ETSI TR 103 852 V1.1.1 (2023-04)

Human Factors (HF);
An Examination of Video Game Usability and Accessibility

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Foreword

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This Technical Report (TR) has been produced by ETSI Technical Committee Human Factors (HF).

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1 Scope

The present document describes and examines the problems arising from inconsistency of usability and accessibility design practices in video game controls and identifies the role of standards-based solutions to inconsistent design practise.

The present document also reports on the challenges relating to implementing usability and accessibility measures in video games. The usability and accessibility measures covered in the present document address their impact on users with hearing, vision, touch, cognitive and motor control types of disabilities. The gap analysis given in the present document refers to an idealized model to identify what needs to be done to bridge any identified gaps. The present document identifies use cases to describe the application of usability and accessibility measures and their relative impact on video games design and identifies mitigations to the identified gaps in the form of additional guidance or standardization from ETSI.

2 References

2.1 Normative references

Normative references are not applicable in the present document.

2.2 Informative references

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The following referenced documents are not necessary for the application of the present document, but they assist the user with regard to a particular subject area.

[i.1] 3GPP SA WG4: "Multimedia Codecs, Systems and Services".

[i.2] ETSI TR 101 568: "Human Factors (HF); A study of user context dependent multilingual communications for interactive applications".

[i.3] AbleGamers.

[i.4] Game Accessibility Guidelines.

[i.5] International Game Developers Association.

[i.6] The ablegamers charity.

[i.7] Can I play that?

[i.8] ISO/TR 22411:2021: "Ergonomics data for use in the application of ISO/IEC Guide 71:2014".

[i.9] ISO/IEC Guide 71:2014: "Guide for addressing accessibility in standards".

[i.10] ETSI EG 203 350 (V1.1.1): "Human Factors (HF); Guidelines for the design of mobile ICT devices and their related applications for people with cognitive disabilities".

[i.11] EN 301 549 (V3.2.1) (2021-03): "Harmonised European Standard; Accessibility requirements for ICT products and services" (jointly produced by ETSI/CEN/CENELEC).

[i.12] IEEE Standards Association (SA) P2843: "Accessibility and Digital Inclusion Working Group (ADIWG); Standard for Measuring Accessibility Experience and Compliance".

[i.13] Ludogogy: "Designing for accessibility in games".

[i.14] WC3: "WCAG 2.0 Guidelines".

[i.15] Can I play that?: "Accessibility-reference-guides".

[i.16] Game Accessibility Guidelines: "Full list".

[i.17] Can I play that?: "Color-blindness-accessibility-guide".

[i.18] Journal of Neurologic Physical Therapy; 2013; 37(4): "Video games and rehabilitation: using design principles to enhance engagement in physical therapy". Keith Lohse, Navid Shirzad, Alida Verster, Nicola Hodges, H F Machiel Van der Loos.

[i.19] International Journal of Audiology; 2014: Listening effort and fatigue: What exactly are we measuring? A British Society of Audiology Cognition in Hearing Special Interest Group 'white paper'. Ronan McGarrigle, Kevin J. Munro, Piers Dawes, Andrew J. Stewart, David R. Moore, Johanna G. Barry & Sygal Amitay.

[i.20] Frontiers in Psychology; 2022: "Listening Effort Informed Quality of Experience Evaluation". Pheobe Wenyi Sun and Andrew Hines.

[i.21] World Health Organization: "Health-topics".

[i.22] W3C Candidate Recommendation Draft 25 January 2023: "Web Content Accessibility Guidelines (WCAG) 2.2".

[i.23] Medical News Today: "What-does-neurotypical, neurodivergent, and neurodiverse mean?".

[i.24] Games and Culture: "Disability and Video Games Journalism: A Discourse Analysis of Accessibility and Gaming Culture". Sky LaRell Anderson and Karen Schrier. 2022; Vol. 17(2) 179-197.

[i.25] Information: "Game Accessibility and Advocacy for Participation of the Japanese Disability Community". Muneo Kaigo and Sae Okura. 2020; 11, 162.

[i.26] The 16th International Conference on the Foundations of Digital Game; 2021; 28, 1-9; Grounded Theory of Accessible Game Development; Jozef Kulik, Jen Beeston and Paul Cairns.

[i.27] News: "Gaming for Everyone, the Accessibility Features of Forza Horizon 5".

[i.28] News: "Making Empathy Accessible in Life is Strange: True Colors, Available Now for Xbox One and Xbox Series X|S".

[i.29] Blog: "The Last Of Us Part II, Accessibility Features Detailed".

[i.30] Article: "Hellblade Accessibility - Accessibility Features".

[i.31] 3GPP TR 26.926: "Traffic Models and Quality Evaluation Methods for Media and XR Services in 5G Systems".

[i.32] Federal Communications Commission (FCC): "The United States' 21st Century Communications and Video Accessibility Act (CCVAA)". Wednesday, January 27, 2021.

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3 Definition of terms, symbols, and abbreviations

3.1 Terms

For the purposes of the present document, the following terms apply:

accessibility: design of products, devices, services, vehicles, or environments to be usable by people with disabilities

useability: quality or state of being usable

user experience: user's perceptions and responses that result from the use and/or anticipated use of a system, product, or service

3.2 Symbols

Void.

3.3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

ACS	Advanced Communication Services
ADF Japan	Accessible Design Foundation of Japan
AR	Augmented Reality
ASL	American Sign Language
BSL	British Sign Language
CVAA	Communications and Video Accessibility Act
CVD	Colour Vision Deficiency
dB	decibel
ESA	Entertainment Software Association
HUD	Heads Up Display
ICD	International Classification of Diseases
ICT	Information and Communications Technology
IGDA	International Game Developers Association
NPC	Non-Player Character
OS	Operating System
QoE	Quality of Experience
SA	System Aspects
SDO	Standards Development Organisation
TSG	Technical Specification Group
UI	User Interface
VR	Virtual Reality
WCAG	Web Content Accessibility Guidelines
WHO	World Health Organisation
XR	eXtended Realities

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4 Context

4.1 Background Information

At the time of preparation of the present document there is no existing common standard for the design and implementation for accessibility and usability in video games. Though ETSI, ITU and 3GPP have covered video games within other work.

NOTE: Whilst the general term is "video game" the technology used in video games extends to interactive media for work, education, and entertainment.

3GPP TSG SA WG4 (SA4) [i.1] have developed and published a number of technical specifications of codecs for speech, audio, video, graphics, and other media types related to emerging services such as eXtended Realities (XR) in specification 26.926 'Traffic Models and Quality Evaluation Methods for Media and XR Services in 5G Systems' [i.31] and gaming, as well as the system and delivery aspects of such contents.

ITU-T E2E Network Characteristics Requirement for Video Services which examines the balance between Quality of Service while ensuring a satisfactory Quality of Experience (QoE) level to the end users during the service delivery covered video games within its scope and with a liaison agreement with ETSI ISG F5G meant they were consulted during the creation of this requirement.

Previously, ETSI TR 101 568 [i.2] from the Human Factors (HF) group reported on the issues around consistent localization within video games and examined the language and the interface requirements to accommodate differences between languages.

At the time of writing there are some limited specific regulations that exist which apply to video games (i.e. general usability guidance applies). The United States' 21st Century Communications and Video Accessibility Act 2010 [i.32] (CVAA) did attempt to bring up-to-date accessibility guidelines to Advanced Communication Services (ACS), which are considered to include video games with communication elements including text and voice chat, and the User Interface (UI) elements to reach embedded chat applications. Video game trade groups including the Entertainment Software Association have requested waivers of CVAA enforcement for video games, arguing that while there is strong interest in the video game community to provide accessibility, video games are first and foremost for entertainment and not for communication, and that because of the complexity of video game software, there are few standardized solutions compared to other ACS platforms. The exclusion of anyone by seeking such waivers is a concern. This examination will aim to counter those concerns.

The affected elements include the various forms of input devices and the user experience. Whilst some industry players have begun to address accessibility there are no independent standards addressing accessibility in this domain. Which this exanimation will address.

EXAMPLE On September 4, 2018, Microsoft released the Xbox Adaptive Controller designed primarily to meet the needs of gamers with limited mobility, the Xbox Adaptive Controller features large programmable buttons and connects to external switches, buttons, mounts, and joysticks to help make gaming more accessible on Xbox One and X/S consoles and Windows 10 PCs. It can also support various type of 1st and 3rd party adaptive accessories.

4.2 Current State

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In the area of accessibility and usability in video games so far only guidelines from advocacy organizations (i.e. not formal SDOs) have been published. These groups include:

- AbleGamers [i.3];
- Game accessibility guidelines [i.4];
- International Game Developers Association (IGDA) [i.5];
- the ablegamers charity [i.6]; and
- Can I Play That? [i.7].

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These are important areas to address as video games makes use of telecommunications, audio-visual media services, the web-based technologies. While these areas do have their own accessibility requirements, they do not automatically apply to videos games which can make use of the same accessibility methods.

It is important to note that video games are not just used for entertainment purposes they are also used as important tools for training, education, and healthcare. In healthcare patient nonadherence with therapy is a major barrier to rehabilitation. Recovery is often limited and requires prolonged, intensive rehabilitation that is time-consuming, expensive, and difficult. The use of video games in rehabilitation makes use of the behavioural, physiological, and motivational effects of gameplay. Research has shown that video games are beneficial for cognitive and motor skill learning in both rehabilitation science and experimental studies with healthy subjects. Physiological data suggest that gameplay can induce neuroplastic reorganization that leads to long-term retention and transfer of skill. There is evidence showing that key factors in game design, including choice, reward, and goals, lead to increased motivation and engagement. Motion controllers can be used to practice rehabilitation-relevant movements, and well-designed game mechanics can augment patient engagement and motivation in rehabilitation.

Though a key point video game play is used as a supplement to traditional therapy not a replacement [i.18]. In training and education video games are used to help enhance or develop skills in learning in preparation for roles they may perform as part of their job. Along with games have been known to enhance the following skills in learners. Firstly cognitive, games enhance mental rotation abilities. It improves the learners' problem-solving skills by encouraging them to solve problems through trial and error. It also boosts creativity amongst the learners. Secondly, motivational, games boost self-esteem when the learners work through obstacles and conquer them. Games provide instant feedback so that learners know immediately where they are going wrong. Thirdly, social games are often not solo activities. In fact, most learning games encourage employees to collaborate and play in a team or in competition with each other. Learners get to develop their social skills that lead to long-term social relationships.

With ICT accessibility being often complemented by assistive technology. Interoperability of the two is required to ensure access by persons with disability to ICT and ICT based services on equal basis with others. Video games are often included under ICT products. Video games these days are not just for entertainment they are also a tool for learning, communication, and societal interaction. Therefore, barriers to access because of usability limitations and limited support of assistive technologies are discriminatory. Due to the nature of video games, they can serve as entry to learn and experience another culture as they represent a prominent element of popular culture, with the ability to play as well as participate in video game discourse being a matter of inclusion and equality [i.26]. For example Western (North America/Europe) games enjoying Eastern (Asian) games and vice versa. Barriers to this should be minimal or even non-existent.

Researchers from Japan [i.25] have discussed how to define accessible video games by adapting the Accessible Design Foundation of Japan (ADF Japan) definition "accessible products and services" (*Kyoyohin* products and services) as things "designed to be used by as many people as possible, including older persons and persons with disabilities". These products and services are characterized by the following principles:

1) they meet various physical and intellectual needs;

2) they are easily communicable using multiple means (e.g. visual, auditory, and tactile aids);

3) they are operational methods that can be intuitively understood and cause little psychological strain;

4) they are easy to use with little physical burden (i.e. they can be handled with minimum effort and easily accommodate motion, approach, etc.); and

5) all of their components are considered safe, including materials, structure, function, procedure, and sustainability-friendly features. There are three parts which make up *Kyoyohin* Products and Services shown in figure 1.

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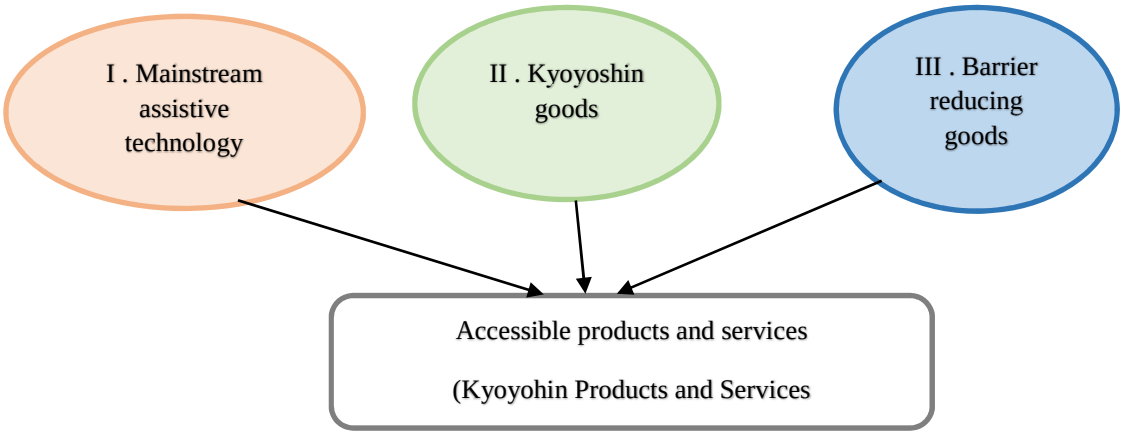

Figure 1: Concept of Kyoyohin products and Services

From the Japanese perspective definition, a video games could be described as accessible if it makes use of assistive technology and has reduced barriers to be used along with designed or created to be played by the widest group of people as possible. This aligns with efforts in Europe and America to improve and ensure accessibility and useability within video games.

The reasons why it can be difficult create usable video games is that there is a conflict between a high-usability level and great user-experience. This might seem to be a contradiction, but there is an important difference between the two. Usability is about the "ability to use" something whereas user-experience is about feelings. The aim for a usable product or service is to make it easy to use, whilst QoE makes it a good experience that users may wish to repeat.

A product or service can be considered to have a high level of usability when:

1) It requires less mental effort to use.

2) The frequency of mistakes using it is less, or when the mistakes are less disastrous.

3) It is more powerful, where "more powerful" means that it can be used to do more or do it faster.

4) It is more learnable, that is, when a user can figure it out quicker.

There are guides and tools which can provide metrics to measure the usability of a video games. While user-experience is not like usability - it is about feelings. The aim here is to create satisfaction. The game designers want the user to feel satisfied before, during and after they have played their chosen video game. To do that they need to take all kinds of things into consideration. These can include:

1) Environment.

2) Colours (affects interaction/navigation within a digital space).

3) Touch.

4) Audio feedback.

5) Visual feedback.

6) Trust (confidence in actions or a system).

7) Branding.

8) Usefulness.

9) Emotional effect.

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This is much harder to achieve. None of these things can be accurately analysed or where effective metrics exist to measure their effect. Most developers try to find the right balance between high usability and high user-experience. Overall, the player should never ever feel helpless or stupid when playing a video game. This equally applies to all kind of products related to them, including accessories, peripherals, software, and devices used to access and play the games. When it comes to the usability, there is a big difference between our assumptions and reality therefore testing, reviewing, and applying feedback is important in ensuring the balance between useability and the user experience.

Many different format and ways to experience video games from AR, VR mobile to personal computers and dedicated devices (handheld/tv) mean that a common standard for implementing accessibility measures is vital to scale and adapt to which ever device is being used to play the video game.

From various standards bodies there are technical reports and guides which provide guidance plus test evaluation criteria for consumer devices a summary of which is given below. The data and information provided in these documents can be applied to be video games though they are not the primary focus of these documents:

- Ergonomics data for use in the application of ISO/IEC Guide 71:2014 [i.8]. This document provides ergonomics data for standard developers to use in applying ISO/IEC Guide 71:2014 [i.8] to address accessibility in standards. These data can also be used by ergonomists and designers to support the development of more accessible products, systems, services, environments, and facilities.

- ISO/IEC Guide for addressing accessibility in standards [i.9]. The purpose of this Guide is to assist standards developers to address accessibility in standards that focus whether directly or indirectly, on any type of system that people use. It provides guidance for developing and writing appropriate accessibility requirements and recommendations in standards. However, this Guide contains information that can also be useful to other people, such as manufacturers, designers, service providers and educators.

- ETSI Human Factors: Guidelines for the design of mobile ICT devices and their related applications for people with cognitive disabilities [i.10]. The document contains design guidelines for mobile devices and applications that will enable persons with limited cognitive, language and learning abilities (including people with age-related cognitive impairments) to have an improved user experience when using mobile ICT devices and applications. The guidelines apply to the design of mobile ICT devices and mobile applications (whether they are standalone or whether they provide access to related services). The guidelines in the document complement existing usability and accessibility guidelines.

- ETSI/CEN-CENELEC: Harmonised European Standard; Accessibility requirements for ICT products and services [i.11]. This document specifies the functional accessibility requirements applicable to ICT products and services, together with a description of the test procedures and evaluation methodology for each accessibility requirement in a form that is suitable for use in public procurement within Europe. The present document is intended to be used with web-based technologies, non-web technologies and hybrids that use both. It covers both software and hardware as well as services. It is intended for use by both providers and procurers, but it is expected that it will also be of use to many others as well.

- IEEE SA: Standard for Measuring Accessibility Experience [i.12]. This standard defines test evaluation criteria which can be used to measure the accessibility user experience of devices, applications, websites, appliances, and emerging immersive devices such as Augmented Reality and Virtual Reality (AR/VR) systems by people with different disabilities and the elderly. Evaluation criteria for both user experience and compliance are defined.

5 Design Challenges

5.1 Introduction

The design challenges of video game accessibility and usability has two key issues:

- on one side how users (with disabilities) access information or interact with the game; and

- on the other side how, the developers enable accessibility and useability (by removing obstacle) [i.13].

From WCAG guidelines ideally content should be perceivable (be able to receive audio/visual feedback), operable (able to input actions and commands), understandable (understand and process the information the game gives to the user), and robust (able to work with current and future input agents) [i.14]. While EN 301 549 [i.11] specifies the functional accessibility requirements applicable to ICT products and services, together with a description of the test procedures and evaluation methodology for each accessibility requirement in a form that is suitable for use in public procurement within Europe. As it covers both hardware and software it is applicable to video games. This is supported by the ETSI EG 203 350 [i.10] while it does not provide design guidance it aims to simplifying end-user access to ICT devices, services, and applications by providing recommended terms for basic and commonly used ICT-related objects and activities, limited to those terms that end users are commonly exposed to. With video games generally released in multiple countries ensuring consistent use of terms is important but the limitation of this guide is only using five languages: English, French, German, Italian, and Spanish (as spoken in their respective European countries). Most of the design challenges when addressed can be considered good design practice for the benefit of all users but disabled users can be left out without them being addressed. The following sections draw from WHO definitions [i.21], WCAG guidelines [i.22] and EN 301 549 [i.11].

5.2 Hearing

5.2.1 Definition

The WHO defines deafness and hearing loss as a person who is not able to hear as well as someone with normal hearing - hearing thresholds of 20 dB or better in both ears - is said to have hearing loss. Hearing loss may be mild, moderate, severe, or profound. It can affect one ear or both ears and leads to difficulty or a lack of ability in hearing conversational speech or sounds. Recently, there has been research and efforts to determine listening effort and use it to inform the quality of the experience [i.19]. The perceived quality of experience for speech listening is influenced by cognitive processing and can affect a listener's comprehension, engagement, and responsiveness. Quality of Experience (QoE) is a paradigm used within the media technology community to assess media quality by linking quantifiable media parameters to perceived quality [i.20]. While this area of research has yet to be included in standards or technical requirements it may prove valuable when implementing the audio aspect of video game design to improve audio accessibility and useability.

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