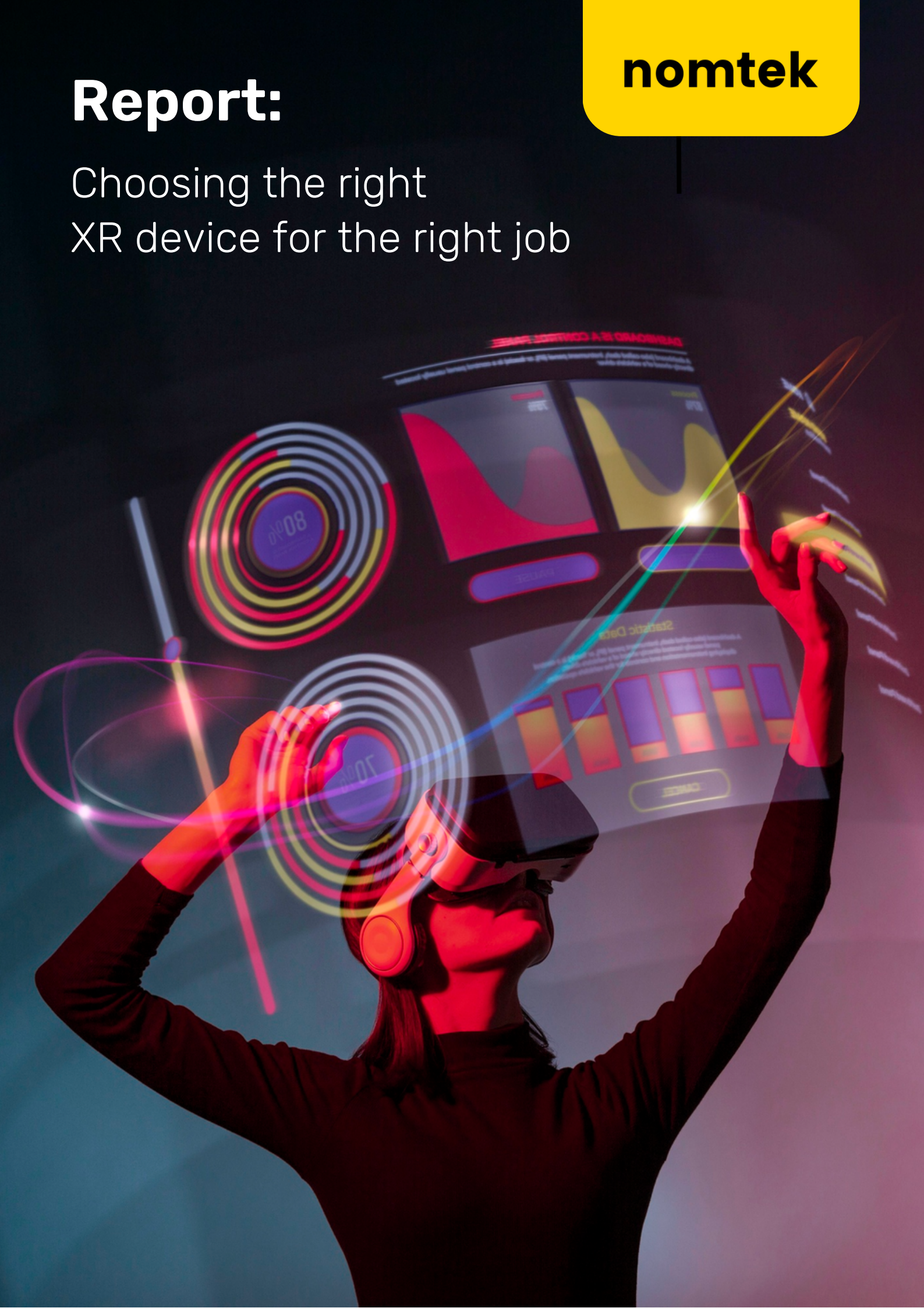
nomtek

Report:

Choosing the right XR device for the right job



Introduction

Leaving the realm of a hyped-up novelty, extended reality (XR) has started maturing, gradually transforming how we work, learn, and interact with digital content. From providing immersive training environments to enhancing customer engagement in retail, XR has the potential to enhance operations in many industries.

Unlocking this potential requires a thorough understanding of which device aligns best with a specific business need and use case.

XR is an umbrella term that includes virtual reality (VR) and augmented reality (AR). The market is teeming with XR devices, including headsets, glasses, and AR-enabled smartphones. Each of these devices has its unique features, advantages, and specific use cases. This report aims to help decision-makers, innovators, and investors navigate this complex landscape and make informed choices about implementing XR technologies in their business contexts.

XR Market Insights

A thorough comprehension of the XR market is instrumental in shaping adoption and investment strategies. The XR landscape is varied and vibrant, with a market volume projected to reach between $394.8 and $597.54 billion with a CAGR of around 38% by 2030 (1,2). Significant market growth is linked to the increasing adoption of XR technology across different verticals such as training and simulation, healthcare, manufacturing, or entertainment and art.

Growth in the market volume

According to Statista, the market volume of AR software — the largest segment in the AR market — will increase to $11.58 billion in 2023. The XR market, e.i., VR and AR, is expected to close 2023 with $31.12 billion in combined revenue.

Deloitte's latest research reveals that by 2035, VR/AR technologies could contribute a substantial $760 billion to the U.S. economy, representing approximately 2.4% of GDP. In parallel, a report by Meta suggests the EU could see a contribution of around 489 billion euros from these technologies, equivalent to approximately 2% of GDP.

A comprehensive study from the Analysis Group predicts that by 2031, global economic gains from VR/AR adoption could reach a staggering $3 trillion.

Integration into Daily Life

Interest in AR and VR among Americans is surging, with 79% expressing interest in VR and 50% having already utilized AR technology. Current VR use is dominated by gaming, exploration, and media consumption, while AR finds widespread application in gaming and online shopping. As much as 70% of Americans anticipate AR becoming commonplace in daily life.

- 82% envisage increased personal use of AR and VR.
- 53% plan to purchase a headset within the next three years.

Beyond leisure, XR technologies are perceived as valuable educational tools by 88% of respondents and as means to combat social isolation by 66%. Additionally, 77% would consider using AR or VR for virtual travel experiences.

The Surge in AR Startups

The US has witnessed a considerable upswing in AR startups in recent years, with the tally standing at 1,027 in 2023. The growth indicates a vibrant entrepreneurial environment within the XR industry, hinting at an incoming wave of innovative solutions and fresh viewpoints.

Adoption Spurred by Deskless Workers

A report by McKinsey highlights that the world's 2.7 billion deskless workers could emerge as principal adopters of immersive technology. This demographic represents nearly 80% of the global workforce, signaling a gargantuan potential market for XR solutions.

Sources:

https://www.mckinsey.com/spContent/bespoke/tech-trends/pdfs/mckinsey-tech-trends-outlook-2022-immersive-reality.pdf

https://www.thevrara.com/

https://tracxn.com/explore/Augmented-Reality-Startups-in-United-States

https://www.statista.com/outlook/amo/ar-vr/ar-software/worldwide

https://advanced-television.com/2022/09/07/overhalf-of-us-vr-headet/

Grasping the Fundalementals of XR Technology

To decide which XR devices are best suited for particular applications, it's vital to understand the underlying technologies and concepts. While XR encompasses many immersive technology solutions, we can split the hardware into three categories:

- AR headsets and glasses
- VR headsets
- Mobile AR

In this chapter, we delve into different types of XR technologies, including AR headsets and glasses, mobile AR, VR headsets, and the essential concept of degrees of freedom (DOF) in XR.

AR headsets and glasses

AR headsets and glasses overlay digital information onto the real world, augmenting the user's perception and interaction with their environment. These wearable devices enable hands-free access to information, improving productivity and providing immersive experiences across various applications, from gaming and entertainment to industrial work and healthcare.

VR headsets

VR creates an entirely simulated environment for users to interact with, isolated from the real world. Users wear VR headsets that track their head movements and render 3D graphics to their eyes, creating a sense of presence in the virtual world. VR has found use cases across gaming and entertainment, training and simulation, and design.

Mobile AR

Mobile AR leverages the capabilities of smartphones and tablets to deliver AR experiences. With the aid of built-in cameras and sensors, mobile devices can superimpose digital content onto the physical world as viewed through the device's screen. This form of AR has seen widespread adoption due to the ubiquity of smartphones and the ease of integrating AR features into mobile applications.

Note: While we have split VR and AR devices into two different categories, it's very likely that, as the technology sophisticates in upcoming years, we can see devices that combine these two modalities of immersion.

Understanding degrees of freedom (DOF) in AR and VR devices

Degrees of freedom (DOF) refers to the number of ways an object can move in three-dimensional space. In the context of AR and VR, DOF relates to how a device tracks a user's movements.

A device with 6 DOF can track both positional and rotational movements in three dimensions, along the X, Y, and Z axes. This ability to trace full movement and rotation leads to precise tracking and a highly immersive user experience, akin to natural movement in real life.

Conversely, a device with 3 DOF can track only rotational movement, simple head tilts and turns, along these axes, but not positional shifts. This limitation results in a less immersive experience, as the user's range of motion is restricted.

At nomtek, we consider devices with 6 DOF as true representatives of extended reality. The ability to fully interact with the user's movements is key to complete immersion, bridging the gap between the digital and physical worlds seamlessly. However, 6 DOF isn’t necessary in specific use cases — e.g., field service and maintenance — to provide additional context that helps professionals complete tasks.

Evaluating XR Hardware and Software

Selecting the right XR hardware and software is vital to ensure a successful implementation and to maximize return on investment. The following are key criteria to consider:

Interoperability — ecosystem

The ability of the XR device to integrate seamlessly with existing systems and software is crucial. If a project will be consumed by a large audience located in different operating systems, the chosen XR device should support a wide range of platforms, with SDKs, APIs included.

Interoperability is especially important in commercial XR applications that need large adoption across user bases and devices to succeed.

Battery life

The battery life of the XR device impacts its usability, especially for prolonged or field use. For time-demanding tasks, consider devices with robust battery life or those that support quick charging and hot-swappable batteries.

Connectivity

The device's ability to connect to high-speed networks such as WiFi 6 or utilize cloud rendering services can significantly enhance performance. This connectivity is essential for real-time rendering, multi-user experiences, and high-quality content.

Field of view (FOV)

A wider field of view can provide a more immersive and realistic experience, allowing for richer content display and interaction.

Movement during usage

Consider the user's movement requirements during usage. Devices with higher degrees of freedom and accurate motion tracking can provide a more natural and immersive experience.

For safety purposes, VR devices weren’t designed to let the user move around freely but rather stay within a set perimeter to avoid collisions with surrounding objects, alive or not.

Standalone vs. tethered

Tethered and standalone are two key categories of VR and AR devices. Tethered devices, like Varjo, offer highly immersive experiences as they are connected via cable to powerful computing units (e.g, a PC). But the cable connection can sometimes be restrictive (difficult for fitness applications).

Standalone devices are all-inclusive, housing the necessary CPU, GPU, and memory within the headset, providing users more freedom. In the past, these standalone headsets were limited by computing power, but with the emergence of devices Quest Pro, Quest 2, or HTC Vive XR Elite, they now offer high-quality, complex VR and AR experiences. Standalone devices can also be plugged into PCs.

Capabilities of sensors and scanners

A device's sensors and scanners can highly influence the richness of the experience. For example, built-in sensors and scanners let real and virtual objects interact. But not all headsets have inside-out tracking, and some require additional sensors in the room to track movement.

Lighting in the environment

The device's performance under different lighting conditions, both indoor and outdoor, is another crucial consideration. Some devices may require specific lighting conditions for optimal performance.

Indoor vs. outdoor usage

Depending on the intended use, the device's suitability for indoor or outdoor environments can be a key factor. Consider elements like sunlight readability, weather resistance, and spatial tracking capabilities.

Regulation (privacy, cameras)

XR devices use cameras and other sensors to scan their environments. In data sensitive industries, compliance with privacy regulations is crucial. Make sure how the device is processing data and security measures taken by the platform provider.

Comfort during long wear

Comfort is crucial, especially for applications requiring prolonged use. Factors such as weight, balance, padding, and adjustability can significantly affect user comfort. Some devices can also get pretty warm during operation.

Glasses wearers considerations

Ensure the device is comfortable and functional for users who wear glasses. Some devices offer prescription lens inserts or adjustments to accommodate glasses. There's also interpupillary distance (IPD) adjustment, which aligns the lenses with the user's pupils, thus ensuring optimal visual clarity and reducing eye strain — this can be automatic or manual.

Hygiene considerations

For shared devices, hygiene is a critical consideration. For example, during events where you showcase your assets in XR, devices should be wiped after every user. In this case, a device with easy-to-clean surfaces or replaceable components would work best.

Interaction method: gestures vs. controller

For use cases where you need to use your hands to complete tasks outside of the XR experience (e.g., field service and maintenance), gesture-based control would make more sense. When you need precision to complete a task in the XR application (e.g., design), a controller might be a better option.

System on chip (SoC)

The device's processing power can significantly affect performance, especially for complex or high-resolution content. When rendering on a device, a powerful SoC enables better graphical quality due to its ability to process more data. This is especially relevant in 3D modeling where the amount of detail is directly related to the number of rendered triangles: a fundamental element of 3D models. The more triangles a device can render, the more detailed and closer to reality the 3D model becomes. In devices with less powerful SoCs, the triangle size has to be increased, resulting in less detailed graphics.

Thanks to more powerful SoCs, applications run on the headset can be more complex without losing smoothness, i.e., frames per second (FPS).

XR Use Cases in Different Industries

XR technology has grown beyond its initial roots in gaming and entertainment to permeate various industries. Its ability to create immersive and interactive experiences has found valuable applications in fields ranging from training and simulation to healthcare and wellbeing. This chapter will delve into the various use cases for XR in different industries and provide recommendations for appropriate hardware and software options.

Training and simulation

Immersive experiences delivered by XR technologies are optimizing the training and simulation landscape in diverse fields like defense, aviation, healthcare, and manufacturing. These technologies unlock the opportunity for learners to engage with lifelike scenarios, enhancing their comprehension and skill development while minimizing potential risks and training costs. In a study set in a medical context, four out of five people utilizing AR technology reported a boost in motivation to learn, while 93% indicated an improvement in spatial comprehension of the topics.

Recommended technology:
VR and AR

Recommended hardware:

- Varjo Aero and Varjo XR-3 are excellent choices for premium VR, offering high-quality experiences ideal for training and simulation.
- VR Valve Index and HTC Vive Pro 2 are also suitable for training applications.
- Pico 4 and Quest Pro offer portable, versatile VR experiences. Less demanding projects will still fare well with Quest 2.
- Lenovo ThinkReality A3 provides an AR alternative for training scenarios.

Successful implementation:

Lockheed Martin's XR Leap

Lockheed Martin, a leading aerospace manufacturer, uses Microsoft's HoloLens 2 to train its engineers and technicians. The company reported a significant reduction in training time and errors, contributing to increased productivity and quality of work. The AR headset allows trainees to view and interact with holographic representations of spacecraft, offering a hands-on learning experience without the high costs and risks associated with physical models.

Remote collaboration and telepresence

With the rise of remote work, XR technologies offer unique solutions for collaboration and communication. They can create shared virtual environments for team meetings or provide a telepresence for remote assistance. Whether it's a global team meeting or a design brainstorming session, XR technology fosters a sense of unity and shared purpose, making remote work more interactive and immersive.

Recommended technology:
AR and VR

Recommended hardware:

- Quest 2 and Quest Pro are strong choices for their portability and ease of use.
- HTC Vive XR Elite is another great option for enterprise-level collaboration.
- Pico 4 Enterprise can also be considered for remote collaboration scenarios.
- Vuzix Blade 2 and Vuzix M4000 are lightweight AR glasses that work for remote collaboration as well.

Successful implementation:

Remote collaboration in Spatial

- Spatial, a startup specializing in XR, uses AR for remote collaboration. With their platform, users wearing AR glasses can interact with 3D holographic avatars of their colleagues, regardless of their physical location. Spatial's solution has been adopted by companies like Mattel and Nestlé, facilitating efficient remote meetings and design sessions.

Design and prototyping

XR can significantly streamline the design and prototyping process. Designers can create and manipulate 3D models in a virtual environment, reducing the need for physical prototypes. XR technologies can speed up the design process and encourage immersive collaboration.

- Varjo Aero, Varjo XR-3, VR Valve Index, and HTC Vive Pro 2 can all be used effectively for design and prototyping due to their high-quality visual capabilities.

Successful implementation:
Design and Prototyping in XR: Ford

Ford Motor Company uses VR technology for vehicle design and prototyping. Designers use HTC's Vive headsets to visualize and interact with car models in a virtual environment, allowing for rapid iterations and real-time collaboration. This has led to a significant decrease in development time and costs, as well as an improvement in the quality of designs.

Retail and marketing

In retail and marketing, XR creates immersive shopping experiences and enables virtual product demonstrations. Brands can use XR to engage customers in innovative ways, leading to increased sales and brand loyalty.

Recommended technology:
AR and mobile AR

Recommended hardware:

- Nreal Air and Nreal Light are lightweight and consumer-friendly AR glasses that can be leveraged in retail and marketing scenarios for enhanced customer experiences.
- Mobile AR is also an excellent way to bring the merchandise closer to the consumer for product visualization.

Note: Mobile AR solutions are often preferred in retail and marketing due to their broad accessibility. AR advertising significantly enhances the traditional advertising experience, reaching a growing number of products of different sizes and kinds.

Successful implementation:

RefinedAR

RefinedAR enhances customers' shopping experiences. Through the RefinedAR mobile app, customers can visualize furniture in their homes using AR, helping them make informed purchasing decisions.

Field service and maintenance

XR can guide technicians through complex repair procedures or allow remote experts to assist on-site personnel. XR technologies give field workers real-time information and guidance, reducing downtime and errors.

Recommended technology: AR headsets and glasses

Recommended hardware:

- HoloLens 2 with its robust Microsoft integration, is a valuable tool for field service scenarios.
- Vuzix Blade 2, and Vuzix M4000 are rugged, light, and industry-utilized choices for field services.

Note: Consider device ruggedness as well as AR capabilities for field service and maintenance.

Successful implementation:

Shell has been pioneering the use of assisted reality technology in its global oil and gas operations, facilitating remote assistance for frontline workers and thereby reducing unplanned downtime. RealWear assisted reality devices, now deployed in 12 countries, allow field service personnel to connect with off-site experts for real-time troubleshooting.

This is becoming increasingly crucial as the industry's assets age and the number of specialized technicians decreases. The technology not only enhances efficiency and safety but also helps to preserve valuable expert knowledge within the industry. Remote assistance through assisted reality reduces the need for travel, contributing to cost savings and helping companies meet their environmental commitments.

Healthcare

XR technologies can support various healthcare applications, such as surgical planning, patient education, and rehabilitation.

Recommended technology:
AR headsets

Recommended hardware:

- Magic Leap 2 is a high-end AR device with a 60601 certification for use in operating rooms, making it suitable for various healthcare applications. Magic Leap 2 also has certification for use in operating rooms.
- HoloLens 2 will also support surgeons and doctors due to its advanced AR capabilities and the technology’s maturity.

Successful implementation:
AR in Orthopedic Surgery

Dr. Marc Rothermich at Andrew Sports Medicine made history by being the first to use Microsoft's HoloLens 2 headset during a sports medicine surgery. HoloLens 2 lets the surgeon visualize patient MRIs in 3D and access patient data in real time, reducing the need for distractions during surgery. The device's built-in microphone and camera facilitate remote training, enabling other surgeons to observe and assist in real time, enhancing the educational process.

Fitness

XR technologies can make fitness routines more engaging and fun by incorporating game elements and providing real-time feedback. VR enabled fitness apps and games can help users stay active.

Recommended technology: **VR**

Recommended hardware:

- Quest 2, Quest Pro, and HTC Vive XR Elite can be used in fitness scenarios for an immersive and interactive workout experience.

Note: When choosing a VR device for fitness applications, pick standalone options that don't restrict movement and have sufficient computing power.

Successful implementation: Physical Therapy in Virtual Reality

A study done at the Department of Orthopaedics in Dartmouth-Hitchcock Medical Center evaluated VR in physical therapy to improve fitness. The researchers found an overall positive reaction toward the use of virtual reality in physical therapy, noting that the program could offer benefits to patients and healthcare professionals. VR-assisted PT could enhance objective data gathering for monitoring compliance, tracking progress towards goals, and ensuring exercise safety. VR can potentially boost patient engagement and widen access to physical therapy services.

Entertainment and art

The entertainment and art sector has been at the forefront of XR adoption, providing immersive experiences in gaming, concerts, and museums.

Recommended technology:
AR and VR

Recommended hardware:

- Nreal Air and Nreal Light are consumer-friendly devices that can be used for entertainment and art applications.
- Quest 2t is ideal for VR entertainment due to its standalone, wireless design, immersive visuals, and expansive content library that caters to a wide range of interests.

Successful implementations:
Go Be _Yond: An Immersive XR Experience

Yond is an immersive installation that seamlessly blends augmented and virtual reality to create a truly unforgettable experience. Designed by a team of talented creatives, Yond was first presented during the Infinity Festival 2022. In April 2023, Yond was recognized as Interior Design's 2023 MAD Awards finalist.

Wellness

XR is increasingly used for mindfulness, relaxation, and mental health applications. XR technologies can support mental health by providing immersive and calming environments.

Recommended technology: **VR**

Recommended hardware:

- Quest 2, Quest Pro, and HTC Vive XR Elite all offer immersive experiences that can be leveraged for wellness applications.

Successful implementation:
Decreasing Anger and Depression with VR

A 2021 study investigated the effects of audio-only and virtual reality (VR) coupled with neurofeedback body scan meditation on the mood states of healthcare workers during the Covid-19 pandemic. Both methods significantly reduced negative moods such as anger, depression, and tension. However, the VR group showed an increase in happiness and calmness, and a decrease in confusion and fatigue, unlike the audio-only group. The findings suggest that while both delivery methods are effective in reducing negative mood states, VR meditation offers additional benefits in enhancing positive mood states, indicating its potential for broader application in healthcare settings.

Manufacturing

From assembly verification to real-time assistance, XR has many use cases in manufacturing. For example, companies use AR to check if the repair or assembly of the product is proceeding correctly. XR devices can help spot flaws in products on the assembly line. This visualization serves as a potent tool to identify defects or issues that could be overlooked in a traditional setup. AR can also improve warehouse operations. For example, it helps navigate workers in large spaces.

Recommended technology: AR headsets

Recommended hardware:

- HoloLens 2 offers extensive support to manufacturing operations, significantly enhancing production efficiency.
- Magic Leap 2 adds immense value to manufacturing processes by facilitating accurate product assembly and real-time error detection.

Wellness

XR is increasingly used for mindfulness, relaxation, and mental health applications. XR technologies can support mental health by providing immersive and calming environments.

Recommended technology: **VR**

Recommended hardware:

- Quest 2, Quest Pro, and HTC Vive XR Elite all offer immersive experiences that can be leveraged for wellness applications.

Successful implementation: Decreasing Anger and Depression with VR

A 2021 study investigated the effects of audio-only and virtual reality (VR) coupled with neurofeedback body scan meditation on the mood states of healthcare workers during the Covid-19 pandemic. Both methods significantly reduced negative moods such as anger, depression, and tension. However, the VR group showed an increase in happiness and calmness, and a decrease in confusion and fatigue, unlike the audio-only group. The findings suggest that while both delivery methods are effective in reducing negative mood states, VR meditation offers additional benefits in enhancing positive mood states, indicating its potential for broader application in healthcare settings.