

ISO 9241-920:2009-03 (E)

Ergonomics of human-system interaction - Part 920: Guidance on tactile and haptic interactions

Contents

	Page
Foreword	v
Introduction	vii
1 Scope	1
2 Applying ISO 9241-920	1
2.1 Recommendations	1
2.2 Evaluation of products	1
3 Tactile/haptic inputs, outputs, and/or combinations	2
3.1 General guidance on tactile/haptic inputs, outputs and/or combinations	2
3.1.1 Optimizing performance	2
3.1.2 Providing accessible information on tactile/haptic elements	2
3.1.3 Providing contextual information	2
3.1.4 Using consistent labels	2
3.1.5 Identifying system state	3
3.1.6 Minimizing fatigue	3
3.1.7 Providing alternative input methods	3
3.1.8 Maintaining coherence between modalities	3
3.1.9 Combining modalities	4
3.1.10 Presenting realistic experiences	4
3.1.11 Isolation of individual interface elements	4
3.2 Intentional individualization	5
3.2.1 Enabling users to change modalities	5
3.2.2 Enabling force feedback override	5
3.2.3 Enabling users to individualise tactile parameters	5
3.3 Unintentional user perceptions	5
3.3.1 Limiting acoustic output of tactile/haptic display	5
3.3.2 Limiting heat gain of contact surface	5
3.3.3 Avoiding sensory adaptation	6
3.3.4 Recovering from sensory adaptation	6
3.3.5 Avoiding unintended perceptual illusions	6
3.3.6 Preventing temporal masking	6
4 Attributes of tactile and haptic encoding of information	6
4.1 High level guidance on tactile/haptic encoding of information	6
4.1.1 Using familiar tactile/haptic patterns	6
4.1.2 Making tactile/haptic encoding obvious	6
4.1.3 Conformity to user expectations	7
4.1.4 Using sensory substitution	7
4.1.5 Using appropriate spatial addressability and resolution	7
4.1.6 Using tactile apparent location	7
4.1.7 Using distal body parts for high spatial resolution	7
4.1.8 Using higher addressability for trained users	7
4.1.9 Using tactile apparent motion	7
4.1.10 Preventing spatial masking	8
4.2 Guidance on specific tactile/haptic attributes for encoding information	8
4.2.1 Selecting dimensions for encoding information	8
4.2.2 Discriminating between attribute values	9
4.2.3 Limiting the number of attribute values	9

4.2.4	Combining properties	9
4.2.5	Limiting complexity	9
4.2.6	Encoding by object shape	9
4.2.7	Encoding information by temporal pattern	9
4.2.8	Encoding information using vibration amplitude	9
4.2.9	Encoding information by vibration frequency	10
4.2.10	Encoding by location	10
4.2.11	Encoding by temperature	10
4.2.12	Encoding by thermal conductivity	10
4.2.13	Identifying information values	10
 5	 Content-specific encoding	 11
5.1	Encoding and text data	11
5.2	Encoding and using graphical data	11
5.2.1	Displaying tactile/haptic graphics	11
5.2.2	Using grids on tactile graphs	11
5.2.3	Using landmarks in tactile maps	11
5.2.4	Providing scales for tactile maps	11
5.3	Encoding and using controls	12
5.3.1	Using tactile/haptic controls	12
5.3.2	Using size and spacing of controls to avoid accidental activation	12
5.3.3	Avoiding difficult control actions	12
5.3.4	Using force to avoid accidental activation	12
5.3.5	Interacting with controls	12
 6	 Design of tactile/haptic objects and space	 13
6.1	Tactile/haptic display spaces	13
6.1.1	Ease of perceiving multiple tactile/haptic objects	13
6.1.2	Ease of identifying adjacent tactile/haptic objects	13
6.1.3	Maintaining separation between surfaces of objects	13
6.1.4	Separating tactile/haptic elements	14
6.1.5	Avoiding empty spaces	14
6.1.6	Avoiding volume limits	14
6.1.7	Avoiding falling out of the tactile/haptic space	14
6.2	Objects	14
6.2.1	Using appropriate object size	14
6.2.2	Creating discriminable tactile/haptic symbols	14
6.2.3	Creating tactile/haptic symbols from visual symbols	15
6.2.4	Tactile/haptic object angles	15
6.2.5	Tactile/haptic object corners	15
 7	 Interaction	 15
7.1	Navigating tactile/haptic space	15
7.1.1	Providing navigation information	15
7.1.2	Supporting path planning	15
7.1.3	Providing well-designed paths	15
7.1.4	Making landmarks easy to identify and recognise	15
7.1.5	Providing appropriate navigation techniques	15
7.1.6	Providing navigational aids	16
7.1.7	Understanding the tactile/haptic space	16
7.1.8	Supporting exploratory strategies (procedures)	16
7.2	Reconfiguration	16
7.2.1	Reconfiguring the tactile/haptic space	16
7.3	Interaction techniques	17
7.3.1	Implementing interaction techniques	17
7.3.2	Avoiding unintended oscillation	17
 Annex A (informative) Overview of the ISO 9241 series	 18	
 Bibliography	 22	