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PERSPECTIVE ARTICLE

Shared cinematic experience and emerging technologies: Integrating mixed-reality components for the future of cinema

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Abstract

The enduring appeal of traditional cinema viewing in the face of alternative experiences, including streaming services and emerging technologies, such as extended reality, is rooted in its esthetic, cultural, and social significance. While the psychological appeal of shared cinematic experiences has gained attention in scholarship, there is a need to further explore the potential enhancement of these experiences through the integration of immersive technologies. The communal nature of cinema fosters social connection, especially in a post-pandemic context marked by widespread social isolation. This study highlights the psychological benefits of shared cinematic experiences and emphasizes the next phase of cinematic evolution, which integrates mixed-reality components while retaining the traditional communal and focused viewing experience. By merging physical and virtual elements, mixed reality offers a unique avenue for exploring the intersection of technology and psychology in the context of cinema. In addition, this article addresses practical applications for filmmakers and industry professionals by outlining technical considerations for integrating mixed-reality elements throughout the filmmaking process, from production to distribution and viewing. The integration of mixed-reality components represents a significant step in the evolution of cinema, providing valuable insights into its potential implications for the research community and the film industry.

Keywords: Cinema; Mixed reality; 3D filmmaking; Immersion, Personalization***Corresponding author:**James Hutson
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1. Introduction

Despite the rise of streaming services and the impact of the global pandemic, traditional cinema viewing persists^[1]. Several factors contribute to this persistence, including the unique experience that cinema provides, the communal aspect of moviegoing, and the continued relevance of the big screen^[2]. To begin with, traditional feature-length film viewing in a movie theater offers an unparalleled and immersive experience that other forms of entertainment struggle to replicate. The large screen, immersive sound, and shared physical space coalesce into an experience that is difficult to recreate in a domestic setting^[3]. The scale and grandeur of the cineplex facilitate a more significant emotional impact, providing a more immersive experience that engages the senses and emotions in a manner unattainable with smaller screens^[4]. Furthermore, moviegoing constitutes a communal activity that fosters a sense of social connection and shared experience^[5]. Despite the required social distancing due to the COVID-19 global pandemic, individuals

continue to crave social experiences, with cinema-going fulfilling this need. The shared experience of watching a movie collectively engenders a sense of community and social bonding that individual viewing experiences at home cannot replicate^[6]. Finally, the aptly titled “big screen” remains relevant due to the unique and often exclusive content only available in cinemas^[7]. The content encompasses big-budget blockbusters, art-house films, and limited-release films that often remain inaccessible on streaming services. Thus, exclusive content presents a compelling rationale for movie-goers to frequent cinemas, notwithstanding the convenience afforded by streaming services^[8]. At the same time, there are also biological mechanisms that contribute to the cinema viewing experience of an audience.

The psychological appeal of a shared cinematic experience plays a crucial role in the future of cinema. Shared cinematic experiences offer unique opportunities for social and emotional connections, which have demonstrated significant psychological benefits^[9]. Research has revealed that watching a movie collectively can activate neural pathways associated with social bonding and reward processing^[10]. Specifically, oxytocin, a hormone correlated with social bonding and trust, has been found to increase during joint movie-watching experiences^[11]. The finding implies that shared cinematic experiences can foster social connectedness and strengthen relationships among individuals^[12]. Furthermore, these experiences can elicit a spectrum of emotions, including joy, laughter, and tears, which can yield significant psychological benefits^[13]. The emotional impact of a movie has been shown to enhance empathy, cultivate a sense of community, and stimulate personal growth^[14]. In addition, shared cinematic experiences provide opportunities for cultural and societal commentary, enabling viewers to engage meaningfully with complex social and political issues, thereby promoting critical thinking and fostering a sense of social responsibility, further amplifying the psychological benefits of cinema^[15].

At the same time, sociological considerations also contribute to the uniqueness of cinematic entertainment. One distinguishing characteristic is the communal nature of the moviegoing experience and the focused attention it demands from viewers, setting it apart from short-form entertainment like episodic television^[16]. The immersive quality of cinema, as opposed to the size of the field of view, plays a crucial role in capturing the attention of the audience^[17]. Furthermore, cinema brings people together in a shared space, fostering social connections and a sense of community – an increasingly vital aspect in an era marked by social isolation and loneliness^[18].

Simultaneously, cinema requires viewers to engage with the story and characters more profoundly than other forms of entertainment, as the visual and auditory elements create a unique and immersive experience that transports viewers into another world^[19]. The immersive nature of the experience is often viewed as superior to watching movies at home, as distractions in the home environment detract from the focused attention necessary for a genuinely immersive experience^[20].

Moreover, the content produced for theatrical experiences differs from that produced for television, primarily due to the assumption of distractions in the latter^[21]. Television episodes are designed with the understanding that viewers may not be fully focused, leading to redundant and easily followed storytelling^[22]. In contrast, cinema provides an immersive experience demanding the viewer’s full attention, with visual and auditory elements carefully crafted to create a sense of presence and transport the viewer to another world^[23]. The storytelling distinction between cinema and television is evident in the way movies and television shows are written and produced. Movies are typically written with a single, cohesive narrative that unfolds over the entire film, with pacing and structure designed to hold the viewer’s attention and create an emotional and immersive experience^[24]. Television shows, on the other hand, are produced in episodic format, with self-contained episodes designed to be easily followed, even if the viewer has missed previous episodes^[25]. While these differences are admittedly simplified, they provide a framing device to understand the development of the industry that continues to evolve due to audience expectations, post-pandemic attitudes, and emerging technologies.

Cinema, as a form of art and entertainment, has witnessed dramatic evolution over the past century. Technological advancements have altered film production, distribution, and consumption, with digital cinema representing one of the most transformative innovations. The transition from analog to digital has profoundly impacted the film industry, streamlining film production, and distribution processes^[26]. Digital technologies have also empowered filmmakers to create increasingly sophisticated and immersive experiences for audiences. Furthermore, on-demand streaming services, such as Netflix, Amazon Prime Video, and Disney+, have altered movie and television consumption patterns, enhancing convenience and accessibility^[27]. This change has led to a decline in traditional theatrical releases and the emergence of new distribution models. Virtual reality (VR) and augmented reality (AR) represent additional disruptive technologies with the potential to revolutionize

the cinematic experience^[28]. While VR technology offers immersive and interactive experiences, AR and mixed-reality (MR) technologies supplement the real world with an informational layer, redefining film experiences. These technologies promise to elevate audience interaction and engagement in cinema.

Therefore, this study aims to conduct an initial exploration of the themes surrounding the current state of cinema and its future direction. It examines the enduring appeal of cinema, the impact of emerging technologies, and the distinction between cinema and other forms of entertainment in terms of focus and distraction. The discussion delves into the potential to enhance the cinematic experience through personalization, the integration of virtual and physical elements, and real-time analysis of viewer reactions. Furthermore, it emphasizes the importance of retaining the communal and focused viewing experience as a distinguishing factor of cinema. The practical considerations for the integration of mixed-reality components in the next phase of cinematic evolution are also addressed, covering various aspects for filmmakers and theater design. By focusing on audience engagement, visual hierarchy, sound design, camera movement, lighting, audience comfort, screen size, and user interface, filmmakers can effectively utilize mixed-reality elements to enhance the overall cinematic experience. In addition, theater design plays a crucial role in accommodating mixed-reality experiences, encompassing screen size and shape, projection technology, sound systems, lighting systems, acoustics, seating, user interface, and connectivity. By addressing these factors, the film industry can successfully integrate mixed-reality experiences, elevating the traditional cinematic experience while preserving its communal and immersive nature.

2. Literature review

2.1. Evolution of cinema

The early 20th century saw rapid advancements in film technology, which facilitated the creation of more engaging and immersive cinematic experiences. Innovations in camera equipment, lighting, and editing techniques enabled filmmakers to produce films with more elaborate narratives, complex characters, and captivating visual effects^[29]. As a result, cinema evolved from a simple novelty into a powerful and influential medium of artistic expression and cultural commentary^[30]. At the same time, the period witnessed the rise of Hollywood and the studio system, which dominated the global film industry for several decades. The studio system brought with it a standardized mode of production, including the use of sound, color, and the adoption of a three-act narrative structure^[31]. In the

1950s and 60s, filmmakers began to challenge the norms of Hollywood with the emergence of the French New Wave and other international art cinemas^[32].

The current state of cinema is characterized by a diverse and global industry, with films being produced and distributed across various platforms and media^[33]. The rise of digital technologies has significantly impacted the industry, allowing for the creation of increasingly complex visual effects and the development of new distribution models, such as streaming services^[34]. As the latest generation of emerging technologies continues to develop, cinema has been the subject of much scholarly inquiry, with researchers exploring the implications of these innovations. One of the key arguments in the literature is that emerging technologies, such as extended realities, will revolutionize the way movies are produced and consumed. These technologies provide filmmakers with new tools to create more immersive and interactive experiences for audiences^[35].

For instance, while *The Mandalorian* primarily utilized virtual sets for production purposes, it is a notable example of how these technologies can enhance the filmmaking process. The light-emitting diode walls used in the production allowed for a more seamless integration of common gateway interface elements, creating a more engaging and immersive experience for viewers^[36]. However, it is essential to acknowledge that, in this instance, the audience's interaction with the product itself remains largely unchanged. Nonetheless, these emerging technologies have the potential to enable filmmakers to create entirely new worlds and experiences, blurring the lines between traditional cinema and video games. They suggest that as virtual and AR technologies become more sophisticated, they could transform the way audiences interact with and experience films, making them more active participants in the story rather than passive viewers.

On the other hand, the introduction of emerging technologies is also likely to contribute to the decline of traditional movie theaters. The convenience and affordability of streaming services and home entertainment systems have led to a decrease in movie theater attendance as many consumers turn to streaming services as an alternative. These platforms offer a more convenient and cost-effective way to access content, which has resulted in a decline in movie theater attendance and a corresponding increase in streaming service subscriptions^[37]. The rise of serialized content, such as Netflix's *Stranger Things* and *The Witcher*, is another significant trend in the literature regarding the impact of emerging technologies on cinema. The popularity of serialized content is likely to influence the future of movies and cinema. The emergence of binge-

watching and the increasing demand for long-form, serialized content that can be consumed over multiple episodes or seasons is a trend that will continue to shape the cinematic landscape^[38].

The pandemic and the emergence of Disney+ have accelerated these trends, moving the conversation from the future tense to the present. For instance, the Marvel Cinematic Universe and Star Wars properties are navigating the space between episodic and theatrical releases, with Disney+ serving as the platform for both serialized content and exclusive film premieres^[39]. As such, the increasing availability of movies on multiple platforms, such as online streaming services, DVD, and cable TV, is leading to a shift in the way movies are marketed and released. The rise of multiplatform distribution is transforming the way movies are marketed and released^[40]. One notable trend in this context is the move toward day-and-date releases, where movies are released in theaters and on home video platforms on the same day. This approach allows for more flexible and immediate access for audiences and is changing the way movies are marketed and distributed. As a result of these trends, the traditional movie theater experience is being challenged by the convenience and accessibility of home entertainment options^[41]. The industry is now tasked with finding ways to maintain the unique, immersive qualities of the cinema experience while adapting to the evolving landscape of content consumption. In this context, the integration of emerging technologies, such as virtual and AR, may offer opportunities to enhance the cinematic experience and maintain its relevance in an increasingly digital world^[42].

Furthermore, the impact of emerging technologies on cinema has been the subject of much scholarly inquiry, with several arguments and assertions posited regarding the implications of these technologies. One of the key arguments in the literature is that emerging technologies will result in a new form of cinema^[43-45]. These technologies will allow for new storytelling techniques, including interactive experiences and personalized narratives. The successes of interactive experiences, such as Netflix's *Black Mirror: Bandersnatch* (2018) and *Minecraft: Story Mode* (2018), demonstrate the potential for the creation of new forms of cinema that can leverage emerging technologies to create more immersive and engaging experiences for viewers^[46]. Another argument is that emerging technologies will lead to a democratization of movie production and distribution. The widespread availability and affordability of new technologies will empower more people to create and distribute their own movies, allowing for greater diversity in the types of content that are produced and available to audiences^[47]. User-generated

content platforms, such as YouTube and TikTok, have already changed the way movies are made and shared, providing a platform for creators to share their work with a global audience^[48].

Therefore, the rise of social virtual content is another significant trend in the literature regarding the impact of emerging technologies on cinema^[49]. The increasing popularity of extended reality (XR) technologies in social media will lead to a shift in the way movies are watched and experienced. The rise of virtual movie theaters, where audiences can watch movies together in a virtual environment, will create a more social and interactive experience for viewers, changing the way movies are consumed^[50]. In all, emerging technologies have the potential to reshape the cinematic landscape, providing new opportunities for filmmakers and audiences alike to engage with the art form in innovative and transformative ways.

2.2. The rise and fall of three-dimensional (3D) films

The popularity of 3D movies in the early 2000s was driven by the desire to provide moviegoers with more immersive and engaging experiences. Filmmakers and theater designers collaborated to create advanced technologies that enabled 3D content to be displayed on screens in a visually impressive and captivating way^[51]. However, 3D films experienced a decline in popularity following their initial success, due to considerations of cost, comfort, and overuse, as well as the potential for 3D films to make a comeback in the future. The cost of producing and distributing 3D films has been identified as a significant factor in their decline in popularity^[52]. The emergence of 3D cinema and its impact on film exhibitions demonstrated that the technology requires specialized equipment and technologies to display content in theaters, which adds to the overall cost of film production and distribution. For instance, in 2009, The Hollywood Reporter reported that it cost \$15,000 per screen to convert a traditional cinema into a 3D cinema. As a result, smaller films that could not afford the additional costs associated with 3D production and distribution were at a disadvantage in the marketplace. Comfort is another issue that has been cited as contributing to the decline of 3D films^[53]. Studies have shown that 3D glasses can be uncomfortable to wear for extended periods and that the 3D effects themselves may cause discomfort or motion sickness for some viewers^[54]. As a result, some moviegoers may have avoided 3D movies in favor of more traditional cinema experiences^[55].

Overuse of 3D effects has also been identified as a factor in the decline of 3D films. The novelty of 3D effects may have worn off with audiences due to overuse in some

films, detracting from the storytelling and overall quality of the moviegoing experience^[56]. It is essential to recognize that the effects alone cannot carry the weight of the movie, which should have a solid story. Some moviegoers may have become disenchanted with the gimmicky use of 3D effects and began to prefer more traditional cinema experiences^[57]. Despite these issues, some scholars remain optimistic about the potential for 3D films to make a comeback in the future^[58]. Advancements in technology and cinema experiences may enable filmmakers to create more sophisticated 3D content that avoids the issues that contributed to the decline of 3D films in the past. They argue that the advancements in 3D technology over the years have opened the door for a new era in the history of 3D cinema^[59,60].

Overall, past experience suggests that while 3D films may have fallen out of favor, they remain an area of interest for scholars and filmmakers alike. The decline in popularity of 3D films highlights the need for a more nuanced approach to 3D cinema that addresses issues related to cost, comfort, and overuse while embracing the potential of advancements in technology and cinema experiences^[61]. With this in mind, 3D cinema has the potential to evolve and continue to provide audiences with unique and engaging moviegoing experiences in the future. Such considerations need to be foregrounded when making recommendations and prognosticating the future of immersive cinematic experiences. Regardless, the popularity of 3D movies such as *Avatar* (2009) was driven by a desire to create more immersive and engaging cinema experiences for audiences^[62]. The filmmakers and theater designers worked together to create technologies that allowed for 3D content to be displayed on screens in a way that was visually impressive and engaging. This was the first time in cinema history that audiences were able to experience a heightened sense of realism and feel as though they were part of the action.

However, 3D films fell out of favor in the years following their initial popularity due to several factors, including cost, comfort, and overuse issues^[58]. These challenges paved the way for emerging technologies such as XR, to take over as the new means for immersive experiences. The introduction of these immersive technologies has led to the growth and expansion of the cinema industry. Emerging technologies such as VR and AR have increased the audience's experience and provided new opportunities for filmmakers^[45]. The arrival of XR technologies has changed the way in which filmmakers engage with audiences and provided new opportunities for filmmakers to reach larger audiences and grow the industry. Examples can be found in the success of VR experiences such as *The Martian VR Experience* (2016) and *The Walk VR Experience* (2017).

The adoption of XR technologies has allowed for more immersive and interactive storytelling that goes beyond what was possible with 3D movies. These technologies enable the audience to be fully immersed in the story, allowing them to interact with the environment and characters in ways that were never before possible^[63]. One important observation is that head-mounted displays are designed with a 3D and/or interactive experience in mind, whereas theatrical glasses were just a way of adapting old technology and could never be optimized. The headset-wearer enters into the experience with a different set of expectations, which not only enhances the audience's experience but also provides new opportunities for filmmakers to tell stories and engage with their audiences in innovative ways^[64]. Therefore, the popularity of 3D movies in the early 2000s naturally paved the way for the adoption of XR technologies, which have expanded the cinema industry and allowed for more immersive and interactive storytelling. With continued advancements in technology, it is possible that the future of cinema will be even more immersive and interactive, providing audiences with unforgettable experiences. Thus, the evolution from 3D filmmaking to the impact of XR on immersive experiences reflects the industry's continuous pursuit of more engaging and innovative ways to captivate audiences and elevate the art of storytelling.

3. Recommendations

3.1. Impact of emerging technology on cinema

Recent technological advancements in MR, social virtual content, multiplatform distribution, and consumable serialized content have been driving the evolution of cinema and movies. While streaming services and other digital platforms have disrupted the traditional theater experience, the communal setting of watching a film on the big screen still holds a unique appeal^[65]. With the integration of MR technology, movie theaters can offer an even more immersive experience by blending physical and digital elements. For instance, viewers can feel like they are physically present in the world of the movie through a virtual environment that complements the film being shown or creates interactive experiences that enable viewers to influence the narrative in real time^[66]. At the same time, haptics or touch-based feedback is another technology that has the potential to enhance the movie-watching experience in a theater. By incorporating haptic feedback into the seating or wearable devices, theaters can offer a more tactile and sensory experience to viewers^[67]. For instance, viewers can feel vibrations during an action sequence or changes in temperature during a scene set in a cold environment.

To create a compelling movie-watching experience, presence and immersion are key factors. Through XR technologies, movie theaters can provide viewers with a greater sense of presence within the story world by enabling them to move through a 3D environment or using spatial audio to create a more realistic soundscape. However, it is important to note that these technologies come with potential drawbacks and limitations. Not all viewers may want or be able to use MR or haptic feedback, and theaters need to ensure that these technologies are accessible and inclusive for all^[68]. In addition, theaters may face challenges in integrating these technologies into their existing infrastructure and business models^[69]. Hence, accessibility is a crucial consideration for the successful adoption of emerging technologies in cinema.

3.2. Accessibility

As we consider the potential of MR and haptics to enhance the movie-watching experience, the consideration of the accessibility of these technologies and potential solutions for audiences who may face barriers to their use and the following recommendations made is crucial (Table 1). For MR, one potential solution is to offer multiple options for viewers, allowing them to choose whether or not to use the technology. For example, a theater could have a section of the theater with MR headsets available for those who want to use them, while also offering traditional seating options for those who do not. In addition, theaters could offer training or instructional sessions for viewers who are not familiar with the technology, to help them get the most out of the experience^[70]. Haptics may pose more of a challenge

in terms of accessibility, as some viewers may have physical limitations or disabilities that prevent them from using touch-based feedback^[71]. However, theaters could explore other sensory experiences that could be more inclusive, such as incorporating scents or using light and color to create a more immersive environment.

Another important consideration for both MR and haptics is cost. These technologies can be expensive to implement, and theaters may need to find creative solutions to make them accessible to a wider range of viewers^[72]. For example, theaters could offer discounts or promotions for those who choose to use the technology, or partner with technology companies to offset some of the costs. Overall, it will be important for theaters and filmmakers to be mindful of the potential barriers to using these technologies and to work to create inclusive and accessible movie-watching experiences for all audiences. By offering a range of options and working to make the technology more affordable, theaters can ensure that these new forms of storytelling are available to as many people as possible.

3.3. Artificial intelligence-supported MR

MR cinematic experiences blend virtual and physical elements to create an immersive experience for the audience^[73]. With the help of generative artificial intelligence (AI), these experiences can be personalized and tailored to the viewer’s preferences. AI can analyze data on past movie-watching history, genre preferences, and demographic data to customize the experience, including sound and lighting effects, immersive virtual environments, and interactive elements that engage the

Table 1. Accessibility recommendations for the integration of MR and haptics in cinema

Offer multiple viewing options	Theaters should provide a range of viewing options that cater to different preferences and abilities. This could include having a designated section of the theater with MR headsets for those who want to use them, and traditional seating options for those who prefer a standard viewing experience.
Provide training and instruction	To ensure that viewers are able to fully engage with new technologies, theaters should offer training or instructional sessions for those who may be unfamiliar with the technology. This will help audiences maximize their experience and feel more comfortable using advanced devices.
Explore alternative sensory experiences	For viewers with physical limitations or disabilities, haptic technology may not be suitable. Theaters should consider incorporating other sensory experiences, such as scents, light, and color, to create a more immersive and inclusive environment.
Consider cost and affordability	The expense of implementing advanced technologies such as MR and haptics can be a barrier for some viewers. To make these experiences more accessible, theaters could offer discounts or promotions, or partner with technology companies to help offset costs.
Collaborate with accessibility experts	Filmmakers and theater owners should collaborate with accessibility experts to ensure that new technologies are designed and implemented in a way that considers the diverse needs of their audience. This collaboration will help identify potential barriers and develop innovative solutions to create a more inclusive movie-watching experience.
Prioritize universal design	Emphasizing universal design principles in the development of new technologies will ensure that they are accessible and usable by the widest possible range of people. Filmmakers and theater owners should work together to create experiences that are adaptable and flexible, meeting the needs of diverse audiences.

Abbreviation: MR: Mixed reality

viewer in the story^[74]. AI can also assist with the integration of virtual and physical elements. For instance, AI can use sensors and cameras to track the movements of viewers in the theater, adjusting the virtual elements to match the real-world environment^[75]. In Addition, AI-powered tools such as generative adversarial networks can create realistic 3D models of virtual environments that can be combined with real-world elements to create a seamless mixed-reality experience^[76]. One of the ways AI can further enhance mixed-reality cinematic experiences is by analyzing viewer reactions in real-time. AI can track facial expressions and body language to determine how viewers are responding to the movie and adjust the experience accordingly to enhance engagement and emotional impact^[77]. Moreover, site-specific VR is also making its way into cinema, offering a unique and personalized experience for viewers^[78]. LBE pioneers such as *The VOID* (2018), *Miniatur Wunderland Hamburg* (2019), and *TimeRide* (2019) have already created VR experiences that allow viewers to explore virtual environments and interact with their surroundings.

3.3.1. MR for filmmaking

Incorporating MR into the filmmaking process requires careful consideration of the standard dimensions of a movie theater. The distance between the viewer and the screen plays a crucial role in determining the level of immersion and field of view of the MR experience. To optimize immersion, filmmakers should aim to match the distance between the viewer and the screen to the

resolution and field of view of the virtual environment^[79]. However, the standard dimensions of a movie theater also present opportunities for enhancing the MR experience. With the use of AR and VR technologies, additional surfaces and areas in the theater can be utilized to expand the immersive experience for the audience. By projecting virtual environments or objects on the ceiling and walls of the theater, a truly immersive and interactive mixed-reality experience can be created^[80].

In addition, the communal aspect of cinema-going can be leveraged to enhance the shared psychological experience of the audience. AI-powered tools can analyze real-time data on viewer reactions and adjust the immersive elements of the MR experience to match the audience’s emotional state. This personalized and engaging experience can create a more communal and social aspect of cinema-going, further enhancing the mixed-reality experience. Filmmakers must take into account both the standard dimensions of a movie theater and the potential for expanded surfaces to create the optimal mixed-reality experience.

In light of these emerging technologies and their potential impact on cinema and movie-going, it is important for filmmakers to consider how they can take advantage of these technologies to create more immersive and engaging storytelling experiences. In the following section, we will provide some recommendations for filmmakers looking to incorporate MR, haptic feedback, AI, and other technologies into their filmmaking process (Table 2).

Table 2. MR considerations for filmmakers

Audience engagement	Filmmakers must consider how the mixed-reality experience will engage the audience. They should focus on how to use the technology to enhance the story and create a more immersive experience that will captivate viewers.
Visual hierarchy	Filmmakers must also consider how the mixed-reality experience will affect the visual hierarchy of the film. In traditional films, the director has complete control over what the viewer sees and when. In mixed-reality experiences, the viewer has more control over what they see and when. This can be a challenge for filmmakers, as they must ensure that the important story elements are still communicated effectively.
Sound design	Sound design is an important consideration in mixed-reality experiences. Filmmakers must ensure that the sound design is appropriate for the mixed-reality experience and that it enhances the overall immersion of the viewer.
Camera movement	Camera movement can also affect the mixed-reality experience. Filmmakers must ensure that the camera movements are smooth and do not cause any discomfort or motion sickness for the viewer.
Lighting	Lighting is also an important consideration in mixed-reality experiences. Filmmakers must ensure that the lighting is appropriate for the mixed-reality experience and that it enhances the overall immersion of the viewer.
Audience comfort	Filmmakers must ensure that the mixed-reality experience is comfortable for the audience. They should avoid using technology that causes discomfort, such as motion sickness or eye strain.
Screen size	The size of the screen used in the mixed-reality experience can affect the overall immersion of the viewer. Filmmakers must ensure that the screen size is appropriate for the mixed-reality experience and that it enhances the overall immersion of the viewer.
User interface	Finally, filmmakers must consider the user interface for the mixed-reality experience. They should ensure that the interface is intuitive and easy to use so that viewers can fully engage with the experience.

Abbreviation: MR: Mixed reality

Table 3. MR considerations for theater design

Screen size and shape	In stadium theaters, the screen size and shape should be designed to enhance the mixed-reality experience. The screen should be large enough to provide an immersive experience and should have the appropriate aspect ratio to accommodate the mixed-reality content.
Projection technology	The projection technology used in stadium theaters should be carefully selected to ensure that it is capable of displaying mixed-reality content. This may require using specialized projectors that are capable of displaying higher resolutions and frame rates than traditional cinema projectors.
Sound system	The sound system in stadium theaters should be designed to provide an immersive audio experience that complements the mixed-reality content. This may require using advanced audio processing techniques, such as spatial audio, to create a more realistic and engaging audio experience.
Lighting system	The lighting system in stadium theaters should be designed to enhance the mixed-reality experience without distracting the audience. This may require using lighting techniques that are designed to work with mixed-reality content, such as dynamic lighting that changes based on the content being displayed.
Acoustics	The acoustics of stadium theaters should be carefully designed to provide a clear and immersive audio experience. This may require using specialized acoustic treatments to minimize echo and improve sound clarity.
Seating	The seating in stadium theaters should be designed to provide a comfortable and immersive experience for the audience. This may require using specialized seating that is designed to work with mixed-reality content, such as seats that can move or vibrate in response to the content being displayed.
User interface	The user interface for stadium theaters should be carefully designed to ensure that it is intuitive and easy to use for the audience. This may require using specialized interfaces, such as touch screens or gesture-based interfaces that are designed to work with mixed-reality content.
Connectivity	Finally, stadium theaters should be designed to provide high-speed connectivity to ensure that the mixed-reality content can be streamed seamlessly. This may require using advanced networking technologies, such as fiber optic cables, to ensure that the content is delivered to the theater in real time.

Abbreviation: MR: Mixed reality

In summary, for filmmakers to create a successful mixed-reality experience, they must consider audience engagement, visual hierarchy, sound design, camera movement, lighting, audience comfort, screen size, and user interface. Filmmakers must focus on how to use technology to enhance the story and create a more immersive experience that will captivate viewers. They must also ensure that the important story elements are communicated effectively and that the mixed-reality experience is comfortable and intuitive for the audience. The sound design, camera movement, lighting, and screen size should all be appropriate and enhance the overall immersion of the viewer. At the same time, to ensure that filmmakers can create successful mixed-reality experiences, it is important to consider how the technology will impact theater design. The following section will explore some of the key considerations for mixed-reality theater design to optimize the experience for both filmmakers and audiences (Table 3).

When designing stadium theaters for MR experiences, several factors must be taken into account to ensure an immersive and engaging experience for the audience. The screen size and shape should be carefully chosen to accommodate the mixed-reality content, while the projection technology should be capable of displaying higher resolutions and frame rates. The sound system should provide an immersive audio experience, and the

lighting system should be designed to complement the mixed-reality content. Acoustics should be optimized, and seating should be comfortable and designed to work with mixed-reality content. In addition, the user interface should be intuitive and easy to use, and high-speed connectivity must be available to stream content seamlessly.

4. Conclusions

The evolution of cinema and movies has been driven by technological advancements, particularly in the areas of MR, haptics, and other forms of immersive storytelling. While streaming services and other digital platforms have disrupted the traditional theater experience in recent years, the future of movie theaters is an interesting topic to consider, especially in light of these technological advancements. The potential of mixed-reality experiences in movie theaters is vast and can revolutionize the movie-watching experience. The standard dimensions of a movie theater present both challenges and opportunities for filmmakers and theater designers to optimize the mixed-reality experience. Further, research is required to explore the full potential of mixed-reality technologies in cinema and their implications for the future of cinema. With the right implementation, mixed-reality technology can offer viewers an even more immersive experience and transform the way that we watch movies.

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Not applicable.

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