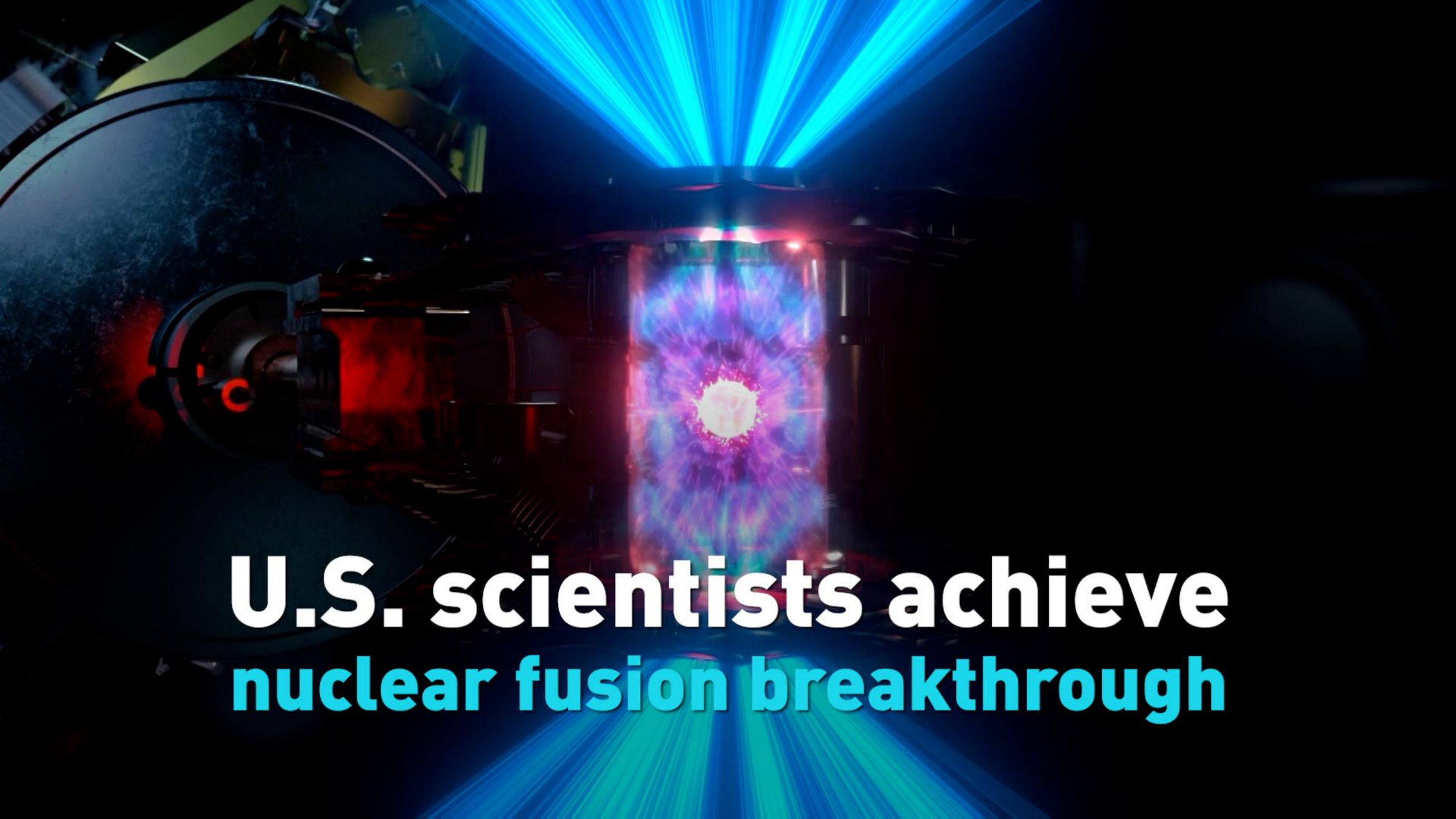
Magic3D is a new text-to-3D content creation tool that creates 3D mesh models with unprecedented quality. Together with image conditioning techniques as well as prompt-based editing approach, we provide users with new ways to control 3D synthesis, opening up new avenues to various creative applications.

Our latest text-to-3D models will be available through **NVIDIA Picasso**, our generative AI cloud service. Please **sign up** to be notified of availability.

(best viewed with Google Chrome on a desktop/laptop)

Abstract

DreamFusion has recently demonstrated the utility of a pre-trained text-to-image diffusion model to optimize Neural Radiance Fields (NeRF), achieving remarkable text-to-3D synthesis results. However, the method has two inherent limitations: (a) extremely slow optimization of NeRF and (b) low-resolution image space supervision on NeRF, leading to low-quality 3D models with a long processing time. In this paper, we address these limitations by utilizing a two-stage optimization framework. First, we obtain a coarse model using a low-resolution diffusion prior and accelerate with a sparse 3D hash grid structure. Using the coarse representation as the initialization, we further optimize a textured 3D mesh model with an efficient differentiable renderer interacting with a high-resolution latent diffusion model. Our method, dubbed Magic3D, can create high quality 3D mesh models in 40 minutes, which is 2× faster than DreamFusion (reportedly taking 1.5 hours on average), while also achieving higher resolution. User studies show 61.7% raters to prefer our approach over DreamFusion. Together with the image-conditioned generation capabilities, we provide users with new ways to control 3D synthesis, opening up new avenues to various creative applications.


U.S. scientists achieve
nuclear fusion breakthrough

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8 DECENT WORK AND ECONOMIC GROWTH
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10 REDUCED INEQUALITIES
11 SUSTAINABLE CITIES AND COMMUNITIES
12 RESPONSIBLE CONSUMPTION AND PRODUCTION
13 CLIMATE ACTION
14 LIFE BELOW WATER
15 LIFE ON LAND
16 PEACE, JUSTICE AND STRONG INSTITUTIONS
17 PARTNERSHIPS FOR THE GOALS
METAVERSE
for
SDGs
GLOBAL PRIZE & VR COMPETITION

WORLD ECONOMIC FORUM
“Human beings are the greatest problem-solvers our planet has ever known.
We are just yet to apply ourselves to this problem with the scale and urgency it requires.”
David Attenborough
Broadcaster and naturalist

Thank
you

Christina@metaverse-institute.org

Christina Yan Zhang

ChristinaYZhang