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Information technology — User interfaces — Evaluating usability of natural user interfaces

Technologie de l'information — Interfaces utilisateur — Cadre pour l'évaluation de l'utilisabilité d'une interface utilisateur naturelle

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Introduction

As smart devices such as smart phones and smart speakers have become popular, new forms of user interfaces have been introduced. One aspect of the new interfaces is mimicking natural ways of interacting with the devices and utilizing speech, gestures, body language, eye gaze and other natural features of human communication through natural user interfaces (NUIs), which allow for faster, smoother, intuitive, and smarter interaction. However, while the concept of NUI is well defined, practical applications of NUI still need to be developed. This is strongly related to the lack of usability of NUI in smart devices.

When specified users of systems, products or services achieve their specified goals with effectiveness, efficiency and satisfaction in a specified context of use (as defined in ISO/IEC 9241-11), usability can be evaluated. Effectiveness is considered as the ability of users to complete tasks with the system (e.g. the NUI). Efficiency measures resources taken by users to complete specified tasks. Satisfaction measures comfort levels of user experience along with acceptance.

It is important that the usability evaluation of NUI concentrates on recognizing the user's intention and focuses on multiple modalities of information flows between the users and the devices.

This document describes a framework for evaluating the usability of NUI. Although the framework can be applied in most general contexts, it is specifically focused on optimizing user experiences in terms of NUI.

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Information technology — User interfaces — Evaluating usability of natural user interfaces

1 Scope

This document provides a framework, requirements and recommendations for evaluating the usability of a natural user interface (NUI) for systems, products or services. Measuring and reporting the usability of the NUI are also described. The usability evaluation focuses on the efficiency, effectiveness and satisfaction of the NUI. This document can also be applied to the usability evaluation of other user interfaces (UIs) for emerging technologies.

2 Normative reference

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 9241-11, *Ergonomics of human-system interaction — Part 11: Usability: Definitions and concepts*

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3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 9241-11 and the following 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/

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3.1 Terms related to natural user

3.1.1
user interface
UI
set of all the components of an interactive system that provide information and controls for the user to accomplish specific tasks with the interactive system

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

3.1.2
natural user interface
NUI
user interface where the user operates the interface through a manner related to everyday human behaviours in a real world

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

Note 2 to entry: Everyday human behaviours refer to behaviours that the user can be expected to have already learned.

Note 3 to entry: Interactions with NUIs typically model interactions performed in the natural world, including (but not limited to) touch, gestures or vocal interactions, or a combination thereof.

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3.1.3
natural user interface interaction
NUI interaction
user-system interaction making use of a natural user interface

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

Note 1 to entry: Naturalness relates to everyday behaviours that the user can be expected to have already learned.

EXAMPLE To perform a “hello” gesture, the user refers to an object by pointing; to order something the user issues a vocal command; or to agree the user nods in the affirmative or voices a vocal onomatopoeia for agreement.

3.2 Terms related to usability

3.2.1
interaction
user-system interaction
exchange of information between a user and an interactive system via the user interface to complete the intended task

Note 1 to entry: Adapted from ISO 9241-110:2020, 3.11 definition of user-system interaction.

3.2.2
diverse users
individuals with differing abilities and characteristics or accessibility needs

[SOURCE: ISO/IEC Guide 71:2014, 2.3]

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3.2.3
diverse contexts
differing contexts of use and differing economic, cultural and organizational conditions

[SOURCE: ISO/IEC Guide 71:2014, 2.8]

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4 Natural user interfaces (NUI)

Natural user interfaces (NUIs) are a special case of user interfaces that focus on the naturalness of interactions that they support.

The evaluation of the usability of an NUI includes:

a) evaluation of the usability of the user interface to accomplish tasks;

NOTE 1 This is similar to the evaluation of any other user interface.

b) evaluation of the usability of the naturalness of the user interface.

NOTE 2 This involves an additional, more specialized evaluation that is described in this document.

The naturalness of the user interface is provided by the NUI interactions, which are recognized and used by the NUI.

NUI interactions attempt to maximize their achievement of the interaction principles identified in ISO 9241-110 as:

— Suitability for the user’s tasks: An interactive system is suitable for the user's tasks when it supports the users in the completion of their tasks, i.e. when the operating functions and the user-system interactions are based on the task characteristics.

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— Self-descriptiveness: The interactive system presents appropriate information, where needed by the user, to make its capabilities and use immediately obvious to the user without unnecessary user-system interactions.

— Conformity with user expectations: The interactive system's behaviour is predictable based on the context of use and commonly accepted conventions in this context.

— Learnability: The interactive system supports discovery of its capabilities and how to use them, allows exploration of the interactive system, minimizes the need for learning and provides support when learning is needed.

— Controllability: The interactive system allows the user to maintain control of the user interface and the interactions, including the speed and sequence and individualization of the user-system interaction.

— Use error robustness: The interactive system assists the user in avoiding use errors and, in case of identifiable use errors, treats them tolerantly and assists the user when recovering from the errors.

— User engagement: The interactive system presents functions and information in an inviting and motivating manner supporting continued interaction with the system.

NUI maximizes the naturalness of its interactions by supporting the following:

— Suitability for the user's tasks: The users of the interactive system with NUI perform tasks in a reasonable manner to how they would perform in the real world with everyday interactions (if the computer was not involved).

— Self-descriptiveness: The interactive system with NUI presents appropriate information to the user in a manner that is related to how the information exists in the real world (rather than in a manner that is optimized for the computer).

— Conformity with user expectations: The interactive system with NUI recognises and processes predictable user interactions in a predictable manner that is consistent with the real world (rather than designed based on typical human-computer interaction styles).

— Learnability: The interactive system with NUI supports the users in the discovery and exploration of its capabilities and information (without the need for formal training regarding the user interface and supported interactions before they can use the system).

— Controllability: The interactive system with NUI allows the user to interact with the NUI in the manner and sequence that is most natural to their preferred manner (rather than in a single prescribed manner).

— Use error robustness: The interactive system with NUI allows the users to try different interactions while avoiding and minimizing any resulting use errors and by providing suitable error recovery where needed.

— User engagement: The interactive system with NUI invites and motivates the users to interact with the NUI in a similar manner to everyday human behaviour in the real world.

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5 Evaluating usability of a natural user interface (NUI)

5.1 Framework

Usability as defined in ISO 9241-11 is a complex concept.

NOTE Usability is one of the outcomes of use of a system, product, or service. There are other outcomes of use, e.g. accessibility, user experience, avoidance from harm from use. This document only focuses on usability.

Different users will experience different levels of usability of the same system, product or service in achieving different goals in different contexts of use. Therefore, evaluation of the usability involves a number of different more specific evaluations that are described in the following subclauses.

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Evaluating usability of NUI involves applying the definition of usability, as illustrated in Figure 1, by considering the following three issues:

— the system, product or service being evaluated (see 5.2), which in this case is the NUI;

— the users, goals, tasks and context of use (see 5.3, 5.4 and 5.5) which determine how NUI will be evaluated and used;

— the components of usability evaluation (see 5.6), e.g. effectiveness, efficiency and satisfaction.

The evaluation of the NUI usability requires evaluation metrics as follows:

a) how to evaluate usability of NUI (see 5.7), which includes:

   1) evaluating the usability of the user interface of the NUI for accomplishing goals;

   2) evaluating the usability of the naturalness of the interactions supported by the NUI;

b) how to measure the components of usability of NUI (see Clause 6);

c) how to report the results of the usability evaluation (see Clause 7).

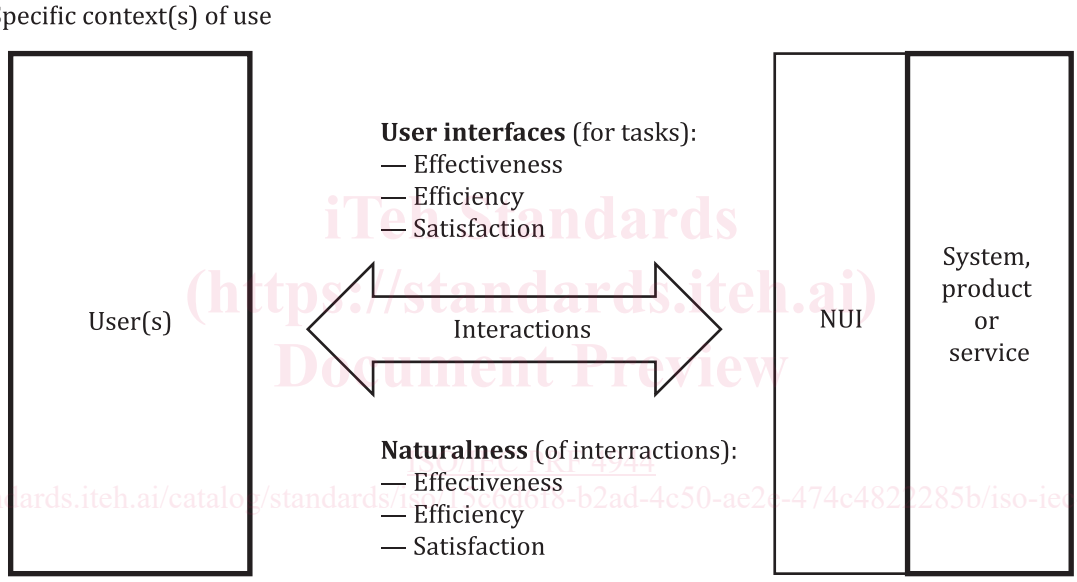

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Figure 1 — Framework for evaluating usability of NUI

5.2 NUI as a system, product or service being evaluated

While usability can be applied to many different things, it is important that usability evaluation focuses on a well-defined object of the evaluation.

While NUI is a part of a system that exists within a context of use, it is important that usability evaluation of NUI is limited to the context of use of the interface and does not extend to the whole system.

NUI can involve multiple media and modalities. It is important to clarify whether the evaluation is focusing on individual components of the NUI or the entire NUI.

5.3 Evaluating usability for diverse NUI users

In order for NUI to be natural, it is important that it be usable by a wide range of users.

When establishing the specified users for evaluating the usability of NUI, it is important to consider the usability of the NUI for diverse users.

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