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BSI Standards Publication

Ergonomics of human-system interaction

Part 820: Ergonomic guidance on interactions in immersive environments, including augmented reality and virtual reality

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National foreword

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A list of organizations represented on this committee can be obtained on request to its committee manager.

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Part 820: Ergonomic guidance on interactions in immersive environments, including augmented reality and virtual reality

Ergonomie de l'interaction homme-système —

Partie 820: Lignes directrices ergonomiques relatives aux interactions en environnements immersifs, y compris la réalité augmentée et la réalité virtuelle

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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This document was prepared by Technical Committee ISO/TC 159, *Ergonomics*, Subcommittee SC 4, *Ergonomics of human-system interaction*.

A list of all parts in the ISO 9241 series can be found on the ISO website.

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

The use of immersive environments is rapidly spreading beyond the fields of research and gaming into many other application areas. Given the human-system issues unique to systems with these characteristics, timely guidance covering these issues is necessary to help all sectors of industry to design, field and operate quality immersive systems and build appropriate trust in products and services that use these systems.

This document provides ergonomics guidance for a range of immersive environments, including those involving virtual reality, mixed reality and augmented reality. This guidance builds on the more general guidance in the ISO 9241 series, which applies to interactive tools and the physical environment within which they are used.

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Ergonomics of human-system interaction —

Part 820: Ergonomic guidance on interactions in immersive environments, including augmented reality and virtual reality

1 Scope

This document identifies ergonomic or human-systems issues and guidance for the development and use of systems involving immersive environments, augmented reality and virtual reality. This includes:

a) environments where the user is provided with a perception of being physically present in a virtually-created world;

b) environments where the user is represented virtually and can interact in a real-world environment;

c) environments involving artificial reality, augmented reality, virtual reality, mixed reality and similar simulated realities;

d) computer-generated environments where the user interacts with simulated objects in a manner similar to how the user would interact with the real-world counterparts of these objects.

This document is not an exploration of the philosophical, ethical or political issues surrounding the use of immersive environments.

This document limits its treatment of the technologies used to create immersive environments to focusing on their interactions with users and does not investigate other aspects of these technologies.

The target audience for this document is decision-makers, designers and engineers who would benefit from the consideration of human-systems issues of immersive environments. Futurists, researchers, technology developers, regulators and legislators could also find this document useful.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

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

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

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

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

3.1 High-level concepts

3.1.1
immersion
<immersive environments> experience and participation in a particular *environment* (3.2.5)

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3.1.2
presence
<immersive environments> psychological sense of being in a particular *environment* (3.2.5)

3.1.3
flow
<immersive environments> state of mind an individual enters when completely involved or focused on any challenging and/or enjoyable activity

3.1.4
naturalness
correspondence with everyday interactions between humans and real-world objects that they interact with

Note 1 to entry: Naturalness relates to everyday behaviours that can be expected to be performed without any specialized learning or training.

[SOURCE: ISO/IEC 4944:—,[1)] 3.1.4, modified — "expected to have already learned" has been replaced by "expected to be performed without any specialized learning or training" in Note 1 to entry, and the EXAMPLE has been removed.]

3.2 Realities and environments

3.2.1
reality
<immersive environments> set of facts, beliefs and rules that are accepted as true

3.2.2
natural world
<immersive environments> world that has actual physical existence

Note 1 to entry: In this document, "natural world" is used to refer to the physical elements of the *real world* (3.2.3).

3.2.3
real world
<immersive environments> *natural world* (3.2.2) as experienced by the *user* (3.4.1)

Note 1 to entry: The real world goes beyond the physical existence of the natural world to also include the facts, opinions and knowledge about, and the actions and experiences of and with, the components of the natural world that are common to most people in the user's society.

Note 2 to entry: The real world represents the perception that individuals have of the natural world. Thus, there can be minor differences between different individuals' perceptions of what the real world is, despite all of these being based on their experiences within the same natural world.

Note 3 to entry: In this document, the term "real world" is used to contrast with artificially-created *immersive environments* (3.2.6).

3.2.4
alternative reality
<immersive environments> possible perceivable *reality* (3.2.1)

3.2.5
environment
<immersive environments> physical, chemical, biological, organizational, social and cultural factors surrounding one or more persons

[SOURCE: ISO 26800:2011, 2.3, modified — "<immersive environments>" has been added as the domain.]

1) Under preparation. Stage at the time of publication: ISO/IEC DIS 4944:2024.

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3.2.6
immersive environment
environment (3.2.5) that surrounds a *user* (3.4.1) and with which the user interacts

Note 1 to entry: For the purposes of this document, immersive environments are those environments that involve virtual, mixed or augmented realities.

3.2.7
virtual reality
interactive experience taking place within a simulated *environment* (3.2.5)

3.2.8
mixed reality
merging of the *real world* (3.2.3) and virtual worlds to generate new *environments* (3.2.5) where physical and synthetic objects co-exist and interact

[SOURCE: ISO/IEC 18038:2020, 3.14, modified — The admitted term "MR" has been removed.]

3.2.9
augmented reality
interactive experience of a *real-world* (3.2.3) *environment* (3.2.5) whereby the objects that reside in the *real world* (3.2.3) are augmented by computer-generated perceptual information

[SOURCE: ISO/IEC 18038:2020, 3.2, modified — The admitted term "AR" has been removed.]

3.3 Systems and interfaces

3.3.1
augmented reality system
view of the physical world that is supplemented by computer-generated text, images, data or other media

[SOURCE: ISO/IEC/IEEE 26511:2018, 3.1.4]

3.3.2
mixed reality system
mixed and augmented reality system
system that uses a mixture of representations of physical world data and virtual world data as its presentation medium

[SOURCE: ISO/IEC 18039:2019, 3.1.13]

3.3.3
user interface
UI
set of all the components of an interactive system that provide information and controls for the *user* (3.4.1) to accomplish specific tasks with the interactive system

[SOURCE: ISO 9241-110:2020, 3.10]

3.3.4
natural user interface
NUI
user interface (3.3.3) where the *user* (3.4,1) operates the interface through an intuitive manner related to everyday human behaviours in a *real world* (3.2.3)

Note 1 to entry: "Natural" refers to the user's expectations, behaviour and feelings that are involved in interacting with an NUI.

Note 2 to entry: Everyday human behaviours refer to actions of the user which can be performed without the need for learning and training beforehand.

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Note 3 to entry: Interactions with NUIs typically model interactions performed in the *natural world* (3.2.2), including (but not limited to) touch, gestures and/or auditory interactions.

[SOURCE: ISO/IEC 4944:—, 3.1.2, modified — "through a manner" has been replaced by "through an intuitive manner" in the definition; "behaviours that the user can been expected to have already learned" has been replaced by "actions of the user which can be performed without the need for learning and training beforehand" in Note 2 to entry; "vocal interactions" has been replaced by "auditory interactions" in Note 3 to entry.]

3.4 Ergonomic-related concepts

3.4.1
user
person who interacts with a system, product or service

Note 1 to entry: Users of a system, product or service include people who operate the system, people who make use of the output of the system and people who support the system (including providing maintenance and training).

[SOURCE: ISO 9241-11:2018, 3.1.7]

3.4.2
guiding user
user (3.4.1) who exerts some level of control over the situation experienced by other users within an *immersive environment* (3.2.6)

EXAMPLE 1 An administrator, who is outside the immersive environment, monitors what is happening in the immersive environment and can make real-time changes to it that will have an immediate effect on users within the immersive environment.

EXAMPLE 2 Within an immersive environment used for training teams, a team leader instructs other members of the team on what they are to do individually.

3.4.3
usability
extent to which a system, product or service can be used by specified *users* (3.4.1) to achieve specified goals with effectiveness, efficiency and satisfaction in a specified *context of use* (3.4.8)

Note 1 to entry: The “specified” users, goals and context of use refer to the particular combination of users, goals and context of use for which usability is being considered.

Note 2 to entry: The word “usability” is also used as a qualifier to refer to the design knowledge, competencies, activities and design attributes that contribute to usability, such as usability expertise, usability professional, usability engineering, usability method, usability evaluation and usability heuristic.

[SOURCE: ISO 9241-11:2018, 3.1.1]

3.4.4
accessibility
extent to which products, systems, services, *environments* (3.2.5) and facilities can be used by people from a population with the widest range of user needs, characteristics and capabilities to achieve identified goals in identified *contexts of use* (3.4.8)

Note 1 to entry: Context of use includes direct use or use supported by assistive technologies.

[SOURCE: ISO 9241-112:2017, 3.15]

3.4.5
user experience
user (3.4.1) perceptions and responses that result from the use and/or anticipated use of a system, product or service

Note 1 to entry: Users' perceptions and responses include users’ emotions, beliefs, preferences, perceptions, comfort, behaviours and accomplishments that occur before, during and after use.

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Note 2 to entry: User experience is a consequence of brand image, presentation, functionality, system performance, interactive behaviour and assistive capabilities of a system, product or service. It also results from the user's internal and physical state resulting from prior experiences, attitudes, skills, abilities and personality, and from the *context of use* (3.4.8).

[SOURCE: ISO 9241-11:2018, 3.2.3, modified — Notes 3 and 4 to entry have been removed.]

3.4.6
harm from use
negative consequences regarding health, safety, finances or the *environment* (3.2.5) that result from use of the system

Note 1 to entry: The negative consequences can be for the user or for any other stakeholder.

Note 2 to entry: Although avoidance of harm from use (i.e. eliminating any exposure of risk that poses potential harm) cannot be achieved completely, the design of an interactive system can aim to mitigate risks to an acceptable minimum.

[SOURCE: ISO 9241-11:2018, 3.2.4, modified — Note 2 to entry added.]

3.4.7
human-centred quality
extent to which requirements for *usability* (3.4.3), *accessibility* (3.4.4), *user experience* (3.4.5) and avoidance of *harm from use* (3.4.6) are met

Note 1 to entry: Provision of the necessary technical functionality is a prerequisite for human-centred quality.

Note 2 to entry: Usability, accessibility, user experience and avoidance of harm from use can only be managed to the extent that they can be controlled by designed aspects of the interactive system.

Note 3 to entry: Human-centred quality is a collective term for the intended outcomes of interaction of the user with the system.

[SOURCE: ISO 9241-11:2018, 3.2.1]

3.4.8
context of use
combination of users, goals and tasks, resources and *environment* (3.2.5)

Note 1 to entry: The "environment" in a context of use includes technical, physical, social, cultural and organizational environments.

[SOURCE: ISO 9241-11:2018, 3.1.15]

3.5 Interaction-related concepts

3.5.1
natural user interface interaction
NUI interaction
user-system interaction making use of a *natural user interface* (3.3.4)

3.5.2
modality
mode of interaction referring to one of the human senses

[SOURCE: ISO 9241-112:2017, 3.11, modified — Notes to entry have been removed.]

3.5.3
multi-modal
mode of interaction simultaneously involving multiple modes of sensing

Note 1 to entry: This usually involves the visual, auditory and *haptic* (3.5.4) *modalities* (3.5.2).

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