

# Content & the Metaverse are Powered by Visual Tech

Top business opportunities of the Creator Economy through 2027

Summer 2021

LDV CAPITAL



# Table of Contents

1. Introduction.....	3
2. Visual Content.....	6
3. Tools.....	8
4. Monetization.....	23
5. Metaverse.....	29
6. Conclusion.....	32
7. Quotes & References.....	35

# Massive shifts in content creation are underway.

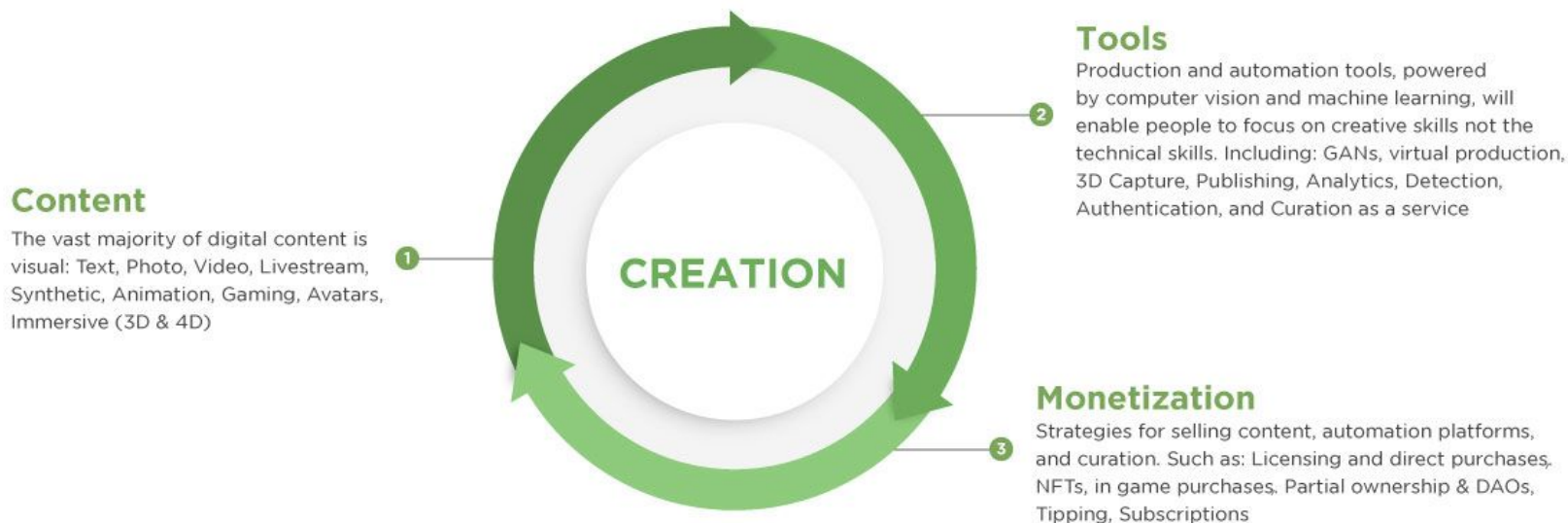
The internet was not always considered “real life”, but now we live as much online as we do in person and this will only continue post-pandemic. We work, date, laugh with grandparents, play games, attend cooking classes, concerts, church services & dinner parties; we participate in politics, appear at court, go to school, shop, visit doctors - all via computer screens.

We find ourselves in the midst of an evolution: **digital is another dimension of our human existence**. Even post-lockdown, people spend 13 hrs of their day online, on average. As we embrace digital life, it is only natural that we choose to represent and express ourselves in new ways online. We want to digitally express our thoughts, tastes, styles, talents ... our creativity.

To showcase our personality and uniqueness online in the same ways we do in person, we are participating more than ever before in generating unique content.

# Content creation requires visual tech

Breakthroughs in visual tech tools for creation, publication, moderation and monetization are fueling the next evolution of content creation. The creative economy has existed for generations, primarily dealing with physical goods (pottery, jewelry, paintings, photos, etc) and over the past two decades has started to become digital. In this report, we examine the top visual tech trends that are now reshaping digital creation and identify the unique business opportunities to support creation over the next five years:



**Visual Technology:** (*def*) any technology that captures, analyzes, filters, displays or distributes **visual data**. It typically leverages **computer vision**, **machine learning**, or **artificial intelligence**.

There will be 100X more visual  
content online by 2027.

# The vast majority of digital content will be visual

There are millions of creators across the globe, producing, selling and building audiences around the content they create. Dubbed the “Creator Economy,” it is one of the fastest-growing business trends taking over headlines.

However, there has always been a creator ecosystem that includes photographers, videographers, writers and artists. Our General Partner was a professional photographer, photo editor and photo agent in the early 1990s. In 2004, he wrote an article “*Will more than 100 billion digital images be captured worldwide by 2005*” and all thought he was crazy.

Due to shifts in online participation and technological advances, over the next five years the amount of content created and shared will grow exponentially. The vast majority will be visual content. Quality, contextual relevance and quantity will be the key aspects to delivering the most valuable content.

## TYPES OF VISUAL CONTENT COVERED

- Text
- Photo
- GIF
- Snackable Video
- Social Video
- Episodic content
- Film
- Broadcasting
- Livestreaming
- Graphic Art
- Motion Graphics
- Cartoons
- Computer-generated graphics
- 3D & 4D
- Immersive content
- Gaming

By 2027, creators won't  
have to be technical, just  
creative, thanks to  
automation tools.



---

Currently, it takes time and (often) years of prior training to produce a single piece of quality and contextually relevant visual content.

It has also typically required deep technical expertise.

A variety of visual technologies are enabling the creation of tools for automating most of the technical skills that were once required to create content.

Soon any one person will be able to compete with full production studios in terms of the quality and quantity of content they can produce.

---

- ▶ Synthetic media & GANs will superpower creation
- ▶ Video production will be automated, virtual & programmable
- ▶ AI will bring motion capture to the masses
- ▶ Nearly all content will be gamified
- ▶ People will have multiple digital identities

# Synthetic media will become ubiquitous

A lot of the content we view today is already computer-generated graphics (CGI), special effects (VFX), or altered by software (e.g. Photoshop). Whether it's the army of the dead in Game of Thrones or a resized image of Kim Kardashian, we see content everywhere that has been digitally designed and altered by human artists. Now, computers and artificial intelligence can generate images and videos of people, things and places that never physically existed.

**By 2027, we will view more photorealistic synthetic images and videos than ones that document a real person or place.** Some experts even project synthetic content will be nearly 95% of the content we view.<sup>2</sup>

**Ads and marketing materials will widely adopt synthetic media.** It will be faster, cheaper and more inclusive in many scenarios to generate objects and people for ads than to hire models, find locations and do a full photo or video shoot.

**Customer service will be provided by synthetic people.** Videos featuring computer-generated synthetic humans will respond to online customer service requests and take over some hospitality services like hotel check-in or restaurant hosts where the questions are always relatively similar and scripted. It will be cheaper, faster, and enable responses to be objective and uniform.

## These People Do Not Exist<sup>1</sup>



Created with NY Times People GAN

**"Synthetic media will significantly accelerate creative expression and lessen the gap between idea and content."**

- Victor Riparbelli, Synthesia Co-Founder & CEO

# Generative algorithms will superpower creation

**"Generative models are supercharging people's creativity. In the next five years, most content is going to be generated by a combination of humans and computers."**

- Peter Welinder, OpenAI VP of Product & Partnerships

Major strides in generative adversarial networks (GANs) are enabling the automated creation of content across all media. GANs will be able to write text, make photos, create game scenarios and more using simple prompts from humans such as "write me 100 words about a penguin on top of a volcano." GANs are the next Photoshop.

**Tools leveraging GANs will inspire creators in the ideation phase**, expanding their thinking and making their process faster.

**GANs will also enable creators to go beyond the physical ability** to create a photo or produce a video.

- Text-based GANs, like OpenAI's GPT3, and the applications built on top of them, are writing text and prompts for authors, marketers and other content creators.
- GANs for photos, like OpenAI's DALL-E or NVIDIA's GauGAN can generate photos from text or simple drawings.

GANs will make creation faster, more accessible and cheaper. Many sectors will be able to capitalize on deploying GAN-based tools:

- **Marketing and advertising** will be a first adopter with GANs driving direct & immediate recommendations of language and images for ads, marketing campaigns, and websites.
- **Gaming will be transformed** as games will create themselves and be personalized storylines for the player.

# Computer vision will aid automation of livestreaming

Livestreaming is one of the fastest-growing segments in online video. Livestreaming is video that is recorded and broadcast in real-time over the internet. Over 60% of individuals aged 18-34 watch livestreaming content daily, making it one of the most popular forms of online content.<sup>1</sup> By 2026, it will be a \$150 billion market.<sup>2</sup>

Livestreaming has transformed gaming with platforms like Twitch amassing +17 billion hours watched in 2020 with +140 million MAU.<sup>3,4</sup> It has propelled esports as the 3rd biggest sport in the US.<sup>5</sup> **Live shopping, cooking, and concerts are the next media segments set to grow rapidly on livestream through 2027.**

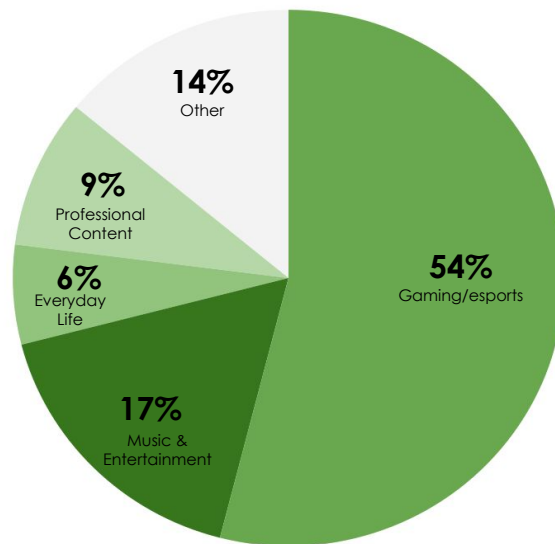
The most successful streamers create quality content that is contextually relevant to their audience but are required to deliver significant quantity to be noticed: top streamers spend 50-60 hours a week livestreaming and many more hours on production.<sup>6</sup>

**Visual tech tools will improve production quality, lessen the time burden on livestreamers, and open up revenue opportunities.**

- Overlay technologies will enable more dynamic content and branding on and around a gamer feed, cooking show or concert.
- Computer vision-enabled sentiment analysis will enable data-driven marketing opportunities.
- Markerless pose estimation and photogrammetry will deliver more immersive content

A major component of livestream success is driving active interaction of their audiences around streamers and their channels. **Automated tools will enable streamers to manage their audience community and increase interactions in real-time.**

Streaming Topics in 2020<sup>6</sup>



# Video production will be automated, virtual & programmable

Video content is on track to constitute 82% of internet traffic by 2023 with the video streaming market expected to hit \$150 billion by 2026.<sup>1,2</sup> In 2020 alone, global mobile video viewers consumed almost 1 trillion hours of video and 72% of people across the globe uploaded a video to the internet.<sup>3</sup>

Video production is still a long, arduous, and expensive process. Generally, to professionally write, direct, shoot and deliver a video with actors, it cost \$1,500 - \$15,000 per finished minute. If the video includes special effects (VFX) or computer-generated (CGI) characters, it can be significantly more. Hollywood productions like The Avengers had a cost of \$330M, which is \$2M per minute.

Hollywood production will remain highly specialized but leverage advances in in-camera VFX and virtual production.

The burgeoning producers like Netflix, Amazon, Hulu, along with producers who are professional videographers, news networks and more will take advantage of the time and cost savings that automation platforms can now offer thanks to breakthroughs in visual tech.

Additionally, **software-enabled programmable video will make video production as easy as making a slide deck.** This will bring video production capabilities to long tail producers like hobbyists and kids who otherwise have no production experience.

## Visual Tech Hardware & Software Automating Video Production

	Storyboarding	Cloud Editing	Auto focus, pan & zoom	Search & Auto-clipping	Auto-Rendering	Color Correction	Auto-Rotoscoping	Graphics	Text to Video
GANs	X								X
Deep Learning	X		X	X	X	X	X	X	X
Computer Vision		X	X	X	X	X	X	X	X
Neuromorphic Compute		X		X	X			X	
GPUs		X		X	X	X	X	X	X

# AI will deliver motion capture to the masses

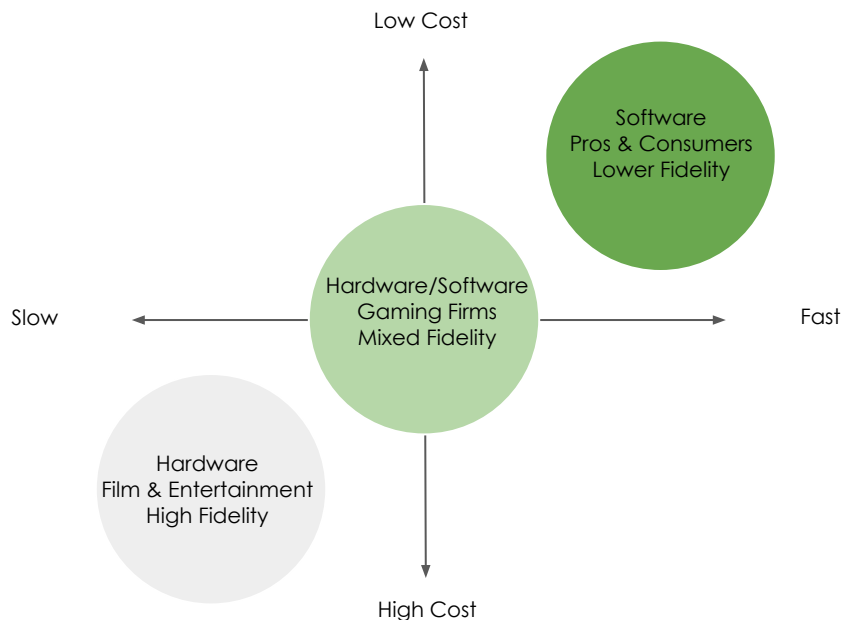
Animations include cartoons, motion graphics and VFX. They will be an increasingly essential part of the content strategy for brands and businesses deployed across image, video & livestream channels.

Motion capture (mocap) is the process or technique of recording patterns of movement digitally such as the recording of an actor's movements for the purpose of animating a digital character in a film or video game. A traditional animator typically creates 4 seconds of content per workday.

**Creators and brands will increase their production of 3D & 4D content powered by motion capture tools in order to efficiently and cost-effectively appeal to larger audiences.** The following technological advances make animation easier, faster, budget-friendly and more widely accessible for content creation.

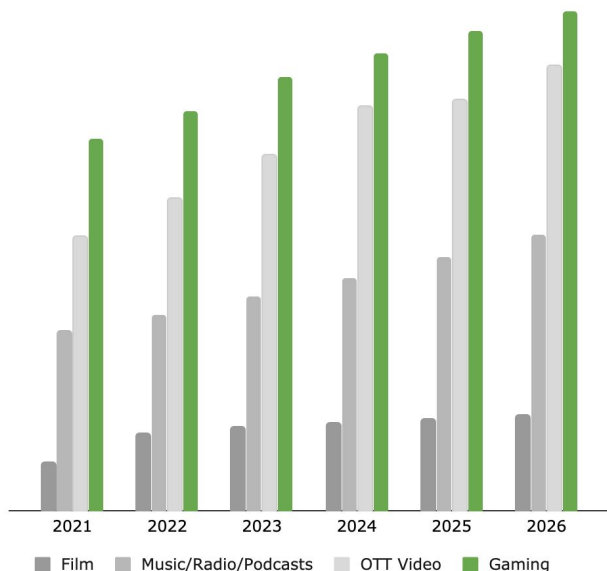
AI algorithms will generate characters and suggest skeletal rigging which is a technique in 3-D animation to create a lifelike movement of digital human bodies. Neural networks trained on motion data will eventually make computer-generated characters move more and more like humans.

## Motion Capture Landscape



# Nearly all content will be gamified

Gaming is Larger than OTT Video,  
Music & Film<sup>2,4</sup>



Gaming has come a long way since Atari Pong in 1972. Gaming now refers to any electronic game played on a console, pc, mobile phone, or headset. It is now bigger than the music and film industry combined and by 2027 it will reach \$235.93 billion globally with more than 3 billion gamers playing across devices.<sup>1,2</sup>

Gamification of content is basically applying typical elements of game playing such as point scoring, interactivity and competition to encourage engagement.

**In the next five years, gaming will become the second highest-grossing form of entertainment after traditional sports broadcasting.**

The growth in numbers, diversity and hours spent playing online games is driving high demand for unique content. AI & cloud infrastructure capabilities play a major role in aiding game developers to build tons of new content.

- **Games with non-gamelike objectives and more diverse storylines** will enable gaming to appeal to wider audiences
- **Generative algorithms (GANs) will create personalized games in real-time**
- **GANs will gamify more types of content**, engaging more players and expanding interactions and community
- **Smaller studios powered by AI will challenge legacy** game developers of today
- **Games as a Service (GaaS) will become a ubiquitous** business model for gaming
- **Game platforms are leading the growth of immersive online interaction** which will likely enable the metaverse

# People will have many digital identities

People have many aspects of their personality and represent themselves differently in different circumstances: the boardroom vs the bar, in groups vs alone, in front of their grandparents vs their girlfriends. Now online, the old school AOL screen names have evolved into profile photos, memojis, avatars, gamertags and more.

Over the next five years, it is estimated that the **average person will have at least 3 digital versions of themselves** both photorealistic & fantastical to participate online. Some will enable public anonymity of the individual, some will be pseudonyms and others will be directly tied to physical identity.

Photogrammetry and camera-based software solutions for body-tracking will make volumetric capture more accessible, enabling accurate 3D full-body representations with freedom of movement for photorealistic avatar creation.

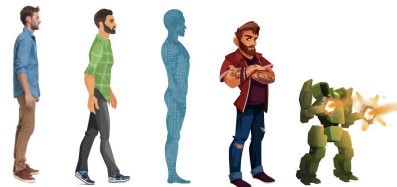
**By 2027, deep learning algorithms will reconstruct 4D models of humans** that are essential for augmented reality (AR), virtual reality (VR) and the metaverse. These applications require not only a reproduction of the appearance but also the ability to change the viewpoint or head pose.<sup>1</sup> Volumetric rendering will be done with a single view from a fixed camera in real-time. Photorealistic controllable 4D avatars might be the future of our existence in multidimensional virtual worlds.

Different avatars will be used for different purposes when participating in various communities and activities virtually. People will decide for themselves how and who they wish to interact as. It will enable people to showcase their persona outside of the typical definitions of gender, race, class, and even species. Over time our virtual existence will be as important as our existence in the analog world.



**"Twenty years from now Earth's population will be 30 billion...10 billion will be us, the real humans. 20 billion will be our digital humans."**

- Dave Smiddy, Former Head of Product at Intel Studios





# Autonomous virtual beings will be omnipresent

A growing portion of the virtual beings we interact with online will be powered by artificial intelligence. These autonomous virtual beings will have personalities, feelings, problem-solving capabilities and more. Some of them will be programmed to look, sound, act and move like an actual physical person.

**Gaming is one of the earliest adopters of autonomous virtual beings.** Whether that is the invisible Watson playing Go, the NBA2K replica of Steph Curry, or totally scripted non-player characters. They will continue to be made smarter and more multi-dimensional with new and better AI.

There will be strong business cases for autonomous virtual beings to be adopted by many industries, including:

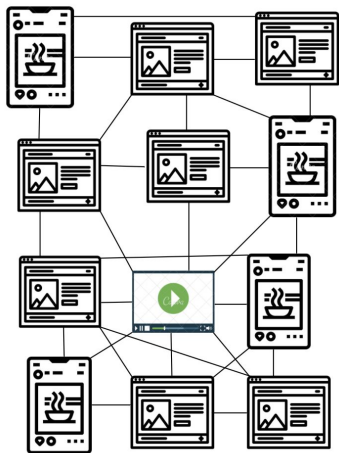
- **Assistants:** Many companies are unveiling different types of visually realistic AI assistants.
- **Healthcare:** Telemedicine will deploy synthetic virtual beings to collect information, triage patients and do minor checkups. This is an especially significant opportunity in mental health.
- **Influencers & brand ambassadors:** There is an exponential growth of influencers who are virtual beings that create narrative storylines that grow over years and have their own personalities.
- **Friends & romantic partners:** Dating-simulation games and virtual text-based relationships already exist. These will evolve into Virtual Beings that can be designed by creators with personalized looks, clothes, and lifestyles.

**"Virtual beings built on human-centered artificial intelligence, that strive to mimic not just a brain but a mind, will not just solve problems, but will also be creative. The human experience will be amplified by this duality and will lead to an empathic and ethical interaction with machines."**

- Andrew Rabinovic, Co-Founder & CTO of Headroom, Former Head of AI at Magic Leap

# Curation & publication will be more data-driven

**The new generation of platforms for content creation leverage software to repackage long-form content** by turning videos, podcasts, or blogs into captions for social media with data-driven programmatic publishing when the right audience is online. They transcribe videos, examine the text, pull out quotes and create matching video clips similar to movie trailers to support captions. Platforms will generate synthetic and animated videos, images with text and videos with music to help business owners to increase engagement, boost conversions and expand the contextual relevance and lifespan of content.



**Automated systems for publishing content will fine-tune and syndicate publishing content** based on the performance of previously published content, automated systems will replicate brand style and scale marketing efforts more effectively to ensure consistency in brand communication. Currently, about three-quarters of AI-generated content gets approved by a human marketer. By 2027, most of such content will likely be of high enough quality to be instantly published without oversight.

As marketing becomes more segmented, advertising platforms will automatically scan content posts, identify intent and enable software to reply with personalized offers on behalf of their business owners. Content curation will be automated with machine learning algorithms to help brands build authenticity and authority.

**Autonomous curation bots powered by smart algorithms will publish personalized information to our interests and aspirations.** We'll see personalized synthetic video content replacing text-heavy newsletters and personal emails.

Games built on the blockchain will showcase a new way of visually interacting with each other that goes beyond games. People forming tight-knit communities online like in the analog world, not only based on mutual interests but around shared virtual experiences and digital assets that they own.

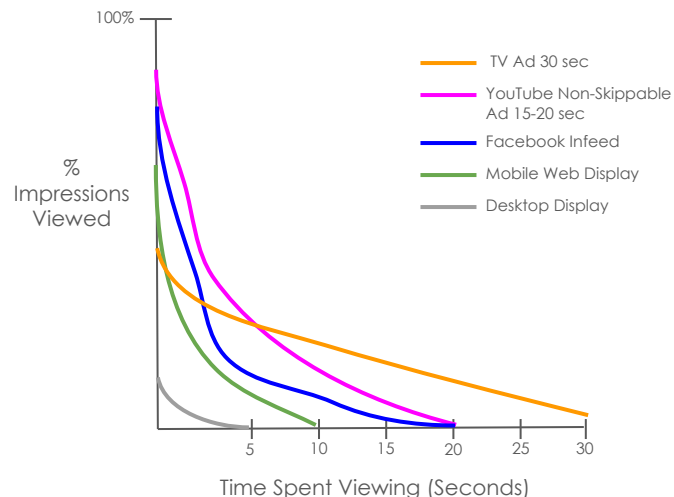
# Analytical tools will inform content creation

The data generated from people consuming content can be automatically analyzed to guide the creation of more personalized and authentic content. Engagement data is already central to decision-making for most forms of content: box office numbers influence big screen movie selection, click-throughs drive marketing, etc. Over the next five years, computer vision and machine learning will increasingly help decode the “why” behind audience engagement:

- **Image and color recognition** helps creators understand which colors and imagery resonate best with their audience and feed that data into the creation process for advertising and marketing
- **Eye-tracking and sentiment analysis** is measuring audience engagement with content informing web designers, video producers and advertisers on the types of content that engage the most
- **Computer vision and artificial intelligence** will become standard for understanding audience engagement and purchasing

Creators and brands will utilize deeper audience insights to identify the right business opportunities for future content production and expand their product offerings to create merchandise, new product lines and more.

Attention Curves by Media<sup>1</sup>



**"Through eye tracking, head tracking and sentiment analysis we are able to track how much attention individuals pay to content and ads. This helps content producers, brands and media sellers optimize for engagement."**

- Yan Liu, TVision Insights, Co-Founder & CEO

---

Since the early days of content creation, creators have desired to control how their content is experienced, manipulated, purchased and published.

Digital Rights Management tools have been in existence for more than 25 years but failed to benefit creators and the general public due to IP challenges, anti-circumvention laws, cost restrictive licenses, complicated workflows and more.

In this next evolution of content creation, visual tech tools will be leveraged for rights management:

---

- ▶ Authentication of Visual Content Will Be Real-Time
- ▶ AI Delivers Automated Content Moderation

# Authentication of visual content will be real-time








Synthetic media will become ubiquitous and most of it will be appropriate. However, bad actors will also use this technology to manipulate content for disinformation.<sup>1</sup>

**Synthetic media detection tools**, today, can be highly effective with photos but they do not yet work well with video in real-time. Furthermore, detection of image and video forgeries will become more challenging to recognize due to the growing levels of sophistication of the tech. Next-generation tools will combine multiple methods to authentic content.

**Authentication of visual content is technically possible with an application at the time it's produced and edited via cryptographic methods with sensor and pixel acquisition.** By 2027, most consumer phones will be able to authenticate content via applications. The blockchain also offers a potential solution to combat the growing threat of digital disinformation.<sup>2</sup> While it will still take the right education, policy, technology, and leaders to push it, the technology holds the necessary keys. The end-game for provenance-based media authentication is hardware-secured capture and this will take longer to materialize.

**Content creators will be able to add metadata containing specific information about the media's origins.** Browser extensions able to check this metadata and verify the authenticity of content will be widely available, and it's just the first step. In the future, authenticity infrastructure will be built into browsers, OS's, mobile devices, etc.

## What do digital forensics experts detect?

	Light reflections in the eyes
	Heartbeat, blood flow, breathing
	Facial warping
	"Fingerprints" of GAN models
	Geometry between several objects
	Skipped frames, tone mismatch, boundary artifacts, face misalignments
	Subtle fading or grayscale elements

# AI delivers automated content moderation

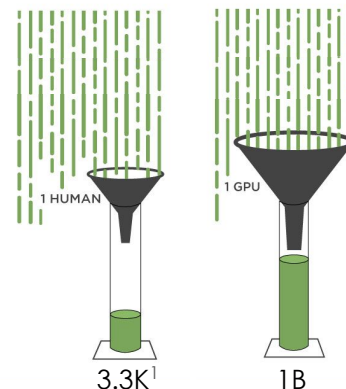
As the quantity of content created and shared grows exponentially, the importance and need to detect disturbing content grows as well. AI and computer vision algorithms are necessary to automate this process by detecting hate speech, graphic pornography, and violent attacks because it is too difficult to do manually in real-time and not cost-effective.

**Computer vision and audio recognition integrated with natural language processing will enable multimodal moderation and it will expand the content moderation capabilities** of AI to go beyond text and photos to video, audio and more. This is in early deployment at companies like YouTube, Snap and more alongside human moderators.

**This multimodal moderation will improve the performance of AI for content moderation and enable it to have a deeper contextual understanding.** Algorithmic models trained to moderate a single type of content will be replaced with a robust multimodal moderation workflow that will be able to cover all types of content in many languages simultaneously.<sup>2</sup>

**In the next five years, cloud-based AI-powered tools for user-generated content moderation will become ubiquitous.**

## Moderation Capabilities (Checks Per Month)



**“AI is essential for moderation; multimodal workflows will enable it to improve contextual understanding to succeed without humans in the loop.”**

- Alfredo Ramos, Clarifai, SVP of Platform & Marketing

Decentralized monetization  
mechanisms will unlock new  
funding.

---

Traditional ways to monetize content include selling exclusive or limited usage rights, affiliate sales, sponsored content, subscription/membership, donations, ads, paid speaking, consulting services and repackaging content into digital products to sell at scale.

Some of the newer ways to monetize content look like a refreshed version of something we've known for years, e.g. product placement first appeared in novels and paintings two centuries ago.<sup>1</sup>

New technologies are superpowering the traditional monetization methods and creating new ones.

- ▶ NFTs will be a major vehicle for direct sales
- ▶ Fractional ownership will diversify content creation
- ▶ Subscriptions hold promise for audience monetization
- ▶ Platforms will connect relevant creators directly to brands



# NFTs will be a major vehicle for direct sales

Direct sales and licensing of digital content have been a primary method for monetization of content. Blockchain is empowering new methods to manage the selling of digital content.

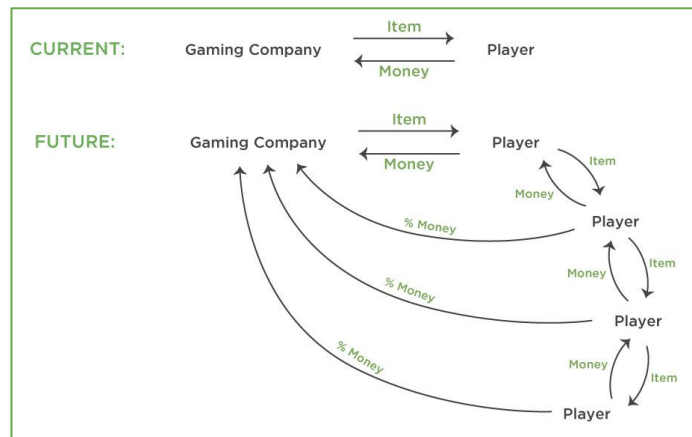
**Non-fungible tokens (NFTs)** are tokenized versions of assets managed on a blockchain. Nearly anything can be made into an NFT and most are visual content. The first opportunity underway for NFTs is collectibles and digital art.

- In the first half of 2021, NFTs grew +2000% to \$2.5B in revenue, the vast majority in collectibles & art.<sup>1</sup>
- This growth rate is expected to slow but will still have an incredible upward trajectory through 2027.
- NFTs open up the opportunity for a fraction of content to be resold multiple times to different people; there is an opportunity in NFT secondary sales.
- Dynamic NFTs and combinable NFTs will grow as well.

## The purchase of NFTs for use in games will significantly increase.

In-game assets & gaming NFTs include gaming skins (i.e. styles), digital clothing and more.

- In-game purchases currently amount to nearly \$122B and 77% of the gaming companies' revenue.<sup>2</sup> They are predominantly created by gaming companies and sold by them with single, direct purchases.
- NFTs sold within games on marketplaces and across games by independent creators will grow.
- Assets will be traded between players and creators. Game platforms will generate revenue off of the secondary sales as well.



# Fractional ownership will diversify content creation

Content creation has always been tied to production budgets. High-end Hollywood films historically needed to raise significant funds to cover production. Thanks to machine learning, computer vision and blockchain technology, raising funds for content creation will be transformed by platforms that enable the fractional ownership of content.

**Fractional ownership platforms that focus on discovery and valuation of specific forms of content, like video, will open up entirely new asset classes built upon content insights and arbitrage opportunities.** They will enable content creators to raise funds from a different pool of investors who may believe in creators or alternative stories, and content styles to generate profit. Over the next five years, platforms dedicated to fractional ownership of books, films, fine art, and virtual real estate will grow.

**Decentralized autonomous organizations (DAOs) will be another mechanism for enabling partial ownership.** A DAO is when a group organizes around a shared mission and coordinates actionable rules that are enforced on the blockchain. They are more transparent than traditional companies, are more globally accessible, and have lower barriers to entry. The assets can be controlled by token holders.<sup>1</sup>

Most DAOs currently are being used for the purposes of funding investments or grants for creators, investing in decentralized applications (dapps), or cater to specific investment opportunities such as owning NFT art and virtual gaming items.<sup>1</sup>

Historically, there has been a significant amount of content that was never produced because legacy big-budget investors didn't see the opportunity. With the advent of fractional ownership, a plethora of content will be made that would otherwise be overlooked.



# Subscriptions are promising for audience monetization

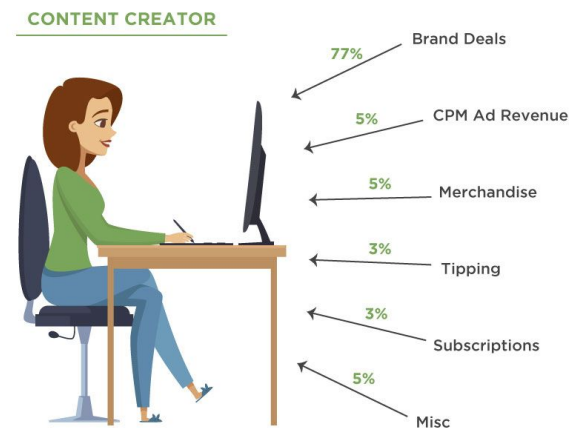
Creators have both new and legacy ways to monetize their creativity. Monetizing audiences is a business where the old is rebranded as the new with small additions.

- **Brand deals and advertising revenue make up ~82% of a creator's income.** Sponsorships with brands for product placement and advertising revenue shared with online platforms make up the bulk of a creator's revenue today.
- **Subscriptions are poised to hold the most promise** for content creators to monetize their audience. Fans and viewers pay for premium membership tiers to support a creator's channel and access additional content. Being a subscriber can get you access to unique content and other benefits.
- **Tipping is still a limited revenue stream** although almost every major social media platform allows tipping as a revenue channel where followers can financially support creators with tips.
- **Merchandise** - Branding on merchandise or creating their own branded products is growing for influential creators and can also generate significant revenue opportunities.

**Curation as a Service (CaaS) performed by humans and automated software bots** will become a growing revenue opportunity for creators who are domain experts. As a tastemaker, the creator will curate content for target audiences via new mediums and tools, similar to how magazines and newspapers have done for centuries. This is another chapter in the ongoing cycles of unbundling and bundling of content.

**Social tokens**, a type of cryptocurrency that is based around an influencer, community or brand, will be explored as a monetization method over the next five years as well. They enable fans to have greater access to a creator and showcase their support and association with a community.

## Creator Revenue Streams 2021<sup>1</sup>



# Platforms will connect relevant creators directly to brands

Sponsor dollars and product placement have always been major channels for top creators to earn money. It's no different with this next chapter. The main change is the ease and drastic increase in audience reach due to distribution via social media, YouTube, Twitch and other platforms. New tools are also significantly decreasing production team size for publishing content which makes it easier and affordable for people to create content.

**Visual tech tools will analyze creators' feeds** so brands can evaluate and automatically select creators that have the best content and communities for the brand to engage with.

**Deep learning and 3D models will place and replace products automatically** in livestreams, videos and photos. This will occur in a photorealistic fashion and give products wider coverage without requiring pre-selection, screening, and recording of products in relation to creators' content.

**Content will become even more clickable** with embedded shopping features, livestream shopping apps and across other channels, further decreasing friction between engagement and purchase.

**Agencies will become white-glove services for top creators** as platforms enable brands and creators to directly connect for sponsorship and product placement.

## Social Media Shopping Features<sup>1</sup>

	Stories	Short-form Video	Livestream	Shopping
Facebook	X	X	X	X
Instagram	X	X	X	X
LinkedIn	X	--	X	--
Pinterest	X	--	--	X
Snapchat	X	X	--	X
TikTok	X	X	X	X
Twitter	--	--	X	X
YouTube	X	X	X	X

(X) Existing Feature (X) Testing (--) Do Not Have

Increased creation and participation in virtual spaces is the foundation for the metaverse.

# Visual tech extends our digital selves into the metaverse

People will expand their digital existence, participate and continue to form communities online around interactive and gamified content. Online interaction will increase in online virtual spaces from working to socializing and education.

**Interactive virtual spaces, powered by visual tech, are otherwise defined as the metaverse.** Today, the foundations are being laid for the rise of the metaverse.

It is likely that there will not be one single metaverse, rather a variety of different metaverses that people visit based on personal interests.

This next stage of the evolution will encompass predominantly 2D with some 3D representations of people, characters and objects.

**Over time, more of the metaverse will become 3D and 4D** as visual technology enables people to create lifelike multi-dimensional models of both real-world objects using just a few images captured on a smartphone as well as fantastical objects and scenes.<sup>1</sup> Over time, it will also include further immersion of the human senses using computer-neural interfaces which allow their users to communicate or control external devices using brain signals rather than the brain's normal output pathways of peripheral nerves and muscles.

Already, **the digital land grab for the metaverse has begun.** While it's not clear how and where the metaverse will play out, the building blocks and ground stakes for what it will look like have started with companies buying up plots. By 2027, most, if not all major companies will have a metaverse strategy similar to the way they all developed a digital strategy and online presence over the past decade.

**“This second wave of AR goes beyond a layering of digital information atop of your physical surroundings; it's a more immersive, integrated and interactive experience. It's driven by a contextual understanding and interaction with the world, responsive to you.”**

- Dr. Helen Papagiannis, Author of “Augmented Human”, Augmented Reality Pioneer ([16+ years](#))



# Businesses need to create metaverse content strategies

**“Enormous strides are being made technologically which will make it possible for even a 6 year old to create photorealistic virtual worlds of their imagination to hang out with their friends. It's not science fiction, it is imminent and businesses should prepare.”**

- Serge Belongie, Professor  
Computer Science, University  
of Copenhagen - DIKU

Brands and businesses will start to create metaverse strategies as an extension of their content strategy. Similar to the 2000s where smart companies recognized the importance of social media, the 2020s will be when the first adopters start to build out their metaverse teams for the next era of the Internet. These strategies, like the metaverse itself, will be based on visual tech.

**Video game engines are positioned to be the compute power behind the metaverse.** Game engines are the software architecture that power video games - they provide the rendering engine, physics engine, localization, scene graphs, cinematic video support and various AIs for game developers. Breakthroughs in-game engine design and GPU compute have enabled games to power much larger communal game experiences of 200+ people playing the same game. Game engines, with the various visual technologies they deploy, will run the metaverse and enable new experiences and newly gamified content (see slide 17):

- **Digital events in the metaverse will be key to building closer connections to fans.** Physical events in the form of concerts and shows will still be very much a part of the physical world. Multi-dimensional concert experiences will take center stage in the metaverse as another evolution from livestreaming and in-game concerts.
- **Immersive storefronts for selling digital-only assets**, like the growing number of NFTs, and real-world goods, will change ecommerce. Entire business divisions will be created to ideate, build, and release these in the same way that physical items and merchandise are sold today.

# Visual content, tools and experiences to deliver massive opportunities.

The next five years will see individual creators who leverage visual tech tools rival professional production teams in the quality and quantity of the content they produce.

Platforms and other decentralized mechanisms will fund creators in a more dispersed fashion than before and support more diverse forms of content. The interactivity and gamification of content, also reliant on visual tech, will more personally engage fans and build communities. Inevitably, the metaverse will grow where we will interact as a variety of our digital selves in games, attend concerts, buy goods, and more.

We are at the start of a new evolution of human digital existence and business opportunities abound.



© 2021 LDV Capital, New York, NY, US. All Rights Reserved. This material is based upon work supported by LDV Capital. Any opinions, findings, conclusions, or recommendations are those of the authors. LDV Capital believes the information in this document is accurate as of its publication date; such information is subject to change without notice. LDV Capital acknowledges the proprietary rights of other companies to the trademarks, product names and such other intellectual property rights mentioned in this document. Except as expressly permitted, neither this documentation nor any part of it may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, without prior permission of LDV Capital and/or any named intellectual property rights holders under this Document.

Follow us @LDVCapital or subscribe to our newsletter. For news and updates, get in touch at [contact@ldv.co](mailto:contact@ldv.co).

## Authors:

### **Evan Nisselson**

General Partner

### **Kat Lopez**

Director of Content & Marketing

### **Abigail Hunter-Syed**

Partner

### **Azeem Khan**

Venture Fellow

# Special Thanks

A special thanks goes out to the following individuals for sharing their insights and expertise with LDV Capital for the research behind this report:

Roy Azoulay  
Founder and CEO  
Serelay

Chris Chaney  
Managing Partner  
C4+

Alban Denoyel  
Co-Founder  
Sketchfab

Niles Heron  
Co-Founder  
Loaded.GG

Yan Liu  
Co-Founder & CEO  
TVision Insights

Matthew Ball  
Managing Partner  
Epyllion

Kate Bradley Chernis  
Founder and CEO  
Lately

Ilke Demir  
Sr. Staff Research Scientist  
Intel Corporation

Jon Jordan  
Editor at Large  
Beyond Games

Hayes Mackaman  
Founder & CEO  
8i

Jakob Balslev  
Founder & CEO  
Rokoko

Cheeseaholic  
YouTuber

James George  
Co-Founder & CEO  
Scatter

Alex Kane  
Co-Founder and CEO  
Volta

Om Malik  
Entrepreneur, Writer,  
Investor

Richard Broadbridge  
Founder & CEO  
4DViews

Brent Chow  
Lead Product Manager  
BCG Digital Ventures

Mitchell Bayer-Goldman  
Co-Founder and COO  
Volta

Dave Laing  
Global Creative Director  
Scotiabank

Jeffrey McGregor  
CEO  
TruePic

# Special Thanks

A special thanks goes out to the following individuals for sharing their insights and expertise with LDV Capital for the research behind this report:

**Rafael Pagés**  
Founder & CEO  
Volograms

**Ken Perlin**  
Founder and Director  
Future Reality Lab at NYU

**Heather Raikes**  
Founder and Director  
Neopoetics

**Neha Singh**  
Founder and CEO  
ObsessAR

**Peter Welinder**  
VP of Product &  
Partnerships  
Open AI

**Rebecca Paoletti**  
Co-Founder & CEO  
CakeWorks

**Vince Pizzica**  
Board Advisor, Investor, &  
*Former* Technicolor Exec.

**Alfredo Ramos**  
SVP of Platform and Marketing  
Clarifai

**Dave Smiddy**  
Former Head of Product  
Intel Studios

**Dr. Helen Papagiannis**  
Author of “Augmented  
Human: How Technology Is  
Shaping The New Reality”

**Konstantinos Rematas**  
Research Scientist  
Google

**Victor Riparbelli**  
Co-Founder and CEO  
Synthesia

**Roy Taylor**  
CEO  
Ryff

**Andy Parsons**  
Director of Content  
Authenticity Initiative at  
Adobe

**Andrew Rabinovich**  
Co-Founder & CTO  
Headroom

**Edward Saatchi**  
Co-Founder and CEO  
Fable Studio

**Vaibhav Vavilala**  
Computer vision expert  
Former Technical  
Director of Pixar

# Quotes & References

# Select Quotes from Interviews (1/6)

"Video production for OTT networks like Amazon Prime, Netflix and HBO Max is booming right now. They have decent budgets and content but, at the end of the day, they are supply chain businesses who focus heavily on bringing things in on time and within budget. The progressive development of automated tools inside cloud based workflows for this tier of production studios is one of the most exciting business opportunities in production today."

- **Vince Pizzica, Board Advisor & Investor, Former Executive of [Technicolor](#)**

"AI has already made its way into high-end animation, VFX, and games in the form of noise and artifact removal as well as increasing image resolution - saving artist time & compute while extending creative reach. In 5 years, we could be looking at AI suggesting new 2D and 3D characters and even animating them for subsequent fine-tuning by expert artists."

- **Vaibhav Vavilala, Computer vision expert, Former Technical Director of [Pixar](#)**

"In our 2020 work, to render an object we needed a voxel grid and its colors. In 2021, we need a single image of an object. We remove the number of requirements and move towards automation. In five years, I believe we'll be able to upload any photo and get an immersive 3D piece."

- **Konstantinos Rematas, Research Scientist at [Google](#)**

"Twenty years from now Earth's population will be 30 billion...10 billion will be us, the real humans. 20 billion will be our digital humans."

- **Dave Smiddy, Former Head of Product at [Intel Studios](#)**

"Interacting with fantastical three-dimensional characters in VR is easy today. The most interesting challenge is to put real people – a real you – in the virtual experience."

- **Richard Broadbridge, Founder & CEO at [4DViews](#)**

## Select Quotes from Interviews (2/6)

"There are three main ways creators are making money on YouTube and they are CPM and ad revenue, selling merchandise, or doing brand deals that are also just sponsored ads. What started out as just fun turned into over 1.2 million subscribers and being able to take care of my family. Whenever I meet my fans they all want advice on their content now or for me to watch it. It's crazy.

- **Cheeseaholic, [YouTube blogger](#)**

"There are more than 10 million game developers today, whereas there were only 30,000 in 2009. More games than ever exist and thousands of new ones are released every day. It also spurs a more level playing field. In an age where equality, discrimination, and social justice are at the forefront of our minds, gaming is an interesting space because you exist as an avatar. You're not limited by physical abilities, color, skin, or gender. Gaming allows the democratization of things.

- **Chris Chaney, Managing Partner at [C4+](#)**

"In five years, 90% of AI-generated content will be of high enough quality to be directly published without human input."

- **Kate Bradley Chernis, Founder and CEO at [Lately](#)**

"Neural networks can learn how humans look and how they move to streamline the process of volumetric content creation."

- **Rafael Pagés, Founder & CEO at [Volograms](#)**

"Volumetric video capture brings a unique ability to communicate with someone interactively. Having a live discussion while being miles apart is the most powerful part of this technology."

- **Hayes Mackaman, Founder & CEO at [8i](#)**

# Select Quotes from Interviews (3/6)

"I think that in the next 5 years, computer vision-based solutions for body tracking will be commoditized and the big tech platforms will offer 3D motion capture camera-based solutions for free."

- **Jakob Balslev, Founder & CEO at [Rokoko](#)**

"Mixed reality will become an art form on par with cinema, theater, gaming, music... but that won't happen until the tools are democratized and creators can have access to them, not just production studios and artists with six figure budgets."

- **Alex Kane, Co-Founder and CEO at [Volta](#)**

"The days of consumers relying on synthetic content detection are ending. Authenticity & provenance are the tools we have for restoring a sense of shared, objective reality and trust."

- **Andy Parsons, Director of [Content Authenticity Initiative at Adobe](#)**

"In 5 years, there will be not only a tool to detect synthetic videos in real-time but also a way to authenticate such content with integrated signals – a watermark of a GAN used to produce it, similar to how we can detect the source GAN of synthetic videos now."

- **Ilke Demir, Sr. Staff Research Scientist at [Intel Corporation](#)**

"This second wave of AR goes beyond a layering of digital information atop of your physical surroundings; it's a more immersive, integrated and interactive experience. It's driven by a contextual understanding and interaction with the world, responsive to you."

- **Dr. Helen Papagiannis, Author of "[Augmented Human](#)", Augmented Reality Pioneer (16+ years)**

# Select Quotes from Interviews (4/6)

"Authentication of content by visually "stamping" it with a verification link (or similar) is not an elegant nor scalable solution. Instead, a new class of metadata will embed origin metadata into a file in an immutable manner."

- **Roy Azoulay, Founder and CEO at [Serelay](#)**

"We are entering a future where determining whether images are created by light, or by computers, will be near impossible. In this new age of synthetic media, TruePic is focused on producing the highest trust digital images & videos, verified at the point of capture. We take a firm stance that the provenance approach is the most effective way to solve this problem holistically and at internet scale."

- **Jeffrey McGregor, CEO at [TruePic](#)**

"The next wave of XR needs creative research that catalyzes the design language bridging the human neurosensory system with three-dimensional digital experience".

- **Heather Raikes, Founder and Director at [Neopoetics](#)**

"I don't think of a killer use case for AR, just like I don't see a killer use case for the web. AR is an underlying layer that will power commerce, entertainment, education, work..."

- **Alban Denoyel, Co-founder of [Sketchfab](#)**

"Once you have a virtual space you think of how to inhabit this space and how to bring procedural animation combined with artificial intelligence."

- **Ken Perlin, Professor of Computer Science and founder and director of the [Future Reality Lab at NYU](#)**



# Select Quotes from Interviews (5/6)

"On top of being difficult to incorporate and an unsure bet, creating skins markets for games is difficult because the SEC may regard them as securities. In the past year every gaming company did 25% over earnings estimates, and is growing so fast they don't care to find a way to disrupt themselves."

- **Jon Jordan, Editor at Large at [Beyond Games](#)**

"Tipping on these platforms is more of an NPR pledge drive than a real demand being fulfilled. What it says to me is that demand exceeds supply. That people have enough money left over after buying merchandise and the tipping is indicative of bloat that supply hasn't handled in a more meaningful way."

- **Niles Heron, Co-Founder at [Loaded.GG](#)**

"AR is already touching many aspects of our lives even if we are unaware of it. We alter our backgrounds on video conference calls, add face filters to our photos and videos, and we're previewing furniture in our living rooms through our phones. Consumers don't necessarily call it AR – it's just seamlessly being integrated into our lives."

- **Brent Chow, Lead Product Manager at [BCG Digital Ventures](#)**

"If we were to create animated videos for targeting or segment testing, we would need AI-powered tools to scale."

- **Dave Laing, Global Creative Director at [Scotiabank](#)**

"Scatter is at the intersection of virtual worlds and human representation. Games are becoming more photorealistic, cinematic, and story-driven. Cinematic storytelling in film relies on verisimilitude. Our product Depthkit adds a layer of real-world presence as our culture transitions to increasingly synthetic virtual spaces."

- **James George, Co-Founder & CEO of [Scatter](#)**

# Select Quotes from Interviews (6/6)

"It will be the norm to have two-way relationships with virtual beings who are powered by AI. Virtual beings will be our coworkers, team mates, and friends and they will communicate just like we do, across video chat and text, games and social media."

- **Edward Saatchi, Co-Founder & CEO of Fable Studio**

"Experiential e-commerce is providing shoppers, particularly younger shoppers, with the interactive experiences they expect. Soon 3D virtual shopping will be table stakes for brands in every retail category."

- **Neha Singh, Founder & CEO of ObsessAR**

"Every year, an increasing share of our time, labor, leisure, spend, socializing, and wealth will be inside virtual worlds. This is both an extraordinary opportunity, as well as a threat for business focused purely in the 'real one'"

- **Matthew Ball, Managing Partner of Epyllion**

# Bibliography (1/6)

"Lurking: How a person became a user" by Joanne McNeil. (February, 2020)

Ace Tech Group. How Interactive Learning Will Shape the classrooms of the future. (March, 2020)

Admix. Games Plus - The Future is interactive entertainment. (July, 2020)

Alex John Lucas. How Artificial Intelligence is being used in typography. (July, 2019)

Allied Market Research. Video streaming market by Component, Solution Type, Streaming Type, Deployment Mode, Revenue Mode, End User 2026. (December, 2019)

Alter Agents, Snap, Inc. and Publicis Media. Data on AR in Consumer Shopping. (May, 2021)

Andreessen Horowitz. Shopatainment. (December, 2020)

Andrew Steinwold. Crypto will change value, NFTs will change society. (July, 2021)

Antler blog. Creator Economy Map. (June, 2021)

App Annie. State of Mobile 2021. (February, 2021)

Apple. Create 3D content with Object Capture. (June, 2021)

Axios AM. (May, 2021)

Axios. The real smell of virtual reality. (June, 2021)

Axios. Tipping is taking over the internet. (April, 2021)

Bloomberg. Clothes That Don't Exist Are Worth Big Money in the Metaverse. (June, 2021)

Bloomberg. Tencent in talks to create \$10b streaming giant. (August, 2020)

BoredPanda. This App That Turns People Into Pixar-Like Cartoon Characters Gets The Internet Buzzing. (December, 2020)

Business Insider. Video game industry revenues grew so much during the pandemic that they reportedly exceeded sports and film combined. (December, 2020)

CB Insights. The Creator Economy Market Map. (June, 2021)

CB Insights. The Creator Economy Explained: How Companies Are Transforming The Self-Monetization Boom. (June, 2021)

Cisco. Annual Internet Report (2018-2023) white paper. (March, 2020)

Clubhouse. Introducing Clubhouse Payments. (June, 2021)

CNBC. TikTok reveals detailed user numbers for the first time. (August, 2020)

CNET. Electronic Arts says artificial intelligence will make game characters much more lifelike. (August, 2021)

CoinDesk. The NFT Game that makes cents for filipinos during COVID. (August, 2020)

Common Thread Collective. A Guided Journey to the Metaverse. (February, 2021)

# Bibliography (2/6)

Content Authenticity Initiative. Video Provenance and the Ethics of Deepfakes. (July, 2021)

Coopahtroopa. NFT Issuance Landscape. (January, 2021)

Coopahtroopa. NFT Value Capture Equation. (February, 2021)

Crypto x Creator Economy. Come for the creator, stay for the economy. (April, 2021)

CVPR 2021. Dynamic Neural Radiance Fields for Monocular 4D Facial Avatar Reconstruction. (January, 2021)

CVPR. HUMAN POSITIONING SYSTEM (HPS): 3D HUMAN POSE ESTIMATION AND SELF-LOCALIZATION IN LARGE SCENES FROM BODY-MOUNTED SENSORS. (January, 2021)

CXL. How to optimize for conversions. (August, 2020)

Dacast. 114 Live streaming statistics every broadcaster should know. (July, 2021)

Debugger. Walmart's Augmented Reality App is Perfectly Low-Key. (June, 2021)

Deep Learning for Deepfakes Creation and Detection: A Survey. (April, 2021)

E&T Engineering & Technology. AI typeface shapeshifts for speedy reading. (May, 2021)

ESPN. LOL quickly gaining on traditional sports in popularity. (December, 2019)

Facebook research. Mixture of Volumetric Primitives for Efficient Neural Rendering. (April, 2021)

Fast Company. This App Uses Machine Learning To Identify Esoteric Fonts. (November, 2017)

Field Level Media. Travis Scott Fortnite Concert Draws 27.7 million unique views. (April, 2020)

Forbes. 50 Million join the creator economy thanks to platforms like onlyfans, youtube, etsy, and twitch. (September, 2020)

Forbes. A 3 pack of Supreme Oreos is now going for \$92,000. (February, 2020)

Forbes. Female gamers are on the rise. Can the gaming industry catch up. (March, 2021)

Forbes. Live streaming e commerce is the rage in china. Is the US next? (December, 2020)

Forbes. Sales Associate Live Streaming Has Become A Must-Have For Brands In China. (June, 2021)

Fortune. Cloud gaming gets a lift from COVID-19 and 5G. Here's how much. (September, 2020)

Fortune. Facebook contest shows just how hard it is to detect deepfakes. (June, 2020)

Fortune. Facebook Deepfake Video Ban May Set Off 'Cat and Mouse' Game. (January, 2020)

Fortune. How Adobe plans to fight the scourge of deepfakes. (October, 2020)

Fractional Art. What is Fractional. (March, 2021)

FT. Why tipping on social media is a troubling development for online workers. (May, 2021)

# Bibliography (3/6)

Games Industry Biz. Travis Scott reportedly grossed roughly \$20m for Fortnite appearance. (April, 2020)

Gartner. Market Guide for Enterprise Video Content Management. (June, 2020)

Gemini. Gaming and Non Fungible Tokens. (April, 2021)

Gizmodo. GADGETS TCL's New Smart Glasses Are Portable Movie Screens. (June, 2021)

Google blog. Project Starline: Feel like you're there, together. (May, 2021)

Grand View Research. Video Streaming Market worth \$223.98 billion by 2028. (February, 2021)

Harper's Bazaar. How artificial intelligence models are taking over your Instagram feed. (August, 2018)

Harper's Magazine. The Anxiety of Influencers. (June, 2021)

HBR. How Blockchain Can Help Combat Disinformation. (July, 2021)

Influence. CreatorScope 2021. (June, 2021)

Insider Intelligence. Social video ad spending will grow 44% by 2021. (March, 2019)

Lara Petrov. Towards New AI-based Animation. (July, 2017)

Li's Newsletter. Apple is holding back the creator economy. (May, 2021)

Li's Newsletter. The Case for Universal Creative Income. (April, 2021)

Lia Zhang. Is There a Link Between Gaming and Gambling? (June, 2019)

Linda Xie. A Beginner's Guide to DAOs. (March, 2021)

Loïc Ledoux. Who Does What In The 3D Avatar Ecosystem? (October, 2017)

Machine Learning of Fonts (November, 2017).

Matthew Ball. What Is an Entertainment Company in 2021 and Why Does the Answer Matter? (May, 2021)

McKinsey. The innovation behind China's Single's Day Shopping Phenomenon. (December, 2019)

Microsoft. New Steps to Combat Disinformation. (September, 2020)

MIT News. Using artificial intelligence to generate 3D holograms in real-time. (March, 2021)

MIT Technology Review. These creepy fake humans herald a new age in AI. (June, 2021)

MIT Technology Review. Deepfake porn is ruining women's lives. Now the law may finally ban it.. (February, 2021)

MIT Technology Review. The year deepfakes went mainstream. (December, 2020)

Morning Brew. Exclusive: Nearly one quarter of Americans have used a VR or AR headset. (July, 2021)

# Bibliography (4/6)

Morning Brew. Meet the startups creating 'high-fidelity' avatars to improve communication. (July, 2021)

Motion Picture Association. Theme Report. (March, 2020)

Nasdaq. Beyond the hype" NFTs will change our economy but not yet. (April, 2021)

New York Times. Designed to Deceive: Do These People Look Real to You? (November, 2020)

New York Times. Technology Could Turn You Into a Tiffany. (April, 2021)

New York Times. TikTok, the fastest way to become a cooking star. (March, 2021)

New York Times. What won't the Nerk Boys Do? (June, 2021)

New Zoo. Global Esports and Live Streaming Market Report. (March, 2021)

New Zoo. Viewership Engagement Continues to Skyrocket Across Games and Esports: The Global Live Streaming Audience Will Pass 700 Million This Year. (March, 2021)

Next Reality. Apple Brings 3D Scanning to macOS Monterey with Object Capture. (June, 2021)

Next Reality. Create Your Own Holograms at Home with the Volu iPhone App. (July, 2021)

Oculus blog. NEW DAY, NEW YOU: AVATARS ARE MORE EXPRESSIVE AND CUSTOMIZABLE STARTING TODAY. (April, 2021)

Pelham Smithers. The rise of gaming revenue visualized. (November, 2020)

Pew Research Center. About 6 in 10 young adults in U.S. primarily use online streaming to watch TV. (September, 2017)

PLAY-TO-EARN. NFT Gaming in the Philippines | English. (May, 2021)

PwC. Global Entertainment & Media Outlook 2021–2025. (March, 2021)

Raconteur. Frankenstein fraud, deepfakes & replay attacks: how to identify identity fraud threats. (March, 2021)

Red Summit Productions. Exploring Disney's Transition from Traditional to 3D Animation. (March, 2021)

Rest of the World. "The despair and darkness of people will get to you". (July, 2020)

RollingStone. TikTok Stars Are Being Turned Into Deepfake Porn Without Their Consent. (October, 2020)

Science Daily. Deepfake detectors can be defeated, computer scientists show for the first time. (February, 2021)

Science Daily. Interactive typeface for digital text. (May, 2021)

Science Focus. Digital avatars allow psychosis patients to make peace with the voices in their heads. (April, 2021)

SignalFire's Creator Economy Map. (2021)

SignalFire's Creator Economy Market Map. (2021)

# Bibliography (5/6)

Stanford Today. Stanford course experiments with ways to recapture dynamic elements of in class teaching. (March, 2021)

Streaming Media. Streaming Views up 72%, CTV and vMVPDs show big gains. (April, 2019)

TechCrunch. Everyone you know is a Disney princess, which means AR is queen. (June, 2021)

TechCrunch. Sentinel loads up with \$1.35M in the deepfake detection arms race. (September, 2020)

TechCrunch. TikTok expands LIVE platform with new features, including events, co-hosts, Q&As and more. (July, 2021)

TechRepublic. 8 Hours and 27 minutes. That's how long the average gamer plays each week. (March, 2021)

TechRepublic. Deepfakes: Microsoft and others in big tech are working to bring authenticity to videos, photos. (July, 2021)

The "Global Gaming Industry: Growth, Trends and Forecast 2020-2025" report. (April, 2020)

The Drum. L'Oreal's background checks. (September, 2018)

The Information. How Influencers Make Money; Poparazzi Pops to the Top. (May, 2021)

The Information. TI Creator Economy: A table of tipping take rates, cameo gets new rival. (May, 2021)

The Verge. Beeple sold an NFT for \$69 million. (March, 2021)

The Verge. Bodies in seats. (October, 2019)

The Verge. Facebook tracks the source of deepfakes. (June, 2021)

The Verge. Facebook's next hardware launch will be its Ray-Ban 'smart glasses'. (July, 2021)

The Verge. Fortnite made more than \$9 billion in revenue in its first two years. (May, 2021)

The Verge. Head of Instagram says Instagram is no longer a photo sharing app. (June, 2021)

The Verge. Netflix gaming expansion starts with mobile. (July, 2021)

The Verge. The trauma floor. (February, 2019)

The Verge. This interactive map uses machine learning to arrange visually similar fonts. (April, 2017)

The Verge. Twitch ended 2020 with its biggest numbers ever. (January, 2021)

The Walrus. The Double Exploitation of Deepfake Porn. (June, 2021)

Trends in Online Influence Efforts. (August, 2020)

Twitter blog. Introducing TipJar. (May, 2021)

University of Buffalo. How to spot deepfakes? Look at light reflection in the eyes. (March, 2021)

Unreal Engine. Inside Gary James McQueen's first digital fashion show. (June, 2021)

# Bibliography (6/6)

USC. The Future of Video Games: More interactive, more global, and more streaming. (March, 2021)

Valuates Report. Video streaming market by Component, Solution Type, Streaming Type, Deployment Mode, Revenue Mode, End User 2026. (December, 2019)

Variant Fund. NFTs make the Internet ownable. (February, 2021)

Variant Fund. The Ownership Economy: Crypto & The Next Frontier of Consumer Software. (July, 2020)

VentureBeat. AI still struggles to recognize hateful memes, but it's slowly improving. (December, 2020)

VentureBeat. Digital try on by Amazon. (June, 2020)

VentureBeat. How NFTs will change games. (February, 2021)

VentureBeat. How Pixar uses AI and GANs to create high-resolution content. (June, 2017)

VentureBeat. Roblox CEO Dave Baszucki believes users will create the metaverse. (January, 2021)

VentureBeat. US gamers are in live with skins and in game cosmetics. (December, 2020)

VentureBeat. Why Accenture lists 'digital twins' as top-five technology trend in 2021. (March, 2021)

Video Benchmark Report. (January, 2021)

Vox. Virtual tips are helping content creators actually make money. (February, 2021)

VRdirect. Stereoscopic vs. Monoscopic 360° Content for VR Projects. (January, 2019)

Washington Post. Silicon Valley is racing to build the next version of the Internet. Fortnite might get there first. (April, 2020)

Washington Post. Virtual try-ons are replacing fitting rooms during the pandemic. (July, 2020)

Where Do Deep Fakes Look? Synthetic Face Detection via Gaze Tracking. (June, 2021)

WIRED. Google's Project Starline Videoconference Tech Wants to Turn You Into a Hologram. (May, 2021)

WSJ. Future of Everything Festival. (May, 2021)

WSJ. Publishers Are Investing in a Second Generation of Audio Articles. (August, 2020)

WSJ. Tech Companies Want to Make Holograms Part of Routine Office Life. (June, 2021)

WY SF0038 Senate Bill 38. (April, 2021)

XDA. Hands-on with the SpatialLabs Stereoscopic 3D display on Acer's new ConceptD. (May, 2021)

YouTube Culture & Trends Report 2021. (June, 2021)

ZDNET. The AI chip unicorn that's about to revolutionize everything has computational Graph at its Core. (December, 2018)