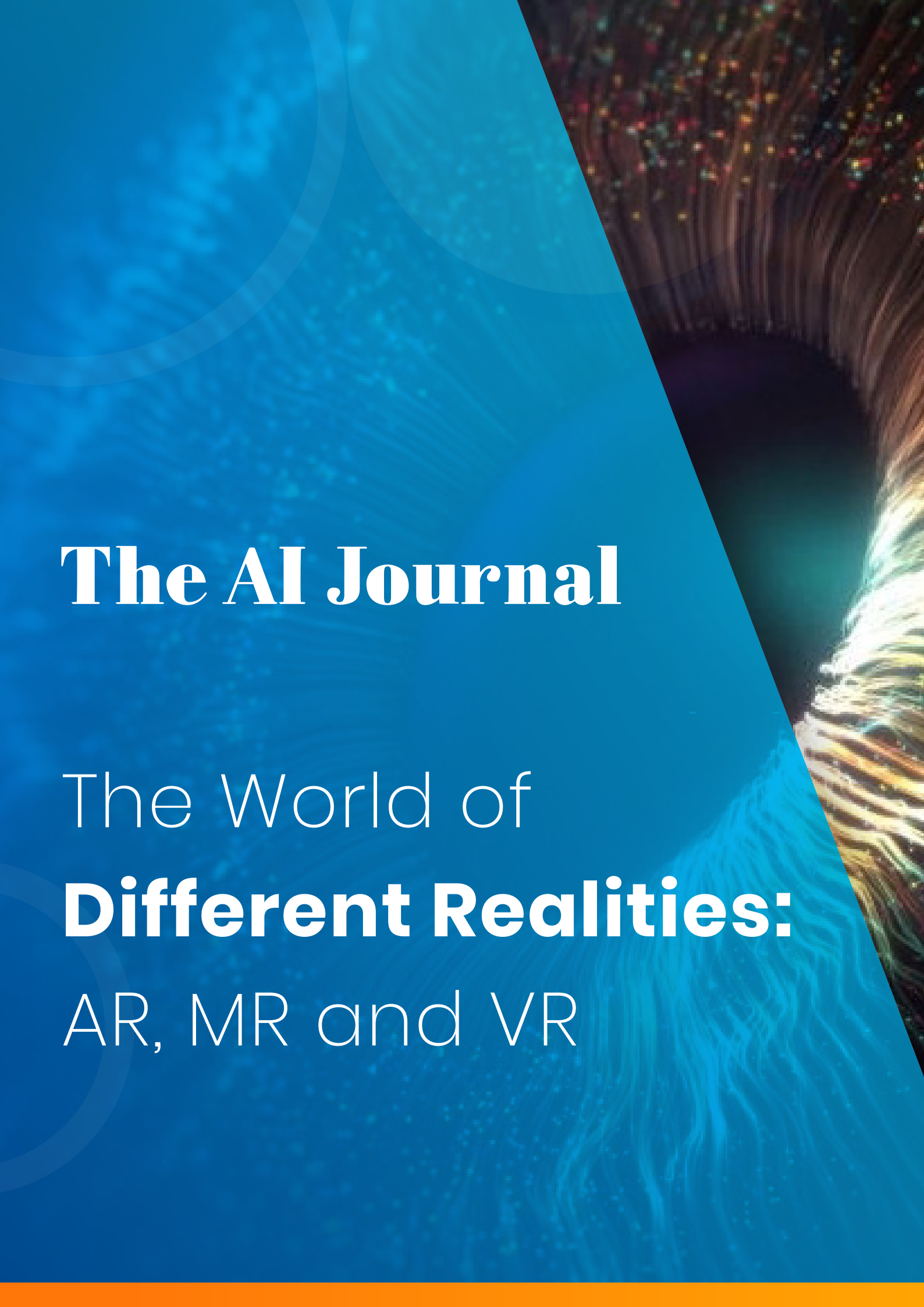

The AI Journal

The World of **Different Realities:** AR, MR and VR

Contents

Foreword

COVID-19 has brought huge challenges. But it has also created brand new opportunities that previously looked almost unfeasible. It has highlighted how new technologies such as Augmented Reality (AR), Mixed Reality (MR), and Virtual Reality (VR) can be our ally to drive more collaboration, spark new innovation, and create amazing relationships with customers, friends, and family.

From the ability to do business with customers in a new interactive way, bringing fresh creativity and innovation with a remote team; getting your health assessed virtually and having your treatment sent directly to you without going to the doctor and having more time to value your life with loved ones instead of commuting; so much has been realised since this dreadful pandemic hit our countries and communities.

To help us to expand on these opportunities as we move to the hybrid world of remote and office settings, we have the fascinating technologies of AR, MR, and VR.

These technologies are changing all fields. Granted some are slower than others, but the shift is definitely visible with different sectors looking to embrace and use the technology in quicker succession.

To give you a couple of examples of where we could see this technology go in terms of monetary value, PwC predicts that VR/AR will boost global GDP by $1.5 trillion and Technavio highlighted in their 2021 market research report that the AR and VR market is expected to grow by $125.19 billion during 2020-2024, progressing at a CAGR of over 35% during the forecast period – wow!

When we look at these figures, it's clear to see there's a lot more ahead of us that we currently don't know. Don't take that in the wrong way – this means a lot more innovation, better training, cross-team collaboration achievements, improved customer experience, and so much more.

From training to manufacturing, gaming to sports, autonomous vehicles to healthcare, military to personal smart glasses, AR and VR are becoming core technologies of greater success, something we're excited to go into detail about in this report.

If you're someone who is approaching this report with caution because you've never come across this technology or thought it is overly complicated to understand, please don't.

As part of the vision of The AI Journal and the role it plays for the AI and emerging tech communities, we're here to give you a democratised view and get your voice heard. Somewhere you can learn without feeling pressure on not knowing a certain topic. A platform and community to learn from in an easily digestible format at your pace. Whether from the people in the trenches who have hands on experience and share this in opinion pieces, live and free events, or reports like the one you're about to dive into.

What we always aim to avoid in these reports is feeding you buzzwords without any real life case studies, examples, or wider consideration points to do with culture, your team, and your customer. What's the point in learning the technical terms that are behind technologies such as AR and VR without knowing where to apply it?

At The AI Journal, we want to create a positive future with you for AI and emerging technologies; be a voice for the community through our open source platform; and to enable businesses to make informed decisions that can add greater value to their team and customers.

It's my personal aim that through thought-provoking reports such as this we can deliver on the above while hosting cross-industry engagement, causing new discussions, and creating world-changing ideas.

I want to give a personal thank you to everyone who took the time to help us shape this report, people who provided their exceptional feedback, and to you for reading this and being a part of The AI Journal's journey – thank you!

The AI Journal

Tom Allen, Founder, The AI Journal

VR, AR and MR – all the alternate realities

"The disruption XR will have on businesses could be likened to the impact the internet itself has had. Every aspect of our working lives will be changed in 10 years. Your smart glasses will be more widely used than your smartphone as a communications/computer display device. You'll take a lot more meetings and attend a lot more events in a fully 3D virtual environment with holograms of your colleagues. Even today in 2021, organisations are using VR to train employees with huge success in information retention and reduction in working errors."

Alex Ruhl, VR Director/Writer, CATS are not PEAS

"In 5-10 years' time, XR technologies will be driving more efficient forms of operating in every function from learning and development to sales and marketing."

Jeremy Dalton, Author, Reality Check; Head of XR, PwC

Science fiction has long envisaged a future in which wiring yourself into Virtual Reality – sensory immersion in a computer-generated alternate reality – is as commonplace as picking up the phone. But it's only in recent years that VR has got into the hands and on the heads of consumers at scale.

As a concept, VR harks back to the 1950s, before it became physically manifest as the first head-mounted, and extremely rudimentary, display in 1968. It wasn't until the 1980s that the term "virtual Reality" was coined, by computer philosophy author Jaron Lanier, when the idea if not the terminology was already a trope of writers such as William Gibson.

From fiction to fact

And it wasn't until the 1990s that the world saw the first wave of mass production of VR, by a company called Virtuality, which ran dedicated VR arcades.

Fiction writers continued to embrace it, and it occasionally reared up in mainstream popular culture, such as in the 1992 movie The Lawnmower Man, in which a scientist turns his gardener into a super-being using a cocktail of VR and psychoactive drugs.

But it's only really in the past five years that VR has started getting into the hands of consumers at scale. Arguably, the most famous pioneer into this generation of VR is Oculus, a company that was subsequently snapped up for $2bn by Facebook, when it launched the PC-connected Rift prototype in 2010. HTC was soon on its heels with its Vive VR, while mobile companies such as Samsung, with its GearVR, and console-maker Sony PlayStation launched their own versions.

What is VR?

VR is defined as a computer-generated simulation of a 3D environment that can be interacted with in an apparently real or physical way. It typically uses a headset as an interface, a helmet donned by the user. When a user moves their head, or uses a device to move within the virtual space, their perspective shifts accordingly.

"Realities" can include computer-generated, graphics-based worlds or 360-degree renditions of real-world video. While the first allows the user to effectively enter a realm straight out of a video game, the latter enables them to enter someone else's real-world experience.

There is also another form of VR that combines 360-degree video with computer-generated content. And this is where the waters muddy around definitions.

Augmented Reality

Augmented Reality gives the user a view of the real world through the lens of a headset, a pair of glasses, or the screen of a smartphone, or a tablet. This view of reality is then augmented, or overlaid with computer-generated sensory content such as video, graphics or sound.

Pretty much everyone has access to a rudimentary form of AR through their mobile phone. If you've scanned a QR code and seen the view of reality through your screen overlaid with 3D graphics, then you've experienced AR.

The most high profile example of AR was Google Glass, which was discontinued after probably being too ahead of its time but has since been reintroduced with less fanfare. Since then, Microsoft's HoloLens has arguably become the most famous AR device.

"AR, MR and VR will transform the quality and effectiveness of business communication and collaboration over a 5-10 year period, much in the way that advances in video technology did in preceding years. The experience of corporation-wide communications will take a leap far beyond the current videoconferencing standard. Products will be designed and tested more quickly and precisely inside AR, MR or VR. Teams within the business will be better-trained and higher-performing after experiencing realistic and engaging educational simulations created in AR, MR or VR. The relationship and communication between the business and its customers will also evolve as a result of AR, MR and VR technologies, allowing customers to experience aspects of the business brand, operation and products in a new level of detail."

Dr. David Trainor, Chief Technology Officer, Sentireal® Ltd

Technically, with AR the graphical and actual worlds do not interact, which is (according to some) what distinguishes AR from...

Mixed reality

Mixed Reality, or Hybrid Reality, is the merging of the real and the virtual, not as discrete elements but as elements that can interact with one another.

For instance, a user could be driving their car wearing a device, seeing the road in front of them superimposed with navigation and GPS data denoting the route, their location, traffic conditions, etc.

Microsoft's HoloLens is the prime example of an MR device. As well as being an AR device. Confused? Don't be. To all intents and purposes, the terms AR and MR are interchangeable.

VR boom

Today's consumer is spoilt by the choice on offer of VR headsets, whether that's a PC-tethered Oculus Rift, a standalone wireless Oculus Quest 2, which negates the need for a powerful rig to run it, or Sony's PlayStation VR (a second generation version was recently announced), the only console-dedicated VR system.

Meanwhile, the world's biggest content providers are investing in VR – YouTube VR is case in point, a channel where users can watch 360-degree videos on their device of choice, or upload their own,

The popularity of VR is set to rocket – revenues were forecast to grow to around $19bn by 2020, and tech giants such as Microsoft, Facebook, Sony, HTC, Valve are continuing to invest in refining the technology.

Estimates vary, but some put sales of AR and VR headsets at around 5.5 million units in 2020 with predictions that that will increase to annual sales of more than 26 million units by 2023.

While VR's arrival to the relative mainstream has been driven by serving the gaming community, its applications extend beyond entertainment and into the realms of training and education, business processes, marketing and medicine. And now that the technology is so affordable to the consumer, its price threshold is nothing for the business owner.

This report will focus on the power of VR in the present and where reality is heading in the future.

Real world education in the virtual world

When many parents are wanting to pull their children away from computer screens, or office workers are urged to take more screen breaks to give their eyes a rest, the idea of strapping a VR headset to someone's head might not initially appeal.

Immersive classrooms

But VR's capacity to teach, to allow students to have experiences beyond the limits of their physical world, to train staff, and to work remotely with colleagues in a shared virtual space has seriously beneficial ramifications in the real world.

VR content can revolutionise education and learning. More schools across the world are adopting the technology, using kit in the classroom to give pupils otherwise-impossible experiences.

They could be transported to the Great Pyramid, or visit the ruins of Roche Abbey in Yorkshire, taking students on virtual field trips to destinations tens of thousands of miles away. VR is clearly a financially less burdensome alternative to a real-life field trip.

In the US, classroom VR is starting to merge with curricula, with the likes of open platform ClassVR allowing students and teachers to create, upload and share their own content across a collaborative online community.

One of the standout advantages of using VR in education is that direct (albeit simulated) experience is a provenly more engaging means of communication than reading a textbook.

VR content is typically viewed on a headset, via a phone, but for schools, it can even be projected onto a wall to create an immersive classroom, allowing children to be transported but still able to interact with one another.

As students mature and move into secondary education, they are inevitably becoming more independently minded, and hence VR headsets are a more popular route to virtual reality than the immersive classroom.

VR is also a powerful medium for teaching kids with learning difficulties, allowing them to learn about aspects of the world in a totally controlled environment. For example, children with neurodiverse conditions such as autism can be taught road safety.

The reality of virtual skills

One of the earliest manifestations of VR was as a training tool for US pilots, thanks to its ability to take a rookie and transport him or her into the skies, and the technology continues to be used today to train flyers.

But VR is being used today to train people for more earthbound, mundane tasks in a risk-free virtual space.

This can include safety training in a virtual representation of a potentially hazardous environment, teaching new staff how to operate complex machinery without the risk of damaging expensive equipment, or enabling surgeons to finesse intricate, and potentially life-threatening, medical procedures.

The fact that consultancy giant PwC has written a recent report on the use of VR for soft skill training, and that its Emerging Technology Group has explored the business value of VR for several years, speaks volumes about its efficacy for businesses.

In 2019, PwC published its Seeing is Believing report and predicted that VR and AR have the potential to add $1.5 trillion to the global economy by 2030.

For PwC, the most appealing applications for the technology are for training leadership, soft skills and other human-to-human interactions. Its research found that v-learning was more effective than classroom learning, that v-learners were 275% more confident to act on what they learned (a 40% improvement vs the classroom); that they were four times more focused than e-learner training; completed training up to four times faster than in the classroom; and were 3.75 times more emotionally engaged to content than classroom learners.

"XR experiences can replace things like surveys and quizzes that gauge a user's feelings or learned information, making learning interactive. In general, AR/MR/VR is an amazing visualisation tool for any purpose such as graphs, safety drill training, engineering, biking, soft skills training, vehicle simulation, etc. Imagination is the limit."

Daria Fedko, CEO, WeAR Studio

"When you stare at a screen, you remember watching something on a screen. Using AR/VR, your brain remembers you lived it. That's why most AR/VR content is called an experience, because that's what it truly is. This has many benefits: faster and more efficient learnings, contextual guidance, 3D visualisation in itself. In a hybrid remote/office work world, AR/VR devices will bring people together in a shared space, something that's never been done before."

Soraya Jaber, CEO & Co-founder, Minsar

"We need to be careful not to dehumanise learning in any way. The world experienced the way that video calling only offers a limited connection in human interaction. But offering learning through virtual worlds could prove very exciting. Creativity will start to become more of a stable in the education system. Children who did not flourish under older education systems may find themselves in a whole new space of learning."

Brian McCarthy, Director, Bold&Break

A virtual shot in the arm for productivity

The irreality of VR is having a dramatic impact on the reality of the bottom line, and more and more businesses are getting onboard.

The unique benefits of VR, and its AR and MR siblings, are not restricted to creating safer and more engaging company training programmes, but are having a significant impact on productivity. How? VR, AR and MR can streamline workflows, improve efficiency and enhance safety, and help manage complex tasks.

That's why companies were expected to spend $17.8bn in 2018, an increase of nearly 95% more than estimated for 2017, according to an IDC report. But while enthusiasm for the technology is clearly on an upward trajectory, growth in the past year can't have been helped by the world being forced into lockdown, with businesses having to consider more urgent issues.

Supercharged productivity

That said, for some businesses, the hit taken from COVID-19 has actually helped drive their alternate reality strategies.

It's why technology giants such as Facebook, which owns Oculus, have made moves during lockdown to "supercharge" remote working and productivity, building on technologies such as Passthrough, which enables workers to switch between the virtual and real world.

Facebook founder Mark Zuckerberg told The Verge last May how the social network is going to be "the most forward-leaning company on remote work at our scale", and explained how AR and VR specifically will give staff who are working from home "remote presence".

Facebook clearly has a vested interest in VR, having forked out a not insignificant $2bn for Oculus while operating an advertising model intent on linking people to one another virtually.

But AR is also helping companies improve productivity and quality across more physical industries because of its ability to reduce human error, save time, boost efficiency and achieve cost-savings.

For example, staff can use wearable or handheld AR devices to remotely request and access help; or don a VR helmet to receive training; businesses can cut costs (and carbon emissions) by stemming the flow of staff from location to location for work purposes by introducing virtual meetings.

In its *Augmented and Virtual Reality in Operations: A guide for investment report*, Capgemini Research Institute

> "Studies have shown that companies that give their employees the option of working from home have boosted their productivity significantly, and feeling the presence of your colleagues in VR conquers Zoom fatigue. The challenges are the same with any new technology; some people are slower in accepting the new tools, and 5-10% of VR users (depending on the headset) complain about dizziness, mostly due to not following recommendations. In time, headsets will be even more lightweight and ergonomic. We are still early adopters."
>
> **Gaby K. Slezák, Partner & Head of XR, Evenness**

Technicians said that many enterprises are using AR and VR tech to enhance their business operations and found that 82% of companies that were currently implementing AR or VR said the benefits were either meeting or exceeding expectations. It found that large-scale AR and VR implementations can realise operational benefits of over 10%.

The report quizzed more than 700 executives in the automotive, manufacturing and utilities sectors. While half of those organisations said they were currently not exploring immersive technologies, they added that they would start doing so in the next three years.

More tellingly, nearly half (46%) of respondents said they believed the technology would become mainstream in their organisations within three years, while a further 38% thought it would become so in the next three to five.

Nuts and bolts

Luxury automotive company Porsche is a gleaming example referenced by

"The biggest challenge in my opinion rests with the decision-makers in the companies or corporations that are considering using XR applications, more so than the technology itself. If these decision-makers embraced XR with the same enthusiasm as what they did with Web technologies 20 years ago, I'm convinced we would have all progressed much further than we currently have. Decision-makers are still wary and are still to be convinced of making significant investments in these types of initiatives, despite the advantages being quite obvious: reductions in cost, savings in time, increased levels of engagement from participants, the creation of new sets of data from interactive and immersive experiences that simply aren't possible via any other medium."

Chris Elson, Client Development Manager, Apache

Capgemini. Staff are being kitted out with AR glasses that overlay step-by-step schematic drawings across their field of view, while also enabling remote engineers to see what the technicians are seeing and doing in order to provide feedback. This has helped slash service resolution times by up to 40%.

Another example is Airbus, which has used VR to allow assembly workers access to digital mock-ups, which can be integrated into production environments. It cut the time typically taken to inspect from three weeks down to just three days.

"The biggest current challenge is the cost, as there is only one serious AR device on the market and that is Microsoft Hololens, which costs from 3,000 to 5,000 USD. Another challenge is the voice assistant software which is good, but still not perfect enough for seamless interaction with the device."

Mario Ramić, Founder and CEO, Takeaway Reality

Capgemini also found that Ford's use of VR has allowed it to identify and then engineer alternative actions by humans captured by body motion sensors during assembling, resulting in a 70% drop in injuries and a 90% cut to ergonomic issues.

Notably, while strict VR tends to be used more in training situations, it's the applications of AR/MR that are regarded by companies – particularly those in heavy industries – as the more relevant and widely used of the technologies.

Competition has never been more rife, and boosting margins by increasing productivity through a relatively cheap form of technology is a no-brainer. VR and AR implementation are a worldwide phenomenon, but it's the US and China that are at the forefront of adoption, where half of all companies are putting VR and AR strategies in place.

The message is clear - an increasing number of major corporations are invested, and investing, in the idea of VR as a powerful tool for bolstering productivity. The rest of the world needs to catch up.

How marketing has tuned into alternate reality

We've already examined how VR, AR and MR are helping businesses cast their virtual eye inwards: educating their workforces, improving efficiencies, reducing injuries and elevating productivity. But growing numbers of businesses are using the tech to look beyond their own operations and engage with consumers.

Shiny new toys

The marketing department has never been one to shy away from innovation, and while its hit-and-miss relationship with shiny new toys doesn't always succeed, VR, and in particular AR, are a standout exception.

Put into the hands and onto the heads of consumers, VR, AR and MR can be a compelling means of promoting your product or service, whether you're a consumer goods firm, an SME or sporting event.

VR's ability to transport people to places they would never usually get to go is its most compelling virtue. Big hitters like National Geographic have taken consumers to far-flung spots of the world, and even into off-planet, into space.

But the tech is equally as accessible to a small independent travel agent, which could give a new lease of life to the old-school holiday brochure by equipping a prospective customer with a headset and taking them on a virtual safari.

Motorsport has long had strong links to VR, which has seen the development of VR-playable versions of games such as Dirt Rally for the PlayStation, so there was always going to be a natural fit for Formula 1 to use VR in its marketing.

Although F1 had long been a sport and an organisation steeped in tradition –

and was often criticised for its resistance to innovation – when it was taken over by Liberty Media In 2016, the new owners were vocal about how they planned to broaden the sport's appeal and embrace technology to improve the consumer experience.

In 2016, Formula 1 signed a deal with virtual reality provider The Dream VR, to literally fulfil the dreams of petrol-heads across the globe. The partnership led to the creation of a F1 VR app, allowing users to gain a 360-degree view from the team garages and paddock, to the starting blocks and finish podium. Liberty has said in the past that one day it hopes fans can experience a Grand Prix from the cockpit of their favourite driver's car.

Aside from capturing the adrenaline pumping speed of a motorsport, VR is equally at home for more sedate brands.

And while not everyone has access to a pricey headset, VR can also be done on the cheap. Stella Artois five years' ago created a virtual reality app that allowed consumers to take to the skies and experience Wimbledon's All England Club courts from the bird's-eye point of view of its official pigeon-hunting Rufus the Hawk. Rather than relying on consumers owning the expensive kit (especially so five years back), or having to provide their own at scale, it handed out Google's super-cheap Cardboard headsets to people at stations, who could then use their smartphone to have a virtual experience.

But as appealing and transportive as VR for the world of marketing, consumer penetration among the population is but a small percentage point.

VR's more nimble sibling

The opposite is the case with the smartphone, a device primed for AR, a technology that's important for the bricks-and-mortar retail sector, not only threatened by the encroachment of e-commerce, but hit by COVID-19 lockdown.

AR apps can pull consumers in with their tactility, with advertising that can be interacted with. They can also be used to let consumer trial products virtually.

Swedish furniture superstore IKEA has embraced AR and made it available to any of its customers owning a smartphone.

Dubbed IKEA Place, the app uses a phone's camera and allows customers to try out new furniture in their homes, by "placing" virtual items into their living spaces. They can then seamlessly order items that fit their aesthetic needs.

In no event

One of the sectors hit hardest by lockdown has been the world of events, so it's little surprise that organisers have been seeking alternatives to their physical experiences. In June, Glastonbury's Shangri-La launched a music and arts festival called Lost Horizon that revellers could attend by donning their Oculus or Vive. The following month, Wireless Festival followed suit with a digital rendering of its three-day event.

Marketers like to tell anyone who's listening about how they are storytellers. And while the best traditional advertising can successfully tell a story, the product message often blunts the narrative cut-through.

But the capacity for VR, AR, and, perhaps down the line, MR, to thrust consumers into those narratives – allowing them to explore a digitally-rendered environment, interact with and virtually try out goods or services – points to a future in which marketers can give consumers a starring role in their brand story.

"Imagine being able to hold and inspect the digital version of a product before buying it. Imagine being able to walk through every room of that airbnb before booking it. Imagine being able to stand at the foot of the Eiffel Tower before going there. XR will bring in the new age of experiential marketing. It's going to be incredible."

Alex Ruhl, VR Director/Writer, CATS are not PEAS

"An important component of the future of XR and marketing will be a battle between the power that XR can provide to marketers and the restraint required for the sake of consumer privacy and the user experience."

Jeremy Dalton, Author, Reality Check; Head of XR, PwC

Campaigns will become completely experiential. You have the possibility to build procedural and dynamic campaigns which can change based on dozens of parameters. Game engines like Unreal will start to play a pivotal role in implementing immersion into brands. Campaigns may live far beyond the sell by date just because of the immersion offered by VR, AR and MR."

Brian McCarthy, Director, Bold&Break

VR + AR = better CX

In the previous chapter, we looked at how marketing has been adopting VR and AR technology to augment advertising campaigns.

We gave some examples of how brands are mixing messaging with experiences. With consumers today urged to socially distance, the case for virtual and remote customer interaction has never been more pronounced.

While VR completely immerses the user in an alternate reality, AR combines the digital world with the real-world as viewed through a screen.

Exclusive previews

Both can give customers a taste of a product or service before they hand over their cash. This is particularly pertinent for the retail sector, where AR apps can give customers experiences that for the seller increase the chance of clinching the deal.

"An area that some enterprises have already started looking into for improving customer experience is using AR for guidance and technical support. By creating AR instruction manuals, as well as deploying AR remote assistance when AR headsets will become more consumer friendly, companies will be able to reduce their spending on technical support and improve customer satisfaction."

Emanuel Tomozei, VR/AR Consultant, The World Bank Group

"If you are not able to go to the shop, you can check how you would look like in a hat, sunglasses or makeup you want. In the next step with improved hand tracking, you will be able to try jewellery and nail polish. Later with an improvement of body tracking, you will be able to try on whole sets of clothes."

Jerzy Pilch, Social AR Creator and Official Facebook Spark AR Partner

For example, fashion retailers like Gucci have been using AR to let customers do just that, with an application that lets a consumer use their phone's screen to 'try on' a new watch or a pair of loafers. Clearly this doesn't need to be done in-store and means a consumer (particularly during the pandemic) can avoid travelling.

With AR, a consumer can visualise how a new item of furniture will look in their living room, and then hit the buy button if they're happy with what they see.

VR and AR can also give consumers the type of access that was previously limited to exclusive events. In 2019, online fashion retailer ASOS launched an experimental feature called Virtual Catwalk, letting a user select a product they are interested in, point their phone's camera at a blank surface and then watch as a miniaturised fashion model wearing that item sashays towards them.

Beyond bricks and mortar

But the applications of AR stretch beyond retail and into FMCG and other consumer goods. Paint company Dulux has created an application that lets people preparing to decorate their homes visualise colour palettes on their walls and skirting; while Coca-Cola has created the Hydr8 concept, which uses AR and VR to encourage people to stay hydrated.

Fast food giant McDonald's started including instructions for how to build a pair of AR glasses out of the packaging for its Happy Meals and a mobile phone. They can then use a dedicated app to watch and interact with stories. As well as entertaining the youngsters (and augmenting their capacity for pester power) through the use of whizz-bang tech, it's an appealing gesture of customer experience.

SMEs and why alternate reality shouldn't cost the earth

VR, AR and, to an extent, MR are becoming big business, but that doesn't mean only big business can get onboard.

According to research published by Technavio in June 2020 in its Global Augmented Reality and Virtual Reality Market 2020-2024 report, the global VR and AR market is expected to grow by $125.19bn between 2020 and 2024.

As more people get comfortable with the notion of alternate reality devices, as more units are sold, as more brands invest in the technology, the more the cost of buying into VR, AR and MR will come down.

The reality is that SMEs are often well placed to take advantage of this tech, which is not as prohibitively expensive as one might initially imagine. And there's a convincing argument that small to medium-sized business owners should not be thinking about not how much VR and AR tech is going to cost them – initial outlay is minimal – but how much it will save them and what it can do for their businesses.

Which reality? VR, AR or MR?

For the SME looking to join in, it's crucial to distinguish between VR, which immerses the user entirely in a virtual world via a headset, AR and MR.

VR is a great means of training staff in an interactive and far more engaging environment than a classroom, whether

> "The biggest benefit that AR offers is increasing customer touchpoints with the brand. Brands that don't often interact with their customers should consider creating AR experiences that would allow their users to directly interact with them."
>
> **Mario Ramić, Founder and CEO, Takeaway Reality**

Alternate reality tech can also help businesses convey technically complex information in a manner far more compelling than a brochure or over-eager salesperson.

Car company Toyota is a case in point. It has used AR to give would-be customers a firmer grasp of its C-HR hybrid model, overlaying images of the car's inner workings onto physical vehicles in showrooms.

Healthcare providers are even utilising AR to minimise pain for patients. A company called AccuVein has taken the guesswork out of finding (and potentially missing) a vein for injection with AR technology that uses a patient's body heat to superimpose a virtual, real-time image of the underlying vasculature of the skin.

Given that VR is still at a relatively nascent stage in terms of take-up among consumers, certainly compared with the ubiquity of the mobile device, its potential for enhancing customer experience is less realised than that of AR.

But there are still plenty of examples of where VR can enhance customer experience. China's Alibaba has created a VR shopping programme, allowing customers to wander virtual aisles of an online store, perusing items and even receiving assistance from a virtual shopping assistant, all from the comfort of their own home.

There are fascinating implications for after-service too. Using VR and/or AR, companies can guide consumers on how to update or fix a product or service. VR can be used to improve customer service by enhancing agents' training; or new employees can polish their communication skills while facing multiple situations in a virtual world.

Or, sounding the death knell for those interminable waits on hold while crackly muzak blares into your ear, technology could provide customers with an entertaining distraction while they wait to speak to a customer service representative.

The permutations for enhancing the customer experience are unlimited.

that's physical or online. It can be used to transport an exec into a virtual meeting space rather than them having to travel physically, thus saving significant time and money. It can be used in product development, visualising a prototype in 3D space, or testing a new store layout.

VR headsets are relatively inexpensive. An Oculus Quest 2 costs around £400, whereas a more powerful, but PC-tethered Oculus Rift S can cost around £300. At the premium, high-res end of the market, Valve's Index and HTC's Vive Pro will set you back around £1000. But on the cheaper end of the scale, prices plummet. Google Cardboard costs anything up to around £20 and Samsung Gear VR is priced around £40 for a headset, although with the last two you'll need a phone to place into the housing.

Then you have MR, which as a term is often used interchangeably with AR. However, technically speaking at least, MR requires a more sophisticated device, such as Microsoft's HoloLens, currently in its second iteration.

From a strictly MR perspective, the HoloLens 2's ability to overlay information and graphics that respond to the real world is what sets it apart from VR and AR.

In manufacturing it can be used to up-skill workforces, help service teams identify faults and communicate with one another, it can boost worker productivity with intricate and responsive checklists and instructions, while in education it can facilitate remote collaboration requiring less direct instruction. It has obvious virtues, but at around $3500, it's not cheap.

"When thinking about going into XR development, remember that you are not investing in the technology, you are investing in a team. Going into such a project it is best to pay utmost attention to what kind of team you would need to build the experience. It is important to look at the expertise, experience, the ambitions, goals, and how they plan to reach those goals."

Daria Fedko, CEO, WeAR Studio

"One piece of advice I'd give to SMEs that are looking to invest in these technologies is to start small with a limited pilot programme, learn from its implementation, and grow your investment in XR accordingly."

Jeremy Dalton, Author, Reality Check; Head of XR, PwC

Cheap and accessible to all

On the other hand, compelling AR experiences can be accessed on any old smartphone. And producing content is financially viable too, even for the smallest boutique business.

There are a raft of tools available for SMEs. Facebook is offering training for its Spark AR suite of tools for free, giving SMEs access to templates, asset libraries and creation tools built for novice Javascript devs, that will let you create AR content. Shopify has produced an AR Quick Look tool that lets online merchants create 3D models of their products.

From a marketing standpoint, there is a plethora of AR apps available for businesses of all sizes. Snapchat has a production tool called Lens Studio, which lets companies produce front camera Face Lenses that manipulate a user's face with branded imagery, and World Lenses, that use the rear camera to superimpose branding on the world beyond them.

For small businesses selling online, AR applications enable prospective customers to 'try on' items such as jewellery. Or they can be used in training to superimpose instructions as an employee works through a complex task.

The low cost of AR makes it the most compelling proposition for SMEs.

The time is right too. According to Gartner, 40% of SMEs said they are currently evaluating AR and VR, and 70% will be doing so by 2022.

For small to medium-sized businesses, making a foray into the alternate realms offered up by VR, AR and possibly MR is a surefire means of cutting costs, enhancing your marketing and sharpening your competitive edge.

"Don't get hung up on the technology. Focus more on the user-experience. Pilot projects and get hands on, as you're never really going to fully appreciate XR's worth until you experience it for yourself. Learn what's possible, and learn from your mistakes."

Chris Elson, Client Development Manager, Apache

What next for VR, AR and MR?

This report has shown that there are numerous opportunities to consider in the future of VR, AR and MR. We hope that the report has provided some useful talking points about the future and how helpful this technology will continue to be.

Here are some final questions for you to consider, that we expect will form part of this debate:

How do we bring more recognition to the leading edge developers of VR, AR and MR tools, such as awards events?

How can the business world be trained to improve the skills of its employees to better grasp the opportunities brought by VR, AR and MR technology?

What kind of events would help to bring these technologies to life?

What work needs to be done to provide more opportunities to bring new talent into the industry to build better tools?

When it comes to integrating these technologies into a business, how can all levels of the business – from board level down - work together to ensure a smooth transition?

To what extent will existing educational institutions welcome VR, AR and MR into the classroom?

Which industries will be quickest to introduce these technologies into their training solutions?

At what point will the cost of entry be reduced enough to convince business leaders to take up VR as a solution to improve cross-business productivity?

When will it be the norm for marketing campaigns to include a VR element?

Will VR help consumer brands to fill the customer engagement gap that was left by COVID?

The AI Journal

The AI Journal
Tom Allen, Founder
tom.allen@aijourn.com
https://twitter.com/TheAIJournal1
https://www.linkedin.com/company/the-ai-journal

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