New Realities
As a constellation of technologies including smart eyewear, game engines, natural language processing and generation, volumetric video, and haptics continues to evolve, it is critical that we draw distinctions between the various digitally mediated realities that span the reality-virtuality spectrum. With AR, VR, MR, XR, and DR—and more R’s inevitably on the way—reviewing their definitions and differences is the first step toward better understanding the future of the field.

AR vs. VR
Though both can be experienced via smart glasses or head-mounted displays, augmented reality (AR) and virtual reality (VR) are fundamentally different, and should be treated as such. AR makes digital alterations or additions to your existing environment, but you generally remain oriented to your physical surroundings. VR immerses you fully in a virtual environment, one that is either artificially generated or emulates real-world surroundings other than your own. While they may share hardware, AR and VR each have unique applications, with enterprise and consumer use cases for AR eclipsing those for VR at present.

MR vs. XR
Mixed reality (MR) anchors virtual elements to corresponding physical elements in your environment—you can still physically interact with objects and surfaces, but their appearance and reactivity may be virtually altered or enhanced. MR experiences do not take place fully in the physical nor the virtual world, but in a hybrid of the two. Extended reality (XR) is more of an umbrella term that spans the reality-virtuality continuum, including AR, MR, and VR. XR sometimes overlaps with varying definitions of the virtuality-reality spectrum, spatial computing, or Web 3.0, and the so-called metaverse.

DR is AR (but not the other way around)
Diminished reality (DR) is not fully immersive, leaving you anchored in your physical environment but with certain visuals, sounds, or other sensory elements suppressed. Thus, all DR is typically considered a subset of AR—that does not mean, however, that all AR is DR.

Technology now blends the physical and virtual worlds.
**Diminished Reality**

**KEY INSIGHT**

Diminished reality (DR) is the field of AR that focuses on virtually masking, reducing, or suppressing features of one’s environment. As smart glasses proliferate and AR becomes commonplace over the next decade, DR presents an opportunity to virtually shape our reality rather than simply build on top of it.

**EXAMPLES**

DR has existed in some form for over a decade, with one of the most ubiquitous examples being noise-canceling headphones. But as the technology matures and is developed for the audiovisual applications of smart eyewear, it will allow users to target specific stimuli to suppress, isolating a specific speaker’s words and appearance in a crowded room, or removing all advertising from view during a walk through the city center. But there are also therapeutic applications for those with unique sensitivities, such as for those suffering from PTSD. One study published by the Institute of Electrical and Electronics Engineers outlines a series of experimental workshops that used DR to assist individuals on the autism spectrum “who are adversely affected by continuously changing surroundings or distracting visual incidents.”

**DISRUPTIVE IMPACT**

Diminished reality forces us to rethink how digital mediation can shape our surroundings by subtractive rather than additive means, improving quality of life for a broad range of users, but not without risks.

**EMERGING PLAYERS**

- Amazon Sumerian
- Apple’s ARKit
- Google’s ARCore
- Vuforia Engine
Smart Eyewear and Head-Mounted Displays

Key Insight

Smart eyewear and head-mounted displays (HMDs) are already on the market; as the devices spread, generating more real-world data with which to update and fine-tune their hardware and operating systems, they are strongly positioned to replace smartphones as the primary personal device.

Examples

The transition from hands-on to heads-up mobile computing has begun, with everyday smart eyewear trickling into the consumer market. Amazon’s Echo Frames, which were quietly made available to the public at the end of 2020, prove that smart glasses can have “dumb” lenses—the tech in these frames is purely auditory (they have an onboard Alexa voice assistant), using bone conduction technology rather than in-ear components. The audio-first approach is a clever way to ease smart eyewear into the market, avoiding the privacy concerns surrounding video-enabled products like the conspicuous—and widely criticized—original Google Glass. It also gives manufacturers more time to engineer the complex smart lens systems that will eventually support XR applications. Watch for sleeker but simpler smart eyewear devices and bulkier but more powerful HMDs like Facebook’s Oculus Quest and Microsoft’s HoloLens to inch closer to one another in terms of capabilities and form factor.

Disruptive Impact

Smart eyewear is expected to upend industries and interfaces designed for the smartphone by offering a more versatile hands-free alternative to the trusted mobile device. HMDs, on the other hand, have already begun to reshape enterprise solutions, from the field to the factory floor. Current smart eyewear, often designed to resemble recognizable traditional eyeglasses with simple but useful connected features, is meant to seamlessly blend into our everyday lives and facilitate daily activities. HMDs, which offer more robust functionality but are too cumbersome and restrictive for casual use on the go, are more commonly used in controlled workplace environments, or for mostly stationary entertainment and gaming. As smart eyewear adds more advanced features, and HMDs become more lightweight and comfortable, the two closely related technologies may begin to converge.

Emerging Players

- Amazon’s Echo Frames
- Apple’s forthcoming smart eyewear product
- Epson Moverio
- Facebook’s Oculus Quest 2
- Microsoft’s HoloLens 2
- Solos
- Snap Spectacles 3
- Vue
- Vuzix Blade

© 2021 Future Today Institute
AR for the Enterprise

KEY INSIGHT
From factory floors to virtual meeting rooms, AR has a broad range of business applications, fueling accelerated investment and growth in the field, while VR takes longer to mature.

EXAMPLES
Microsoft’s HoloLens 2 head-mounted display was designed specifically with business solutions in mind, incorporating cloud and AI functionality, interoperability with industry partners, and a suite of developer tools. The device has already been adapted for the U.S. Army, with thermal imaging and night vision among its many advanced capabilities. Smart eyewear and HMD maker Nreal has announced an Android-compatible “all in one” enterprise headset that looks more like a helmet than a pair of glasses, with on-board edge computing capabilities. The uses of these business-focused headsets are wide-ranging, encompassing everything from monitoring supply chains and complex equipment via digital twins, to hosting remote meetings in 3D, to providing guided AR tutorials as part of workplace training.

DISRUPTIVE IMPACT
Companies of all sizes and industries should be asking themselves where AR can be implemented to streamline and enhance functions and processes throughout the organization. AR devices are now being offered as part of a larger ecosystem, compatible with third-party operating systems and developer kits that allow smaller companies to plug in to existing systems, while bigger companies can design and customize their own.

EMERGING PLAYERS
• CAE
• GIGXR
• Hevolus
• Kognitiv Spark
• Medivis
• Nreal
• PTC
• Spatial
• Trimble
Holograms

KEY INSIGHT

Holograms are light field recordings that, when reproduced, can appear as static or dynamic three-dimensional visuals. The term is also more generally applied to any image that is rendered to appear in 3D.

EXAMPLES

In December 2020, Netflix launched an AR hologram tool ahead of releasing the George Clooney movie “The Midnight Sky.” It let people record and upload a short video message and see it transformed into AR holograms. Blank XR is developing a concert platform that would allow fans to engage with musicians’ holograms via a mixed-reality application. Los Angeles startup Portl launched phone booth-sized boxes that can project a real-time, full-size holographic likeness of a person or character. Holograms have been key to successful concert tours featuring bygone stars like Roy Orbison and Frank Zappa, and will soon allow production companies to draw popular synthetic media influencers like Lil Miquela and artists like Japanese act Hatsune Miku out of our screens and into our spatial environment.

DISRUPTIVE IMPACT

The accurate digital reproduction of faces, bodies, and other complex structures in dynamic 3D form is critical to the evolution of augmented and virtual reality. As smart eyewear edges out the smartphone as our primary personal device, holograms, variously combined with deepfake technology and synthetic media, may soon inhabit our everyday environments. They’ll represent a range of artificially generated characters, celebrity stand-ins, brand spokespeople, historical figures, and lost loved ones. In the medical field, holographic mapping can provide doctors with a 360-degree view of a patient’s internal organs, vessels, bones, and tissue, which can assist with diagnostics and surgeries, with multiple apps already approved by the U.S. Food and Drug Administration. As it evolves, this technology could be used in remote workplace training and collaboration. Expect to hear more about holograms as resolution, volumetrics, and depth of field improve, and as 5G fuels the level of high-bandwidth instantaneous data transfer needed for lifelike holographic streaming.

EMERGING PLAYERS

• Blank XR
• Netflix
• Portl
• Kaleida
• Eyellusion
• Base Hologram Productions
• Hologram USA
• EchoPixel
• OpenSight
• Crypton Future Media

Prominent attorney Robert Kardashian (left), who passed away in 2003, was re-created in holographic form (right) by production house Kaleida in 2020 as a birthday gift for his daughter Kim.

Image Credit: GETTY IMAGES/@KIMKARDASHIAN