International Standard

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Ergonomics of human-system interaction —

Part 920: Tactile and haptic interactions

Second edition
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Partie 920: Interactions tactiles et haptiques

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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 documents 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*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 122, *Ergonomics*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This second edition cancels and replaces the first edition (ISO 9241-920:2009), which has been technically revised.

The main change is as follows:

— The document has been updated to reflect newer research in tactile/haptic interactions.

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.

Introduction

Tactile and haptic interactions have become increasingly important interaction modalities. Mobile interaction relies on gesture-based touch interaction and tactile/haptic control devices and can utilize vibration-based displays as one of several ways to provide information or experiences to the user. Touch, vibration and tactile/haptic interactions are also found in special-purpose computing environments (e.g. simulation, remote control or surgery) and in assistive technologies.

While considerable research exists, a lack of ergonomic standards in this area can possibly result in systems being developed without sufficient concern for either ergonomics or interoperability, leading to serious difficulties related to ergonomics for users of multiple incompatible or conflicting tactile/haptic devices or applications.

This document provides ergonomics requirements and recommendations for tactile and haptic hardware and software interactions, including guidance related to the design and evaluation of hardware, software and combinations of hardware and software interactions. The guidelines are not technology-dependent and will also be applicable to future technologies.

ISO 9241-910 provides a common set of terms, definitions and descriptions of the various concepts central to designing and using tactile/haptic interactions. It also provides an overview of the range of tactile/haptic applications, objects, attributes and interactions.

ISO 9241-940 provides ways of evaluating tactile/haptic interactions for their usability, the validation of requirements and the verification that systems meet the requirements.

ISO 9241-960 focuses on gestures as a specific type of tactile/haptic interaction and describes their features and usability requirements. Information on gesture-based interfaces can be found in the ISO/IEC 30113 series. Information on contactless gestures can be found in ISO TS 9241-430.

For guidance and recommendations on the accessibility of tactile/haptic interactions, including information on the use of braille, see ISO 9241-971. It does not provide recommendations specific to braille but can apply to interactions that make use of braille.

Ergonomics of human-system interaction —

Part 920:
Tactile and haptic interactions

1 Scope

This document specifies requirements and recommendations for tactile/haptic hardware and software interactions. It provides guidance on the design and selection of hardware, software and combinations of hardware and software interactions, including:

— the design or use of tactile/haptic inputs, outputs and/or combinations of inputs and outputs, with general guidance on their design or use as well as on designing or using combinations of tactile and haptic interactions for use in combination with other modalities or as the exclusive mode of interaction;

— the tactile/haptic encoding of information, including textual data, graphical data and controls;

— the design of tactile/haptic objects;

— the layout of tactile/haptic space;

— interaction techniques.

The recommendations given in this document are applicable to a variety of tactile/haptic devices, representing the real world or virtual or mixed realities (e.g. exoskeletons, wearables, force feedback devices, touchables, tangibles) and stimulation types (e.g. acoustic radiation pressure, electrical muscle stimulation) and they can also be found in virtual and augmented environments.

This document provides general information about how various forms of tactile/haptic interaction can be applied to various user tasks.

This document does not include guidance on the role of walking in virtual or mixed realities for tactile/haptic interaction.

NOTE It is recognized that some interactive scenarios can be constrained by the limitation that a real workspace is to be modelled in a virtual environment. Objects can be in suboptimal positions or conditions for tactile/haptic interaction by virtue of the situation being modelled.

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
electrotactile feedback
delivering tactile/haptic sensations to the user by excitation of the cutaneous nerve fibres with electric current

3.2
electrostatic feedback
delivering tactile/haptic sensations of friction to the user by electric force

3.3
information haptification
presentation and exploration of data and their relations through tactile/haptic interaction

3.4
sensory substitution
information usually analysed by one sense provided through another sense

EXAMPLE 1 Tactile sensations can substitute for visual input, e.g. when visible text is transcribed into tactile sensations through braille for an individual who is blind.

EXAMPLE 2 A visual diagram is substituted by an audible representation of the information in the diagram.

Note 1 to entry: Sensory substitution allows the system to provide the same information in more than one modality. It is not a substitution on the part of human perception. For example, persons who experience synaesthesia, which is an involuntary association of one sense with another or one sensory attribute with another, sometimes experience colour when hearing sound.

3.5
tactile
appertaining to touch

[SOURCE: ISO 9241-910:2011, 2.5]

3.6
haptic, adj
appertaining to *haptics* (3.7)

Note 1 to entry: While there is no difference between haptic and *tactile* (3.5) in most dictionary definitions, in the area of haptics, researchers and developers use haptic to include all haptic sensations, while tactile is limited to mechanical stimulation of the skin. In ISO 9241, the word haptic covers all touch sensations and tactile is used in a more specific manner. Also, both terms can be used together to assist in searches.

[SOURCE: ISO 9241-910:2011, 2.2]

3.7
haptics, noun
sensory and/or motor activity based in the skin, muscles, joints and tendons

Note 1 to entry: Haptics consists of two parts: touch and kinaesthesis.

[SOURCE: ISO 9241-910:2011, 2.1]

4 Applying ISO 9241-920

4.1 Recommendations

The recommendations given in Clauses 5 to 9 should be evaluated for their applicability. The applicable recommendations should be implemented, unless there is evidence that to do so would cause deviation from the design objectives.

4.2 Conformance

If it is claimed that a product conforms to the applicable requirements and recommendations in this document, then the procedures used to establish conformance of the product shall be specified. The level of detail of the specification is a matter of negotiation between the involved parties.

NOTE Guidance on the evaluation of tactile/haptic products can be found in ISO 9241-940.

5 Tactile/haptic inputs, outputs and/or combinations

5.1 General guidance on tactile/haptic inputs, outputs and/or combinations

5.1.1 Optimizing performance

The system should be optimized to take into account the following:

a) the accuracy of available devices, the accuracy of the user and the required accuracy of the task;

b) the ability of a user to control the velocity and the force (including direction) involved in operations;

NOTE 1 High speed of user actions is inconsistent with accurate control of force, and vice versa.

c) active exploration over passive exploration, when appropriate;

NOTE 2 This can increase kinaesthetic perception.

d) extended contact area;

NOTE 3 Extended area can be needed depending on the part of the body in contact with a tactile/haptic device.

EXAMPLE 1 The back does not resolve two-point discrimination as easily as the fingertip.

e) multiple point-of-contact operation, when possible and appropriate;

NOTE 4 This can reduce errors and improve tactile perception.

EXAMPLE 2 The use of two hands in reading braille can improve efficiency.

f) the overall amount and distributed nature of cognitive and sensory task demands.

NOTE 5 Effectiveness of tactile and haptic inputs is affected by overall workload, conflict among multi-task demands and/or overload or decrement of particular sensory information channels.

5.1.2 Providing accessible information on tactile/haptic elements

The system should provide accessible alternatives of all tactile/haptic user interface elements, whether those alternatives are automatically presented or not.

NOTE An accessible alternative can describe the user interface element through text, sound labels, synthetic speech or sign language or as braille text.

EXAMPLE Touchscreen buttons with spoken descriptions.

5.1.3 Providing contextual information

The system should provide a context to help the user to understand the meaning of the tactile/haptic perception and the environment or program.

NOTE 1 Contextual information that is helpful includes information about the purpose of the program, and information about possibilities and pitfalls in the environment.