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# Immersive Technologies in the Legal Industry

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## ABSTRACT

From virtual reality (VR) and augmented reality (AR) to mixed reality (MR) and extended reality (XR), immersive technologies are tools by which computer-aided stimuli create the immersive illusion of being somewhere else. They can be used in evidentiary proceedings to provide a reasonable representation of actions, locations, or specific scenarios. They are tools a law firm can use to assist their broader purpose of serving clients. They have the potential to completely transform how legal professionals manage cases. The immersive technologies are not only changing the way people interact with digital environments but also how legal professionals approach their work. The purpose of this paper is to explore the impact of immersive technologies on law practice.

***KEYWORDS:*** *virtual reality, VR, augmented reality, AR, mixed reality, MR, extended reality, XR, immersive technologies, legal industry, law*

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## 1. INTRODUCTION

The legal field is continually evolving, adapting to the changes brought about by technology. As courtroom technology evolves, legal professionals need tools that can keep up. In the ever-evolving landscape of technology, virtual reality (VR) stands as a pinnacle of innovation, propelling users into realms of immersive experiences previously confined to the realms of imagination. This digital marvel is a technology that immerses users in a computer-generated environment, allowing them to interact with it as if it were real. The burgeoning VR landscape necessitates a recalibration of legal frameworks to navigate the intricate intersection of law and technology. VR is reshaping the landscape of how we learn and interact [1]. Virtual reality immerses viewers in a virtual environment while augmented reality overlays digital visuals on real-world objects. They connect virtual and real worlds together using enhanced 3D visuals, simulation, etc., and offer an enriched user experience to the user.

The legal profession has historically been perceived as somewhat traditional, with a strong reliance on physical documents, courtrooms, and face-to-face interactions. It stands at the crossroads of tradition and innovation, where centuries-old principles of justice meet cutting-edge technology. VR represents the next frontier of technological innovation poised to reshape the legal industry. Virtual reality (VR) technology has emerged as a transformative force in various industries, offering immersive and interactive experiences that transport users into simulated environments. Companies increasingly recognize the power of immersive technologies to transform the business environment. Over the past few years, VR has been quietly making inroads into the legal field. The intersection of law and VR offers unique opportunities, especially for those who are tech-savvy and open to exploring non-traditional career paths. In the legal field, the applications of virtual reality have been gaining momentum, particularly in the realm of legal demonstrations.

## WHAT ARE IMMERSIVE TECHNOLOGIES?

The first step in understanding how to use immersive technologies is to learn the differences between its various forms. In their simplest form, immersive technologies consist in adding virtual objects to the real world. There are four types of digital realities

leading to different types of immersive technologies [2,3]:

- *Augmented reality* (AR)- designed to add digital elements over real-world views with limited interaction.
- *Virtual reality* (VR)- immersive experiences helping to isolate users from the real world, usually via a headset device and headphones designed for such activities.
- *Mixed reality* (MR)- combining AR and VR elements so that digital objects can interact with the real world means businesses can design elements anchored within a real environment.
- *Extended reality* (XR)- covering all types of technologies that enhance our senses, including the three types previously mentioned.

These devices also enable new user interactions including spatially tracked 3D controllers, voice inputs, gaze tracking, and hand gesture controls.

Extended reality (XR) is the overarching term used to describe employing technology to blend real life and the digital world. It includes all the machine-human interfaces beyond the physical realm (reality) such as augmented reality (AR), mixed reality (MR), assisted reality (aR), and virtual reality (VR), as illustrated in Figure 1 [4]. Figure 2 shows the XR spectrum [5]. Immersive technologies reside along a continuous scale ranging between the completely real and the completely virtual world. At one end, the real environment refers to the actual physical space, objects, and people that exist in the tangible world around us. At the other end, the virtual environment represents a completely computer-generated and immersive digital space, distinct from the physical reality. The space in the middle is called mixed reality, which is a blend of the real and virtual environments, where digital and physical elements coexist and interact in real time. A range of devices makes up XR, and these are used by consumers and in many industries for entertainment, safety, training, or productivity purposes.

1. *VIRTUAL REALITY:* Virtual reality (VR) is XR at its most extreme. It completely immerses the user in a digital world, often using a computer-generated environment with scenes and objects that appear to be real. The term "virtual reality" essentially means "near-reality." Virtual reality is the key technology for experiencing sensations of sight, hearing, and touch of the past, present, and future. VR is a fully immersive technology where users wear a head-mounted display and experience a simulated world of imagery and sounds. VR enables active learning. The terms, "virtual reality" and "cyberspace" are often used interchangeably. A cyberspace may be regarded as a networked virtual reality. A person using virtual reality can look around an artificial world, move around it, and interact with virtual features or items. This effect is commonly created by virtual reality headsets. Head-mounted displays immerse the user in a virtual environment. Virtual reality is a simulated experience that can be similar to or different from the real world. It is a computer-generated, 3D environment that completely immerses the senses of sight, sound, and touch. The complete immersion of the senses overwhelms users engrossing them in the action. Virtual reality technology includes multiple components divided into two main groups: hardware and software components [6].

   - *Hardware Components:* The hardware components include a computer workstation, sensory displays, a tracking system, wearable devices, and input devices. Sensory displays are used to display the simulated virtual worlds to the user. The most common type is the head-mounted displays (HMDs), which is used in combination with tracking systems. Head-mounted displays are shown in Figure 3 [7]. Users interact with the simulated environment through some wearable devices. VR depends on special responses such as raising hands, turning the head, or swinging the body. A wearable device is important in making these effects realistic. Special input devices are required to interact with the virtual world. These include the 3D mouse, the wired glove, motion controllers, and optical tracking sensors. These devices are used to stimulate our senses together to create the illusion of reality.
   - *Software Components:* Besides the hardware, the underlying software plays an important role. It is responsible for the managing of I/O devices and time-critical applications. The software components are 3D modeling software, 2D graphics software, digital sound editing software, and VR simulation software. VR technology has been designed to ensure visual comfort and ergonomic usage.

2. *AUGMENTED REALITY:* Augmented reality (AR) is a technology that combines real-world environments with computer-generated generated information such as images, text, videos, animations, and sound. It can record and analyze the environment in real-time. In augmented reality, the user typically experiences the real world through a device such as a smartphone,

tablet, smart glasses, or head-mounted display. For example, AR allows consumers to visualize a product in more detail before they purchase it. This feature enhances consumer interaction and helps them never to repurchase the wrong item. The key objective of AR is to bring computer-generated objects into the real world and allows the user only to see them. In other words, we use AR to track the position and orientation of the user's head to enhance/augment their perception of the world. Augmented reality falls into two categories: 2D information overlays and 3D presentations, like those used with games. AR blends the virtual and real worlds by overlaying digital objects and information onto the users' view of the physical world.

To obtain a sufficiently accurate representation of reality, AR needs the following five components [8]:

- *Sensors:* AR needs suitable sensors in the environment and possibly on a user, including fine-grained geolocation and image recognition. These are activating elements that trigger the display of virtual information.
- *Image augmentation:* This requires techniques such as image processing and face recognition.
- *Head-mounted Display*: HMDs are used to view the augmented world where the virtual computer-generated information is properly aligned with the real world. Display technologies are of two types: video display and optical see-through display.
- *User Interface:* This includes technologies for input modalities that include gaze tracking, touch, and gesture. AR is a user interface technology in which a camera-recorded view of the real world is augmented with computer-generated content such as graphics, animations, and 2D or 3D models.
- *Information infrastructure:* AR requires significant computing and communications infrastructure undergirding all these technologies. The infrastructure determines what real-world components to augment, with what, and when.

3. *MIXED REALITY:* Mixed reality (MR) is a term used to describe the merging of a real-world environment and a computer-generated one. Physical and virtual objects may co-exist in mixed reality environments and interact in real time. This is an extension of AR that allows real and virtual elements to interact in an environment. MR liberates us from screen-bound experiences by offering instinctual interactions with data in our living spaces and with our friends. Online explorers, in hundreds of millions around the world, have experienced mixed reality through their handheld devices. Mixed reality is a blend of physical and digital worlds, unlocking natural and intuitive 3D human, computer, and environmental interactions, as shown in Figure 4 [9]. This new reality is based on advancements in computer vision, graphical processing, display technologies, input systems, and cloud computing. Mixed reality has been used in applications across fields including design, education, entertainment, military training, healthcare, product content management, and human-in-the-loop operation of robots [10].
4. *ASSISTED REALITY:* Like mixed reality, assisted reality (aR) is an extension of augmented reality, with a few notable differences to both. One of these differences is that aR is primarily hands-free through the wearing of a headset, whereas AR usually requires the holding of a device such as a mobile phone. While MR is a digital-first, real-world second reality, aR is a real-world first system. It combines software and a head-mounted display. It is best experienced using smart glasses or other wearable technology. The aR market is growing rapidly and promises to be the next great leap to boost workers' productivity. A worker wearing an aR device is shown in Figure 5 [11].
5. *EXTENDED REALITY:* The term "extended reality" (XR) has recently gained favor as an umbrella term that encompasses all of AR, VR, and MR. The primary user inputs for XR devices are described as follows. Voice interfaces are now ubiquitous thanks to mobile devices and standalone smart speakers. Apple's Siri, Amazon's Alexa, Google's Assistant, and Microsoft's Cortana are all voice-driven software interfaces that are continuously gaining new capabilities. Many XR devices enable user control with handheld controllers, which have capabilities beyond button press inputs. Both voice-driven interfaces and human-computer interactions have been developed specifically for XR devices, including gaze and gesture controls [12]. Figure 6 compares conventional computing with extended reality [12].

## IMMERSIVE TECHNOLOGIES IN LEGAL FIELD

Virtual reality (VR) is rapidly changing the way we perceive and interact with the world around us. Initially developed for gaming and entertainment, VR technology has found its way into various industries, including healthcare, education, and even law. VR provides a level of immersion and detail that traditional methods cannot match. Judges, juries, and legal professionals can gain a deeper understanding of

complex cases by experiencing the events in a more realistic and interactive manner. As the courtroom is getting technologically advanced, VR will be able to revolutionize legal proceedings, from evidence presentation to personnel training. VR is swiftly reshaping how legal cases are tried in court. Figure 7 shows the use of VR in the courtroom [13], while Figure 8 shows some lawyers using VR [14]. Beyond the courtroom, VR serves as a valuable training tool for legal personnel.

Immersive technology refers to any technology that blurs the line between the physical and digital worlds, creating a sense of presence and engagement for the user. Immersive technologies are at the forefront of innovation in the consumer technology and life sciences industries. Immersive environments increase efficiency in industry by allowing more thorough and accurate interrogation of an object or environment in real-time. The impact of VR is increasingly felt across a range of industries, and the legal sector is also one of them. As the courtroom is getting technologically advanced, VR will be able to revolutionize legal proceedings, from evidence presentation to personnel training [15].

## APPLICATIONS OF IMMERSIVE TECHNOLOGIES IN LAW

The potential applications of immersive technology are vast and diverse. Initially, VR was primarily used for training purposes, such as creating immersive courtroom simulations for law students to practice their trial skills. As the technology has advanced and become more accessible, its applications in law have expanded to include litigation, mediation, client interactions, legal documentation, legal education, legal research, legal simulation, and client consultations. We now elaborate on specific applications of immersive technology in the law field [16,17]:

- *Legal Demonstrations:* Legal demonstrations are an integral part of the legal process. They involve presenting evidence, recreating scenarios, or providing visual aids to help judges, juries, and legal professionals better understand complex cases. Traditionally, these demonstrations relied on physical exhibits, photographs, diagrams, and witness testimonies. One of the most impactful applications of VR in legal demonstrations is crime scene reconstruction. VR technology can recreate the crime scene in a 3D virtual environment, enabling legal professionals, judges, and juries to walk through the scene as if they were physically present. In personal injury cases or disputes involving vehicular accidents, VR can be a game-changer. The integration of virtual reality into legal demonstrations offers a wide range of benefits, both for legal professionals and the justice system in general.
- *Property and Intellectual Property Disputes*: Virtual reality plays a pivotal role in property and intellectual property disputes. In cases involving real estate, VR can create immersive virtual tours of properties, allowing parties to examine every detail without the need for physical visits. For intellectual property disputes, VR can be used to showcase product designs, patents, trademarks, and copyrights in a visually engaging manner. Instead of relying solely on documents and legal arguments, VR allows stakeholders to experience the alleged infringement firsthand, leading to more compelling and persuasive presentations. Copyright issues loom large as VR content creation burgeons, raising questions about ownership and protection of intellectual property.
- *Witness Testimonies:* VR can enhance the way witness testimonies are presented and received in court. Traditional methods involve witnesses recounting events verbally or through written statements. However, human memory is fallible, and details can be overlooked or distorted over time. With VR, witnesses can provide their accounts in a more immersive and accurate manner. They can step into a virtual environment that replicates the scene of the event, helping them recall details more vividly.
- *Predictive Analytics:* This is another powerful tool that can be integrated into VR applications for legal demonstrations. By analyzing historical case data, predictive analytics can provide legal professionals with insights into potential outcomes and strategies. This can help attorneys make more informed decisions when presenting their cases and predicting how judges and juries might respond to different arguments. Predictive analytics and data analysis capabilities within VR environments will become increasingly sophisticated.
- *Legal Education:* Education is another area that stands to benefit greatly from immersive technologies. Colleges and universities are beginning to incorporate VR into legal studies, providing students with immersive learning experiences. This integration of VR in legal education is preparing future lawyers for the technological advancements they will encounter in their careers. Educators are using immersive technologies to enhance students' professional development. The use of VR in legal education will expand, providing law students with

immersive learning experiences. Virtual reality can be used to simulate courtrooms, trial proceedings, and legal scenarios, allowing students to practice and refine their skills in a realistic virtual environment. Law graduates have the opportunity to offer consultancy services to VR companies, addressing a range of legal challenges.

- *Litigation*: The use of VR technology in litigation is becoming increasingly prevalent, offering law graduates a unique specialization. By recreating crime scenes or accident sites in a virtual environment, attorneys can present evidence in a more immersive and comprehensible manner. This specialization requires not only a firm grasp of legal principles but also an adeptness in storytelling and technological skills to effectively convey complex scenarios in a VR setting. By using immersive technologies, lawyers can create immersive presentations that help the judge and jury understand complex scenarios and visualize evidence in a way that was never before possible.
- *Immersive Evidence Presentation:* One of the most promising applications of AR and VR in the legal sector is through augmented reality presentations. Traditionally, attorneys have relied on static exhibits, documents, and verbal descriptions to make their cases. For legal firms, integrating AR and VR into legal practices is set to transform how evidence is presented through augmented reality presentations, cases are prepared, and decisions are made. AR and VR allow for the creation of 3D models of crime scenes, accident reconstructions, and virtual walkthroughs. This immersive approach helps jurors and judges better understand the context and intricacies of a case. In some criminal trials, AR has been used to recreate crime scenes, allowing jurors to walk through the scene and examine evidence from multiple angles.
- *Legal Simulation:* This refers to the practice of replicating legal scenarios or situations for the purpose of education, training, or skill development. The primary goal of legal simulation is to provide law students and legal professionals with practical experience and a deeper understanding of the legal processes they will encounter in their careers. Educators have recognized the need for experiential learning, leading to the development of various legal simulation tools. These tools included moot court competitions, mock trial programs, and role-playing exercises, all designed to bridge the gap between theory and practice. Unlike traditional methods of legal simulation, which often rely on paper-based materials or computer simulations, VR offers a fully immersive and interactive experience. While creating physical simulations or conducting real trials can be costly and logistically challenging, VR offers a cost-effective and easily accessible alternative. A typical applications of VR in legal simulation is shown in Figure 9 [18].

**BENEFITS**

AR and VR have been the most promising technologies aimed at bringing tech-driven transformation to a variety of sectors. The combination offers various benefits and enables organizations to embark on the path of digitization. The legal sector is one of the many that can be greatly affected by the use of AR and VR. The application of VR in legal settings can revolutionize how evidence is presented, making it more accessible and understandable for juries and judges. Other benefits include the following [16,19]:

- *Enhanced Understanding:* VR provides a level of immersion and detail that traditional methods cannot match. Judges, juries, and legal professionals can gain a deeper understanding of complex cases by experiencing the events in a more realistic and interactive manner.
- *Time and Cost Savings:* VR can save both time and costs in the legal process. It eliminates the need for physical reconstructions, extensive travel, and the transportation of evidence. Virtual courtrooms and remote depositions save time and resources while maintaining the integrity of legal processes. Additionally, VR can expedite case preparation, as it enables legal professionals to access and review evidence more efficiently.
- *Persuasion:* The immersive nature of VR makes legal demonstrations more engaging and persuasive. When judges and juries are actively involved in the case through VR experiences, they are more likely to retain and appreciate the presented information. This can lead to more favorable outcomes for the parties involved.
- *Accessibility:* Immersive technologies are more accessible than ever. VR can make legal proceedings more accessible to individuals with disabilities. Virtual environments can be tailored to accommodate various accessibility needs, such as providing visual or auditory cues for those with hearing or visual impairments. This is a significant step towards a more equitable justice system.

- *Collaboration:* AR can enhance remote client meetings and create collaborative workspaces for legal teams. AR makes remote meetings more interactive and engaging, improving communication and understanding. It also allows legal teams to work together on case preparation from different locations, facilitating real-time collaboration and increasing overall efficiency.
- *Communication:* Many law firms have employed the use of AR and VR to improve client engagement and team communication. It is easier to communicate with your teams from the comfort of your home as a lawyer. Virtual reality facilitates better communication between legal professionals, witnesses, and clients. It allows for clearer presentations of evidence and arguments, reducing the risk of misinterpretation.

## CHALLENGES AND CONCERNS

Immersive technologies do not come without challenges. Although their integration into legal demonstrations offers numerous advantages, it presents certain challenges and concerns. Implementing VR and AR technology can be daunting, especially if you are not familiar with the latest trends and best practices. As technologies such as augmented reality presentations are increasingly implemented in legal situations, legal challenges will inevitably arise. As with all technology implementation, the challenge is using these tools to enhance existing processes. Other challenges include the following [16,20]:

- *Costs:* Cost is a major hurdle, with VR setups costing anywhere from several thousand dollars to hundreds of thousands of dollars, potentially limiting access for smaller courts and underfunded jurisdictions. Implementing VR technology can be expensive, especially for smaller law firms or courts with limited budgets. This includes the cost of VR headsets, software development, and ongoing maintenance. However, as VR technology becomes more widespread, costs are likely to decrease over time.
- *Training*: Legal professionals and judges may require training to effectively use VR technology in court. Familiarity with VR interfaces and tools is essential to ensure that the technology enhances rather than hinders the legal process. Training programs and resources will be necessary to bridge this knowledge gap.
- *Data Security and Privacy:* Privacy concerns take center stage in VR environments. With VR technologies collecting vast amounts of personal data, there is a heightened focus on privacy and security. Immersive technologies can collect and display real-time data, raising concerns about the privacy and security of this information. VR applications in legal demonstrations involve sensitive case-related data. Ensuring the security and privacy of this information is crucial. Legal organizations must implement robust data protection measures to safeguard against breaches or unauthorized access. Legal practitioners must navigate issues carefully to comply with privacy laws and regulations.
- *Ethical Concerns:* The use of VR in legal demonstrations raises ethical questions, such as the potential for manipulation or bias in virtual reconstructions. Could immersing judges in a virtual scene introduce emotional bias? How can we ensure these recreations are both accurate and fair? Legal professionals must adhere to ethical standards and guidelines to maintain the integrity of the justice system. As the use of VR in legal demonstrations grows, legal and ethical guidelines specific to this technology will continue to develop. Regulatory bodies and legal organizations will establish best practices to ensure the responsible and ethical use of VR in the courtroom.
- *Intellectual Property:* VR content creation presents a myriad of intellectual property (IP) challenges, necessitating vigilant attention from legal practitioners. Copyright issues loom large as VR content creation burgeons, raising questions about ownership and protection of intellectual property.
- *Regulatory Compliance:* As immersive technologies become more prominent, organizations and agencies are starting to focus on creating regulatory processes and guidance for these novel products. As immersive technology innovation continues to outpace development of existing regulatory frameworks, companies need to be diligent in their efforts to keep up with and predict best practices and regulatory questions. As VR becomes more integrated into legal education and practice, a regulatory framework is needed to ensure responsible use and adherence to ethical standards.

## CONCLUSION

Immersive technology has become a buzzword in recent years, promising to revolutionize various industries and transform the way we experience the world around us. Immersive technologies, including virtual reality, augmented reality, and mixed reality, are increasingly deployed within industrial applications and are transforming the landscape of

legal demonstrations. Clients, courts, businesses, opposing counsel, and the rest of the world are embracing both the benefits and the detriments of these technologies. To stay in business in the digital age, lawyers and law firms need to understand these tools because they can increase a firm's efficiency, productivity, and accuracy by orders of magnitude.

While immersive technologies in law practice are still evolving, their potential to revolutionize how lawyers interact with clients, collaborate globally, and offer more accessible legal services is significant [21]. As immersive technologies continue to advance, the legal community must adapt and embrace the opportunities that they present. The future of virtual reality in legal demonstrations is promising. Immersive technologies will become more accessible to law firms and courts of all sizes. More information on the integration of immersive technologies into the legal industry is available from the books in [22,23].

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**Figure 1 Extended reality (XR) includes AR,MR, and VR [4].**

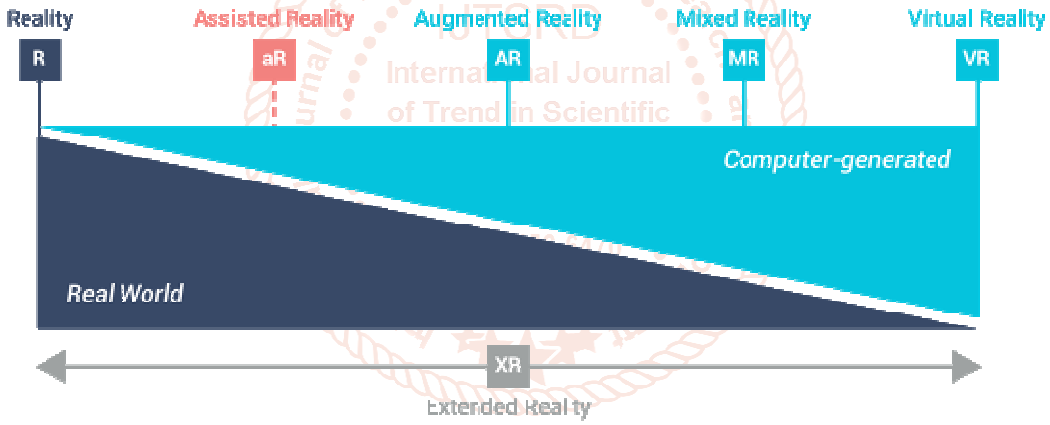


**Figure 2 The XR spectrum [5].**

**Figure 3 Head-mounted displays [7].**

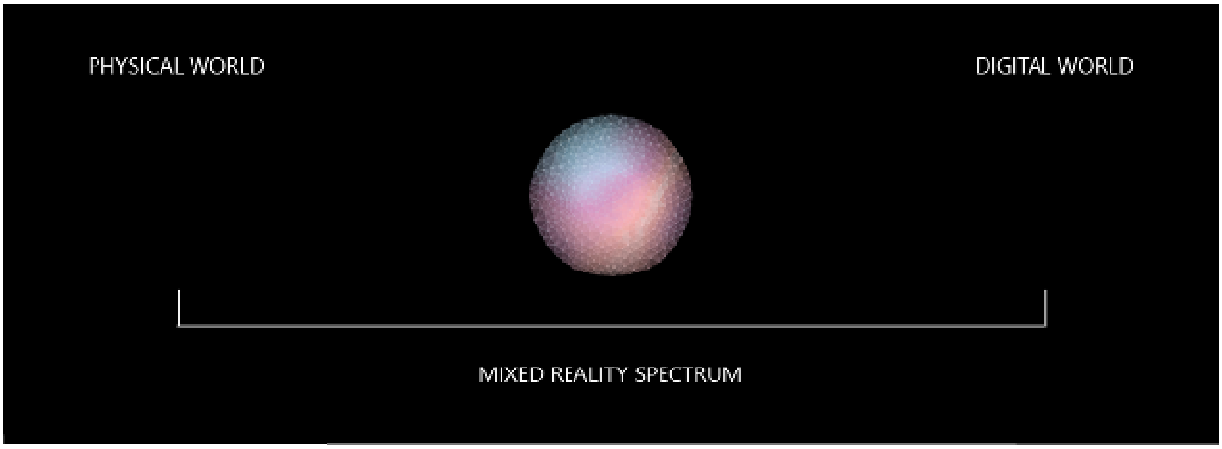


**Figure 4 Mixed reality is a blend of physical and digital worlds [9].**

**Figure 5 A worker wearing an assisted reality device [11].**

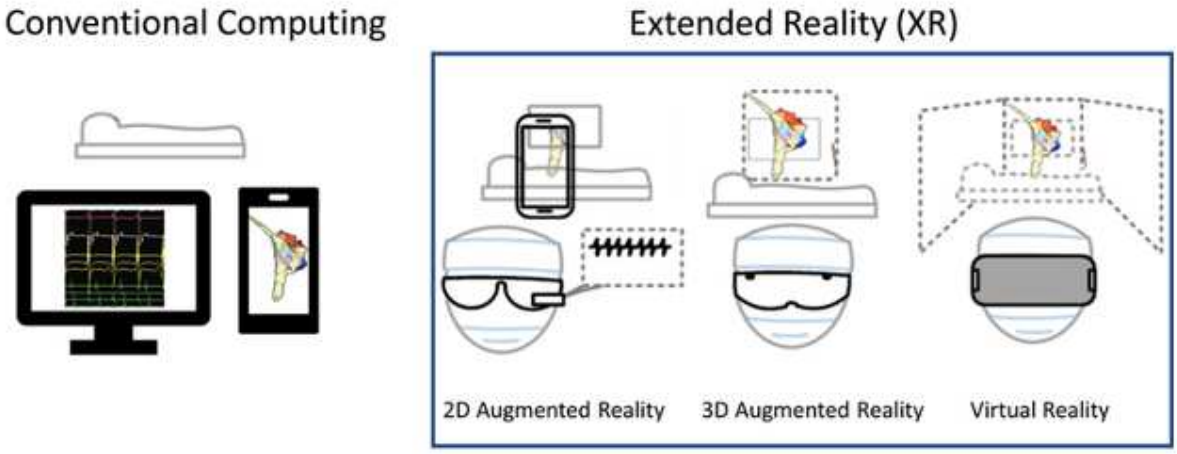


**Figure 6 Comparing conventional computing with extended reality [12].**

**Figure 7 Use of VR in the courtroom [13].**

**Figure 8 Some lawyers using VR [14].**

**Figure 9 A typical applications of VR in legal simulation [18].**