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Computer graphics, image processing and environmental data representation — Augmented and virtual reality safety — Guidance on safe immersion, set up and usage

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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

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Foreword

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This document was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 24, *Computer graphics, image processing and environmental data representation*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html and www.iec.ch/national-committees.

Introduction

Market research assessed the requirement for standards and guidelines to help shape best practice in the application and use of augmented reality (AR) and virtual reality (VR). AR/VR technologies are continuing to evolve, this document recognizes this by addressing relevant concepts that may be applied to future and emerging technologies, and this document supplies specific examples to illustrate various categories of concern that should be considered for safe use. Although platform and other AR/VR guidelines exist, this research pointed to a need to establish formalized industry standards for best practice guidelines for the safe usage of AR/VR across a broad range of domains. Following this market research, BSI consulted with many key stakeholders in the sector and ran workshops to discuss specific AR/VR standards ideas and to assess key priorities for standards development in this area. AR/VR health and safety (H&S) was unanimously a major area of concern for stakeholders, and one they felt could hold back the growth of the sector if not addressed.

H&S is a concern for all industry sectors, but in certain areas such as the built environment, military simulation, first responder training and manufacturing and utilities, adoption of AR/VR is being hindered because H&S is not being appropriately considered. This document will provide surety to AR/VR stakeholders that the technology can be used safely across sectors and by consumers.

Safe immersion is a key area of H&S concern for stakeholders. VR, in particular, can lead to users experiencing motion sickness and disorientation, and disconnects users from their immediate surroundings, these and other effects could cause serious safety concerns in many environments. There are various factors that contribute to this, including the design and development of content, the device set-up (e.g. device not correctly positioned on the users' head), the space in which the device is used, time spent immersed, and more. What may be considered as safe is also affected by the situation (e.g. home use vs industrial use) and the sector of activity (e.g. training in a call centre vs at height on a building site). This document will take the full gamut of AR/VR use into account to provide holistic guidance for the market.

For this document, sound and haptics are less significant than visual modes and are thus considered out of scope. Despite this, it is acknowledged that, particularly in industrial settings, accurate audio fidelity may be an important training consideration.

Our understanding of AR/VR safety is still developing so this document will initially provide guidelines for organizations and consumers to consider when using the technology, and in the development of content. This document will achieve this by describing risks and considerations of AR/VR use, provide guidance to mitigate these potential issues, and finally provide AR/VR specific templates and tools for risk assessment and reporting. Noting the rapid development of AR/VR technologies, this document will be updated at appropriate moments to reflect new technological developments if and when they introduce risks not previously considered. The annex materials provide particular considerations for:

a) AR and VR distinctly;

b) enterprise and consumer usage distinctly; and

c) within particular sectors/scenarios.

This document has been developed with consideration of the needs of stakeholders belonging to two main categories. These interests are categorized as such:

1) an enterprise perspective, consisting of organisations that are implementing or managing the use of AR/VR, and therefore providing guidance to employees on safe use practices. This enterprise perspective also encompasses technology manufacturers or other service providers; and

2) a consumer perspective, informing technology manufacturers how to ensure safe use of devices by end consumers, and informing consumers of risks they should be cognizant of (e.g. how VR may impact post-use motor skills).

The reality-virtuality continuum

Milgram and Koshono first conceptualised the VC from the real environment to the virtual environment[1]. Reality, AR, AV and VR are all positioned on the VC as shown in Figure 1.

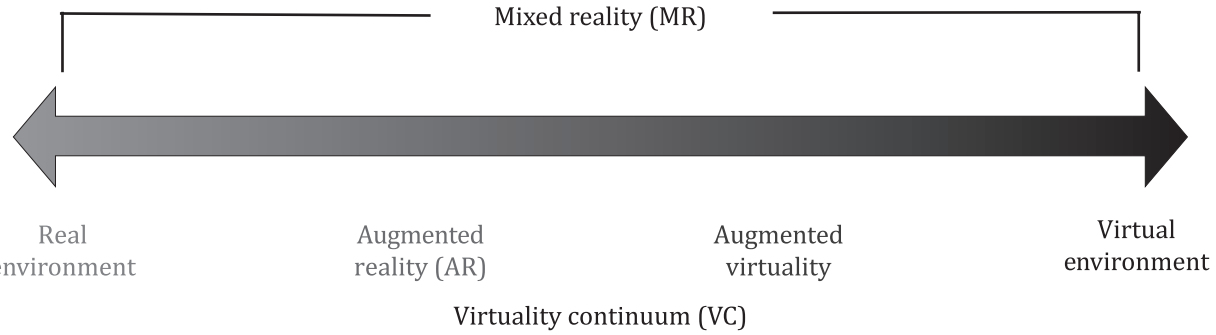


Figure 1 — Reality Virtuality (RV) Continuum (adapted from Milgram and Kishono[1])

The focus of this document is on AR and VR which are well-defined reality modes that have been in use for several decades.

Distinguishing virtual from real

In developing taxonomies for the VC, concepts of real and virtual images and objects also need to be considered. A real object has an objective existence, whereas in the VC context, a virtual object is computer-generated. Similarly, a real image has luminosity at the point where it appears to be located whereas a virtual image has no luminosity at its apparent position. These concepts are well established in optics[3].

Different aspects of distinguishing reality from virtuality are shown in Figure 2. The observer can view a real object (A) directly or indirectly via a real or virtual image. Further, a virtual object (AA) can be created by computer that can be viewed as a real image or virtual image in the case of a stereoscopic display. Modern head mounted displays may allow:

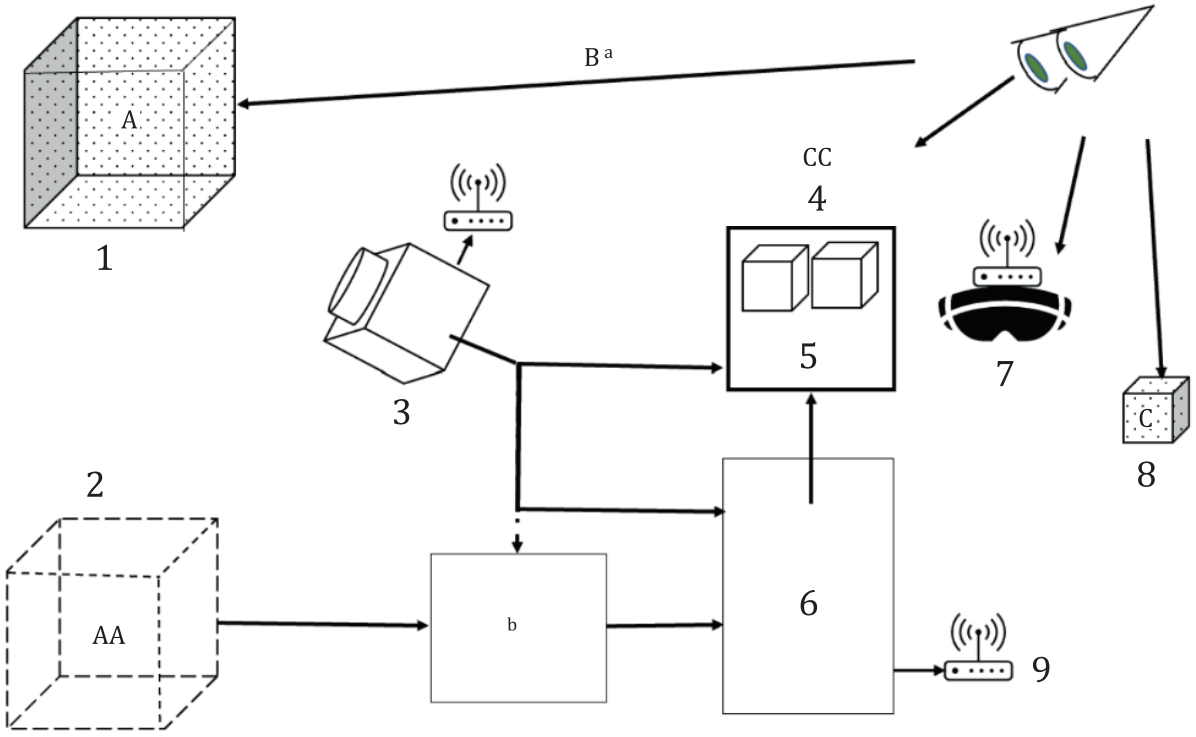
a) direct viewing of a real image of a real object;

b) indirect viewing of the same real object from a real computer synthesized image;

c) viewing of a real image from a virtual object; and

d) viewing of a virtual image simultaneously.

The HMD can access the camera and computer data via wireless technology or other similar technology.



Key

1 Real object / real image
2 Virtual objects (e.g. Created with a compute)
3 Sampling apparatus (e.g. Camera, sensor, mobile phone, etc.)
4 Non-direct viewing (synthesising display)
5 Real images
6 Computer with graphics capability
7 Head mounted display
8 Virtual Image (e.g. mirror image, holograms)
9 Wifi or Bluetooth® connection providing remote connections
a Direct viewing.
b Model: $T^2 = U^2 + V^2$ $y=mc^2$.

Figure 2 — Different aspects of distinguishing reality from virtuality adapted from Milgram and Kishono[1], and Stothard and Shiranai 2023[4]

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1 Scope

This document specifies how augmented reality (AR) and virtual reality (VR) devices are to be set up and used in the enterprise workplace in a manner that ensures health and safety (H&S) is maintained, H&S consequences are understood, and additional risks are not introduced. Within this concept of safe usage, there is particular focus on guidance around safe immersion (time) and safety in the workplace.

This document defines the concepts of AR, VR, the virtuality continuum and other associated terms such as augmented virtuality and mixed reality. This document provides guidance on:

a) setting up AR systems;

b) setting up VR systems;

c) safe usage and immersion in AR systems both in the consumer and enterprise domains;

d) safe usage and immersion in VR systems both in the consumer and enterprise domains.

This document focuses on visual aspects of AR and VR. Other modes such as haptics and olfactory are not addressed within this document.

This document covers both the hardware (the physical AR/VR head mounted displays) and areas of visual stimulus (the environments and graphics displayed in those headsets). This document does not cover all possible visual stimulus scenarios; focus is directed toward those areas that are known to have implications on safe use. This specifically includes the source vection (visual illusion of self-motion in physically stationary AR/VR users) and/or motion (physical movement of AR/VR users) and associated safe use considerations.

NOTE AR/VR have some shared safety concerns, but many are distinct to AR or VR and a consumer or enterprise environment. As such all of these are in scope, and this document is structured to account for these differences.

2 Normative references

There are no normative references in this document.