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Information technology — Computer graphics, image processing and environmental data representation — Mixed and augmented reality (MAR) reference model

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Foreword

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

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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.

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Introduction

This document contains annexes:

— Annex A gives examples of existing MAR solutions and technologies and how they fit into the MAR reference model.

— Annex B gives examples of representative MAR systems and how their architecture maps to the MAR reference model.

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Information technology — Computer graphics, image processing and environmental data representation — Mixed and augmented reality (MAR) reference model

1 Scope

This document defines the scope and key concepts of mixed and augmented reality, the relevant terms and their definitions and a generalized system architecture that together serve as a reference model for mixed and augmented reality (MAR) applications, components, systems, services and specifications. This architectural reference model establishes the set of required sub-modules and their minimum functions, the associated information content and the information models to be provided and/or supported by a compliant MAR system.

The reference model is intended for use by current and future developers of MAR applications, components, systems, services or specifications to describe, compare, contrast and communicate their architectural design and implementation. The MAR reference model is designed to apply to MAR systems independent of specific algorithms, implementation methods, computational platforms, display systems and sensors or devices used.

This document does not specify how a particular MAR application, component, system, service or specification is designed, developed or implemented. It does not specify the bindings of those designs and concepts to programming languages or the encoding of MAR information through any coding technique or interchange format. This document contains a list of representative system classes and use cases with respect to the reference model.

2 Normative references

There are no normative references in this document.

3 Terms, definitions and abbreviated terms

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1 Terms and definitions

3.1.1
augmentation
virtual object (3.1.24) data (computer-generated, synthetic) added on to or associated with target *physical object* (3.1.15) data (live video, real world image) in an *MAR scene* (3.1.9)

Note 1 to entry: This equally applies to physical object data added on to or associated with target virtual object data.

3.1.2
augmented reality
type of *mixed reality system* (3.1.13) in which *virtual world* (3.1.25) data are embedded and/or registered with the representation of *physical world* (3.1.16) data

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3.1.3
augmented virtuality system
type of *mixed reality system* (3.1.13) in which *physical world* (3.1.16) data are embedded and/or registered with the representation of *virtual world* (3.1.25) data

3.1.4
display
device by which rendering results are presented to a user using various modalities such as visual, auditory, haptics, olfactory, thermal, motion

Note 1 to entry: In addition, any actuator can be considered display if it is controlled by MAR system.

3.1.5
feature
primitive geometric element (e.g. points, lines, polygons, colour, texture, shapes) and/or attribute of a given (usually physical) object used in its detection, recognition and tracking

3.1.6
MAR event
trigger resulting from the detection of a condition relevant to MAR content and *augmentation* (3.1.1)

EXAMPLE Detection of a marker.

3.1.7
MAR execution engine
collection of hardware and software elements that produce the result of combining components that represent on the one hand the real world and its objects, and on the other those that are virtual, synthetic and computer generated

3.1.8
MAR experience
human visualization and interaction of an *MAR scene* (3.1.9)

3.1.9
MAR scene
observable spatio-temporal organization of physical and *virtual objects* (3.1.24) which is the result of an *MAR scene representation* (3.1.10) being interpreted by an *MAR execution engine* (3.1.7) and which has at least one *physical* (3.1.15) and one virtual object

3.1.10
MAR scene representation
data structure that arranges the logical and spatial representation of a graphical scene, including the *physical* (3.1.15) and *virtual objects* (3.1.24) that are used by the *MAR execution engine* (3.1.7) to produce an *MAR scene* (3.1.9)

3.1.11
marker
metadata embedded in or associated with a *physical object* (3.1.15) that specifies the location of a superimposed object

3.1.12
MAR continuum
spectrum spanning physical and virtual realities according to a proportional composition of physical and virtual data representations

Note 1 to entry: Originally proposed by Milgram et al.[1].

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3.1.13
mixed reality system
mixed and augmented reality system
system that uses a mixture of representations of *physical world* (3.1.16) data and *virtual world* (3.1.25) data as its presentation medium

3.1.14
natural feature
feature (3.1.5) that is not artificially inserted for the purpose of easy detection/recognition/tracking

3.1.15
physical object
real object
object that exists in the real world

3.1.16
physical world
physical reality spatial organization of multiple *physical objects* (3.1.15)

3.1.17
point of interest
single or collection of target locations

Note 1 to entry: Aside from location data, a point of interest is usually associated with metadata such as identifier and other location specific information.

3.1.18
recognizer
MAR component (hardware and software) that processes *sensor* (3.1.19) output and generates *MAR events* (3.1.6) based on conditions indicated by the content creator

3.1.19
sensor
device that returns detected values related to detected or measured condition or property

Note 1 to entry: Sensor may be an aggregate of sensors.

3.1.20
spatial registration
establishment of the spatial relationship or mapping between two models, typically between *virtual object* (3.1.24) and target *physical object* (3.1.15)

3.1.21
target image
target object (3.1.22) represented by a 2D image

3.1.22
target object
physical (3.1.15) or *virtual object* (3.1.24) that is designated, designed or chosen to allow detection, recognition and tracking, and finally *augmentation* (3.1.1)

3.1.23
tracker
MAR component (hardware and software) that analyses signals from *sensors* (3.1.19) and provides some characteristics of tracked entity (e.g. position, orientation, amplitude, profile)

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3.1.24
virtual object
computer-generated entity that is designated for *augmentation* (3.1.1) in association with a *physical object* (3.1.15) data representation

Note 1 to entry: In the context of MAR, it usually has perceptual (e.g. visual, aural) characteristics and, optionally, dynamic reactive behaviour.

3.1.25
virtual world
virtual environment
spatial organization of multiple *virtual objects* (3.1.24), potentially including global behaviour

3.2 Abbreviated terms

Abbreviated term	Definition
API	Application program interface
AR	Augmented reality
AVH	Audio, visual, haptic
GNSS	Global navigation satellite system
MAR	Mixed and augmented reality
MAR-RM	Mixed and augmented reality reference model
MR	Mixed reality
POI	Points of interest
PTAM	Parallel tracking and mapping
SLAM	Simultaneous localization and mapping
UI	User interface
VR	Virtual reality

4 Mixed and augmented reality (MAR) domain and concepts

4.1 General

MAR refers to a spatially coordinated combination of media/information components that represent on the one hand the real world and its objects, and on the other those that are virtual, synthetic and computer generated. The virtual component can be represented and presented in many modalities (e.g. visual, aural, touch, haptic, olfactory) as illustrated in Figure 1. The figure shows an MAR system in which a virtual fish is augmented above a real world object (registered by using markers), visually, aurally and haptically.

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