Scholastic Ophthalmology

Editorial

Volume 2 Issue 1 January 2026

Virtual Vision: How Artificial Intelligence and Virtual Reality Are Shaping a New Era for the Blind and Low Vision Community

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Received: December 04, 2025; **Published:** December 15, 2025

Introduction

Over 1.1 billion people globally live with some degree of vision loss, including 43 million who are blind and Over 1.1 billion people globally live with some degree of vision loss, including 43 million who are blind and 295 million with moderate-to-severe visual impairment [1][2]. According to the World Health Organization and ICD-11, low vision is defined as presenting visual acuity worse than 6/18 but better than or equal to 3/60 in the better eye, while blindness is defined as visual acuity worse than 3/60, or a visual field limited to less than 10 degrees around central fixation [3][4]. The most common causes of vision impairment worldwide include uncorrected refractive errors, cataract, glaucoma, diabetic retinopathy, and age-related macular degeneration—conditions that disproportionately affect populations in low- and middle-income countries [5].

As immersive technologies such as virtual reality (VR) and artificial intelligence (AI) become increasingly embedded in education, healthcare, and rehabilitation, they offer transformative opportunities—but also raise concerns about digital exclusion for individuals with blindness and low vision (BLV). Most VR systems are inherently designed for sighted users, relying predominantly on visual-spatial interfaces and cues, thereby creating a widening accessibility gap for the visually impaired [6].

The recent literature review by Liu et al. (2024) [7] addresses this very gap, highlighting how AI-driven solutions are beginning to make VR more accessible to the BLV population. Despite a comprehensive search, only four studies met the inclusion criteria—underscoring how early and underexplored this field still is.

AI Strategies to Improve VR Accessibility

Among the key AI-powered accessibility strategies are:

- Audio scene descriptions: Generated through natural language processing (NLP) and computer vision, these narrate spatial layouts and environments in real time.
- Semantic edge detection and depth estimation: These tools help low vision users interpret spatial relationships and navigate safely in virtual environments.
- Text-to-speech (TTS): This converts digital content into spoken words, offering auditory access to menus, labels, or signage.
- Braille block recognition: Supported by deep learning models, this system offers haptic and audio feedback to simulate tactile navigation.

Real-World Innovations in Assistive Devices

These AI strategies are reflected in a growing number of real-world assistive devices:

- Envision Glasses provide AI-powered scene description, object recognition, and text reading for real-time situational awareness [6].
- IrisVision Inspire, based on a VR platform, helps users with central vision loss by enhancing clarity and contrast [8].
- OrCam MyEye 3.0, a compact device mounted on glasses, reads text, identifies products, and recognizes faces hands-free.
- Microsoft Soundscape, recently made open source, allows navigation using 3D spatial audio cues, aiding orientation and mobility [9].

These innovations have begun to redefine how individuals with vision loss experience their surroundings, offering tools for greater independence and participation.

Challenges and Ethical Considerations

Despite this progress, significant challenges remain [7]:

- Limited testing environments: Many tools are still in prototype stages and tested in controlled lab settings.

- Minimal end-user involvement: Lack of collaboration with BLV users during design reduces real-world usability.
- Scarce clinical validation: Few tools are supported by robust trials or long-term outcome data.
- Accessibility gaps: Affordability, device availability, and digital literacy remain major barriers, particularly in underserved regions.
- Ethical issues: These include risks of algorithmic bias, privacy concerns, over-reliance on automation, and data security.

The success of these technologies depends not only on innovation but also on collaborative and inclusive implementation [10]. Developers, clinicians, low vision specialists, and the BLV community must work together to ensure these tools are not only functional—but also adaptable and culturally relevant.

The Role of Clinicians and the Way Forward

As eye care professionals and researchers, we are uniquely positioned to evaluate these technologies, guide their clinical application, and advocate for accessible innovation. By integrating assistive technology into low vision care, promoting patient-centered trials, and educating stakeholders about digital inclusion, we can support broader adoption.

For patients who can no longer read a classroom board, navigate public transport, or explore a museum, these technologies offer far more than convenience—they offer opportunity, confidence, and agency.

Conclusion

AI and VR are opening powerful new dimensions of access for blind and low vision individuals. However, their long-term impact will hinge on whether these innovations are developed with empathy, grounded in clinical evidence, and scaled with equity in mind. The future of digital inclusion will not be defined by technology alone, but by our collective commitment to ensure that no one is left behind in the virtual age.

Conflict Of Interest

The author declares no conflicts of interest.

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