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Road vehicles — Ergonomic aspects of human vehicle interactions — Taxonomy for the classification of adaptive interactive vehicle systems

Véhicules routiers — Aspects ergonomiques des interactions homme-véhicule — Taxonomie pour la classification des systèmes interactifs adaptatifs pour véhicules

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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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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.

This document was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 39, *Ergonomics*.

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

With increasing technical feasibility of artificial intelligence (AI), more companies are integrating AI-based adaptivity and personalization into vehicle systems to adapt their behavior and/or content to the needs or expectations of individual users or groups of users. This enables vehicle systems to match individual user preferences and assist and ease execution of non-driving related functions. For the driving context, this offers the potential to reduce workload and distraction by helping users to handle large amounts of information within road vehicles. Nevertheless, there is no uniform classification for the capacities and characteristics of the type of adaptivity for vehicle systems.

This may lead to several risks of misunderstandings and unmatched expectations for different stakeholders as well as for the end user. If the type of the adaptivity is not clear to the end user, it can lead to uncertainty and a lack of transparency, predictability, algorithmic awareness, and understanding of the vehicle system's capacities and limits. Developers as well as the manufacturers as stakeholders also bear the risks of misunderstandings or unmatched expectations within all phases of the development process (ISO/IEC/IEEE 29148).

The ISO 8235 was developed to classify vehicle functions regarding their type of adaptivity and parameters used to achieve the adaptations.

Standardizing the types of adaptation of vehicle systems serves the following purposes:

a) enables end users to assess the extent and limitations of adaptation specified by the manufacturers, suppliers and researchers,

b) provides an unambiguous framework for the specification of adaptive vehicle systems and the technical differentiation of the respective types of adaptivity in the requirement phase,

c) provides clarity and transparency in communication on the topic of adaptive vehicle systems for manufacturers, suppliers as well as researchers,

d) reduces uncertainty about the capacity and limitations associated with non-transparent black box technology solutions for the manufacturers,

e) prevents misunderstandings and deviating expectations between development partners of adaptive vehicle systems and therefore,

f) prevents unnecessary effort, duplicate work and costs in the development and evaluation of adaptive vehicle systems.

Road vehicles — Ergonomic aspects of human vehicle interactions — Taxonomy for the classification of adaptive interactive vehicle systems

1 Scope

This document provides a taxonomy to classify the type of adaptivity within vehicle systems. The taxonomy includes five types ranging from no adaptation (type 0) to adaptations based on interpreted user characteristics and context data (type 4). This document provides definitions of the five types of adaptation and explains adaptation in a consistent and coherent manner. By offering definitions and descriptions of the five types, this document can be used to classify the adaptivity within vehicle systems according to the types.

This document is intended to be applied to all components of vehicle systems that the driver and/or other occupants interact with either while driving or while parked. This includes vehicle information systems, communication systems, for example, navigation systems or mobile devices connected to the vehicle infrastructure, traffic and travel information (TTI) systems, as well as vehicle comfort systems, for example, climate control, massage, or ambient lighting. The taxonomy is also applicable to third-party software provided by third-party suppliers that is displayed and/or operated in the vehicle.

The taxonomy can also be applied to interactive exterior elements, like windscreen wipers or pedestrian communication devices and non-driving-related functions that are novel to future vehicles in the context of automated driving, such as playing a video.

The information and communication vehicle systems described in this document exclude driving-operation or driving-assistance systems. Consequently, safety-related functions governed by Automotive Safety Integrity Level (ASIL) specifications (ISO 26262) are not addressed. Implementation and validation of data collection/detection are also beyond the scope. Additionally, priority handling, as well as varying legal regulations across countries, are not covered in the taxonomy.

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
adaptable vehicle system
interactive system within a vehicle that can change its behaviour and/or content triggered by configurations from the user

[SOURCE: Reference [8]]

3.2
adaptation
proactive changes in the system behaviour and/or content based on user configurations, pre-defined rules or self-learned system rules

3.3
adaptive vehicle system
interactive system within a vehicle that can proactively change its behaviour and/or content triggered by certain events without intervention from the user

Note 1 to entry: Adapted from Reference [7].

3.4
black box
idealized mechanism that accepts inputs and produces outputs, but is designed such that an observer cannot see inside the box or determine exactly what is happening inside that box

Note 1 to entry: This term can be contrasted with *glass box* (3.13).

[SOURCE: ISO/IEC 18031:2011, 3.6]

3.5
context data
influencing factors from both, the general context of use as well as situational factors and conditions resulting from the surrounding environment

3.6
data processing
manner in which real time inputs are analysed by the system to decide on the suitable reaction and/or *adaptation* (3.2)

3.7
enhanced data
data that has been processed to enhance its quality, accuracy, or relevance

Note 1 to entry: This involves cleaning, filtering, combining data from multiple sources and adding contextual information before storage.

3.8
exterior element
element outside the vehicle with the function of taking on different states

3.9
individualization
modification of interaction and presentation of information to suit individual capabilities, needs and preferences of users

[SOURCE: ISO 9241-129:2010, 3.3, modified — "preferences" was added to the definition.]

3.10
non-driving related function
secondary (3.15), or *tertiary task* (3.17) the user can execute inside a vehicle that is not related to the *primary driving task* (3.12)

3.11
preference
predilection of a user pertaining to a vehicle system

Note 1 to entry: This includes the user's tastes, likes and dislikes with respect to the vehicle system and its properties.

[SOURCE: ISO/IEC TR 15938-8:2002, 2.2.2.41, modified — The original term was user preferences, in the definition predilection replaces preference and the note to entry was originally part of the definition.]

3.12
primary driving task
activity that the driver undertakes to maintain longitudinal and lateral vehicle control within the traffic environment

[SOURCE: ISO 17287:2003, 3.2.17]

3.13
priority
relative importance of two or more messages which determines their ranking in a time sequence or emphasis of presentation

[SOURCE: ISO 16951:2021, 3.10]

3.14
real-time learning
process of using live data input to continuously improve the vehicle system algorithms based on continuous learning

3.15
secondary task
function that increases the safety for the driver, the car and the environment

EXAMPLE Setting turning signals or activating the windshield wipers.

[SOURCE: Reference [9]]

3.16
stakeholder
person or organisation that may influence a decision or activity, may be influenced by it, or may have the impression of being influenced by it

Note 1 to entry: Stakeholders may include: users, purchasers, system owners or managers, and persons indirectly influenced by the operation of a system, product or service.

Note 2 to entry: Different stakeholders may have different needs, requirements and/or expectations.

[SOURCE: ISO 9241-11:2018, 3.1.9, modified — Affect(ed) was replaced by influence(d).]

3.17
tertiary task
any function regarding entertainment and information systems

[SOURCE: Reference [9]]

3.18
trait
temporal stable and cross-situational consistent characteristics of the user's personality

[SOURCE: Reference [10]]

3.19
user identification
identification of user groups, such as family members sharing the same car key, and the identification of numerical identifiers, such as 1, 2, 3, etc., that users can utilize independently, is not limited to the identification of individuals by methods such as facial recognition

3.20
user interface
all components of an interactive system (software or hardware) that provide information and controls for the user to accomplish specific tasks with the interactive system

[SOURCE: ISO 9241-129:2010, 3.9]

4 Application

The taxonomy can be applied to classify systems or components within vehicle systems based on their type of adaptivity. As Figure 1 illustrates, vehicle systems are a comprehensive assembly consisting of several components. Each of these vehicle systems, for example, an infotainment system is further subdivided into several subsystems, e.g. a navigation system. Within each subsystem, various functions are organized, such as the destination input function or route guidance function within a navigation system.

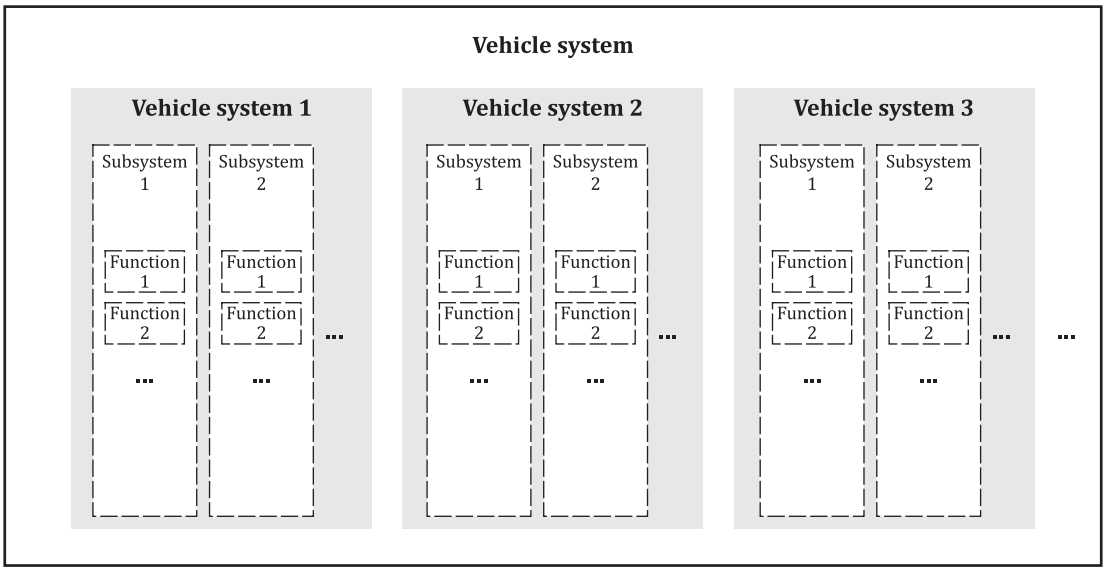

Figure 1 — Conceptual architecture of vehicle systems

The taxonomy is intended for application to all components of vehicle systems, classifying the type of adaptation to the driver and/or other vehicle occupants, either while driving, standstill or being parked. The taxonomy can also be applied to interactive exterior elements, like windscreen wipers or pedestrian communication devices and non-driving-related functions that are novel to future vehicles in the context of automated driving, such as playing a video. Functions provided by third-party suppliers are also included in the intended application.

When specifying the adaptivity type for a vehicle system, the documentation shall transparently state the relevant component, tailored to the appropriate target audience, e.g. for developers in the technical specification or for end users in the product description.

If the classified vehicle system includes multiple components, the documentation shall provide a clear description indicating the relevant component and whether other components of the vehicle system have a different adaptivity type. This transparency ensures a relatable application of the taxonomy and enables the classified adaptivity types of vehicle systems to be comparable.

To define the adaptivity type of a vehicle system, the taxonomy is applied to the required data and data processing, as shown in Clause 5. More than one type can be applied to one vehicle system and its components, and combinations of types are possible.

5 Classification of the type of adaptivity for vehicle systems

5.1 General

Vehicle systems are classified into five types of adaptation ranging from type 0 with no adaptation, to type 4 as the highest type of adaptation. Vehicle systems at higher adaptation types exhibit more advanced data processing capabilities, including the ability to learn from observing user interactions.

In 5.2 to 5.6, each adaptation type is characterized by a general description, the necessary data and data processing requirements, and an illustrative data flow accompanied by a conceptual architecture.