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An Examination of Video Game Usability and Accessibility

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ETSI

650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - APE 7112B
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Foreword

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

Modal verbs terminology

In the present document "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the ETSI Drafting Rules (Verbal forms for the expression of provisions).

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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

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

NOTE: While any hyperlinks included in this clause were valid at the time of publication ETSI cannot guarantee their long-term validity.

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.

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

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

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].

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.

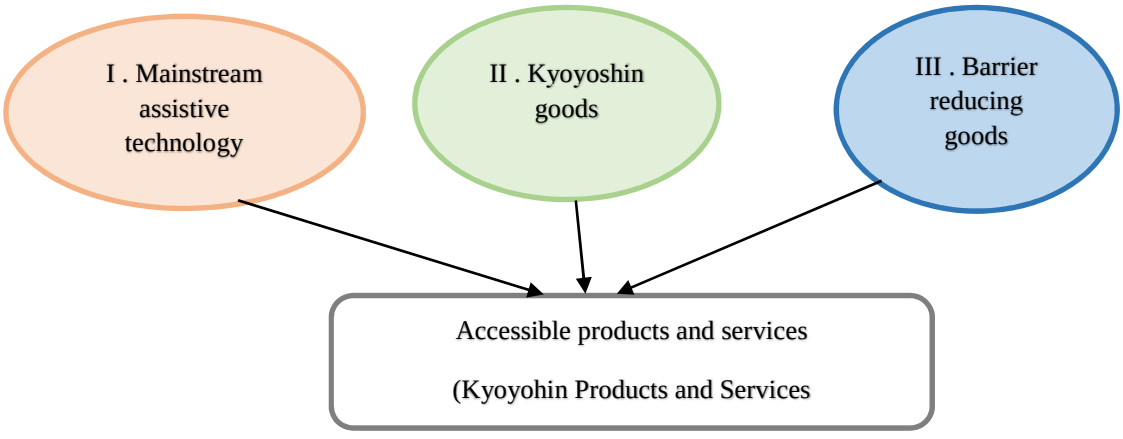


Figure 1: Concept of Kyoyohin products and Services

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.

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.

5.2.2 Current Requirement Usage without Hearing

Where ICT provides auditory modes of operation, the ICT provides at least one mode of operation that does not require hearing. This is essential for users without hearing and benefits many more users in different situations.

NOTE: Visual and tactile user interfaces, including those based on sign language, may contribute towards meeting this clause.

5.2.3 Current Requirement Usage with Limited Hearing

Where ICT provides auditory modes of operation, the ICT provides enhanced audio features. This is essential for users with limited hearing and benefits many more users in different situations.

NOTE 1: Enhancement of the audio clarity, reduction of background noise, providing a joint non-oral option, adjustment of balance of both audio channels, increased range of volume and greater volume in the higher frequency range can contribute towards meeting this clause.

NOTE 2: Allowing the use of Assistive Listening Devices, such as headsets with noise cancellation (connected by cable, Bluetooth®, or WLAN) can contribute towards meeting this clause.

NOTE 3: Users with limited hearing may also benefit from non-hearing access (see clause 5.2.1).

5.3 Vision

5.3.1 Blind and Low-Vision

The World Health Organization (WHO) defines Blindness as visual acuity of less than 3/60 (0,05) or corresponding visual field loss in the better eye with best possible correction. (ICD-10 Codes 3, 4 & 5) while Low Vision corresponds to visual acuity of less than 6/18 (0,3) but equal to or better than 3/60 in the better eye with best correction. (ICD-10 Codes 1 & 2). This means an individual with low vision may struggle to perform visual tasks. A near blind individual may have unreliable vision and blind individual is without sight.

Where ICT provides visual modes of operation, the ICT provides at least one mode of operation that does not require vision. This is essential for users without vision and benefits many more users in different situations.

NOTE 1: A web page or application with a well-formed semantic structure can allow users without vision to identify, navigate and interact with a visual user interface.

NOTE 2: Audio and tactile user interfaces.

NOTE 3: Screen readers assistive technologies.

5.3.2 Colour-Blindness

Colour blindness occurs when an individual is unable to see colours in a normal way. It is also known as colour deficiency. This means they cannot distinguish between certain colours. This usually happens between greens and reds, and occasionally blues. There are different degrees of colour blindness. Some people with mild colour deficiencies can see colours normally in good light but have difficulty in dim light. Others cannot distinguish certain colours in any light. The most severe form of colour blindness, in which everything is seen in shades of grey, is uncommon.

Where ICT provides visual modes of operation, the ICT provides a visual mode of operation that does not require user perception of colour. This is essential for users with limited colour perception and benefits many more users in different situations.

NOTE: Where significant features of the user interface are colour-coded, the provision of additional methods of distinguishing between the features may contribute towards meeting this clause.

5.4 Cognitive *(Neurotypical, Neurodivergent and Neurodiverse)*

There are a broad range of issues and problems which can affect a person's cognitive ability. In general, though it is often a reduced ability to understand new or complex information and to learn and apply new skills. This means it can often take longer for a person to learn how to do something new or means they struggle to retain large amount of information that is given to them in a short period of time. The term "neurotypical" describes someone who thinks and processes information in ways that are typical within their culture and society. They tend to learn skills and reach developmental milestones around the same time as their peers. The meaning of "neurotypical" is also subjective, to an extent. Within culture and society what is considered typical can vary according to the context. The term "neurodivergent" describes people who process information and behave in a way that differs from the actual or perceived norms of a particular culture. It refers to the idea that differences in the human brain are natural and normal and, in many cases, can lead to meaningful and positive insights and abilities though there are cases where these differences require lifetime medical and assisted care. The term neurodiversity refers to the wide spectrum of ways that people think. It frames differences in cognition as variations, all of which are equally normal and valuable. People are described as neurodiverse when their thought patterns, behaviours, or learning styles fall outside of what is considered "normal," or neurotypical. Neurodiversity may be used alongside the terms "neurotypical" and "neurodivergent" to identify where individuals are on the neurodiversity spectrum. However, everyone is included in neurodiversity, regardless of how their brain functions [i.23].

The ICT provides features and/or presentation that makes it simpler and easier to understand, operate and use. This is essential for users with limited cognition, language, or learning, and benefits many more users in different situations.

NOTE 1: Adjustable timings, error indication and suggestion, and a logical focus order are examples of design features that may contribute towards meeting this clause.

NOTE 2: Providing an audio output of the text is an example of providing support for people with limited reading abilities.

NOTE 3: Providing spelling aid and word prediction of the text is an example of providing support for people with limited writing abilities.

NOTE 4: Interaction with content can be made easier, and less prone to errors, by presenting tasks in steps that are easy to follow.

5.5 Motor Control/Physical

Difficulties with (fine) motor control and physical movement can mean an individual has difficult with moving quickly or suddenly, coordination and/or sensation of feedback from objects. This can be to due muscle weakness or lack of muscle control which can caused by problems with the individual nervous system.

Where ICT requires manual actions, the ICT provides features that enable users to make use of the ICT through alternative actions not requiring manipulation, simultaneous action, or hand strength. This is essential for users with limited manipulation or strength and benefits many more users in different situations.

NOTE 1: Examples of operations that users may not be able to perform include those that require fine motor control, path dependant gestures, pinching, twisting of the wrist, tight grasping, or simultaneous manual actions.

NOTE 2: One-handed operation, sequential key entry and speech user interfaces may contribute towards meeting this clause.

NOTE 3: Some users have limited hand strength and may not be able to achieve the level of strength to perform an operation. Alternative user interface solutions that do not require hand strength may contribute towards meeting this clause.

Where ICT products are free-standing or installed, all the elements required for operation will need to be within reach of all users. This is essential for users with limited reach and benefits many more users in different situations.

NOTE 4: Considering the needs of wheelchair users and the range of user statures in the placing of operational elements of the user interface may contribute towards meeting this clause.

5.6 Summary

It could be considered that the key to accessibility is for the user interface to be customizable to each of their (end-user) specific needs.

6 Usability and Accessibility within Video Games

6.1 Introduction

The identified solutions in this clause are solutions identified from various Games Accessibility Guidelines ([i.16] and [i.15]) and endorsed in the present document. They cover most possible solutions to ensuring accessibility in video games, but the solution listed are non-exhaustive.

6.2 Hearing

Deaf and hard of hearing users are seeking the same kind of immersion in games that hearing experience. Users want to and understanding know what is happening within the game [i.15].

Provide subtitles for all important speech. And, if any subtitles/captions are used, they should be presented in a clear, easy to read way.

Provide a visual indication of who is currently speaking.

Support text and visual means of communication alongside voice in multiplayer.

It should be that all important supplementary information (e.g. the direction the direction of sound an action is coming from) conveyed by audio is replicated in text/visuals.

6.3 Vision

6.3.1 Blind and Low-Vision

This is about ensuring users can perceive the visual experience of the game. There are many different aspects to vision including colour, near vision, distance vision, central vision, peripheral vision, visual field, depth perception, light sensitivity, ability to recognize motion, time it takes to register what a user sees, eye strain, motion sickness, ability to focus and time it takes to do so, natural fluctuations in visual acuity, etc. [i.15].

Solutions identified in Games Accessibility Guidelines ([i.16] and [i.15]) and endorsed in the present document:

1) There should no essential information is conveyed by a colour alone. It could be supported by using shapes, sounds and animations to support the information.

2) Use an easily readable default font size plus allow the font size to be adjusted along with simple clear text formatting.

3) Provide high contrast between text/UI and background.

4) It should be interactive elements/virtual controls are large and well-spaced, particularly on small or touch screens.

5) They should screen reader support for mobile devices along with general support for screen readers in elements such as menus and installers.

6) Should provide an option to adjust contrast.

7) Should allow interfaces to be resized.

8) Should make use of distinct sound/music design for objects and events.

9) Should provide an audio description track.

6.3.2 Colour-Blindness

Users with colour-blindness have difficulty distinguishing some colours from each other; purple might look like blue; brown might look like green, and red might look like black. These are just a few examples. Users with colour-blindness experience a variety of problems in video games. Information presented through colour can be unreadable or completely invisible, friendly players can look like enemies, and game elements can become camouflaged against each other. This can lead to frustrating gameplay experiences, and some games can be rendered entirely unplayable [i.15].

Solutions from [i.17]:

1) Should make use of colour-blind preview tools/simulators to better understand how colour-blind players will experience the video game.

2) If it cannot be avoided using text colours for information, there should be another visual element present to inform the user, such as an icon, image, or border. Also, it is best to avoid making the text itself more visually complex, as this can make it harder to read for players with dyslexia or reduced vision.

3) If it cannot be void using colour to distinguish information, then it should be considered implementing a colour-blind mode for the user to use. Ideal colour-blind modes allow the user to choose the colours of the most important element. For example, if the video game is a team-based game, allow the user to set the colours for "their team" and "opposing team".

4) It should be easy to find the colour options in the menus. Either by implement a specific accessibility menu or including them in the graphics options. It should be as easy as possible for users to find the options than can make the experience playable.

6.4 Cognitive

Cognitive disabilities or cognitive difficulties covers a wide array of experiences, including executive dysfunction, information processing, memory loss, and dyslexia, as well as those with triggers for photosensitivity, sensory overload, and motion sickness. This concerns the presentation of information within video games [i.15].

Solutions identified from various Games Accessibility Guidelines ([i.16], [i.15]) and endorsed in the present document:

1) It should include tutorials for all essential functions.

2) Allow users to progress through text prompts at their own pace.

3) Should include contextual in-game help/guidance/tips.

4) Should indicate/allow reminder of current objective during gameplay.

5) Should indicate/allow reminder of controls during gameplay.

6) Should include a means of practicing without failure, such as a tutorial, practice level or sandbox mode.

6.5 Motor Control/Physical

User with reduced mobility or dexterity have diverse needs when it comes down to accessibility in games, but in general terms there are options that benefit most of them. The way users interact with a game is either through a keyboard, mouse, gamepad, or a touchscreen and this means that these options can be used by all players, disabled or not [i.15].

Solutions identified from various Games Accessibility Guidelines ([i.16], [i.15]) and endorsed in the present document:

1) Should allow controls to be remapped/reconfigured and adjust the sensitivity of controls.

2) Should ensure controls are as simple as possible or provide a simpler alternative.

3) Should ensure that all areas of the user interface can be accessed using the same input method as the gameplay.

4) Should include toggle/slider for any haptics.

5) Should support more than one input device.

6) Make interactive elements that require accuracy (e.g. cursor/touch-controlled menu options) stationary.

7) Should ensure that multiple simultaneous actions (e.g. click/drag or swipe) are not required, and included only as a supplementary/alternative input method.

8) Should ensure that all key actions can be carried out by digital controls (pad/keys/presses), with more complex input (e.g. analogue, speech, gesture) not required, and included only as supplementary/alternative input methods.

9) Avoid repeated inputs (button-mashing/quick time events).

10) If producing a PC game, support windowed mode for compatibility with overlaid virtual keyboards support.

11) Avoid/provide alternatives to requiring buttons to be held down.

12) Do not rely on motion tracking of specific body types.

13) Should support play in both portrait and landscape.

14) Do not make precise timing essential to gameplay - offer alternatives, actions that can be carried out while paused, or a skip mechanism.

15) Include a cool-down period (post acceptance delay) of 0,5 seconds between inputs.

16) Should Provide very simple control schemes that are compatible with assistive technology devices, such as switch or eye tracking.

7 Gap Analysis

7.1 Ideal State

An ideal state of video game accessibility and useability are that the video game can meet all the requirements under EN 301 549 [i.11]. The are many potential solutions for what these could be. Due wide range of different designs with video games themselves for example the players perspective can vary from first-person, second-person, third-person, top-down, isometric, etc. This could affect how accessibility is implemented within the video game itself. This is before the different types and styles of play and genre are considered. But this variability should not dissuade designers and developers from implementing accessibly measures into games.

Examples of measures that can be implemented to meet the requirements if EN 301 549 [i.11] include:

- Motor Control/Physical: Remappable controls support accessible controls/assistive devices.
- Hearing limited or without: Subtitles - closed-captions.
- Vision: Colour-blind options - Research has shown the most common form of colour-blindness is the red-green variety. As many as 8 percent of all men have some variation of colour-blindness. So, video game developers should include an alternative way to provide in game information, other than colour.
- Cognitive: Tutorials - Many people in the world are kinaesthetic or tactile learners. Meaning they learn by actually carrying out the activities themselves. For these people tutorials are invaluable. Tutorials give users the ability to learn how to play the game without fear of loss or defeat. This allows users with cognitive disabilities to learn the mechanics of the game without fear of failure.

A complete list of options depends on a game's genre and the designer's intentions for the player. So, the ideal state would have to cover all the options possible within the framework of a particular game. But this creates another set of problems as implementing any ideal state will increase the time, money and resources needed to complete the production of a video game which not all video games studios will be able to achieve.

7.2 Current State

There is today a wide range of accessibility and useability implementations within video games. What follows is gives examples of overviews of how three types of games have different levels of accessibility and useability implementations.

An example of the broadest range of accessibility measures has been implemented in a video game which is a racing video game set in an open environment based in a fictional representation of a particular country. During offline game play the player has the option of adjusting game speed which can provide more time to react-to the on-screen events. There are options to enable visual accessibility options to change the colour of game map icons and the user interface. This makes it easier to visualize game elements and menu items by compensating for colour blindness. With players able to choose from Deuteranopia (Green), Protanopia (Red), and Tritanopia (Blue). The individual colour-blind filters that apply to all of the game visuals, including cars and the environment around the player. This does not change the game UI as it can be adjusted separately. High Contrast mode makes it much easier to read text across the game's colourful backgrounds. The game also supports full controller remapping functionality and support for 3rd part and custom controllers. This enables players to customize their controller and wheel settings to their preference. Subtitles can be enabled for all pertinent diallage in cinematics and gameplay which the options to adjust font, background opacity and highlight keywords. This game includes support for screen reading narration that reads text, buttons, and other elements aloud - allowing audio to guide the player through the game. Also, the game supports Speech-to-Text and Text-to-Speech to communicate with other players a player meets in the game. In an update to the game players can enable American Sign Language (ASL) and British Sign Language (BSL) for cinematics in the Accessibility menu. This feature works by using a picture-in-picture display of an ASL or BSL interpreter during cinematic game scenes. Players can change where the interpreter appears on screen and adjust the background colour to their preference.

An example of average range of accessibility measures implemented in a video game is an action, adventure, role-playing game. It is presented in a fixed camera, third-person perspective; in certain instances, free camera movement is available to player. This game is able to take advantage of global settings on the platform which are button remapping and screen zoom feature. The game itself has subtitles always on by default along cues to show who is speaking. It has additional options of the text speed to be changes, enable or disable gyroscope controls and ability to play one-handed. The accessibility features this game is missing are to visual measures such as colour blindness while the measures it has relate to are hearing, cognitive and motor control.

An example of a video game with minimal accessibility measures implemented in a video game is a single player, story-driven turn-based role-playing game. It has no dedicated accessibility menu. Now, not to say that that is a bad thing as it could be argued that all options are accessibility, and anything that allows the player to customize their play style makes it accessible. A player can adjust the battle speed from sort of a standard-setting that they have, and then there's also a, there's also slow battle speed. So, if they need sort of time to kind of be able to decide which buttons to be able to push, then this will basically help them out with that. The player is able to adjust the camera movement speed which is helpful for cognitive disabilities. So, if the player finds they get motion sick from the camera moving pretty fast, they are able to adjust that. Also, the player is able to adjust the, where the camera is positioned. While subtitles are present there are no options to adjust how they appear. The game also lacks controller remapping so instead they player would have to rely on the global settings of the platform is they require a custom controller layout or make use of a co-player to help them through parts of the game they cannot manage due to being unable to adapt the controls of the game.

There are different reasons as to why there are different levels of accessibility within video games. One reason is the amount the resources of the developers as a greater number of features are added to the game more time is need for testing, implementation etc. Another reason is the knowledge and experience of the developers themselves while unfortunately often in design people do not think to implement features, they do not see a need for or are oblivious to other needs which are not their own. Sometimes when there is no mandated requirement for a feature to be included it is simply not implemented. Though overall implementations of accessibility measures are getting better though the large disparity in how and the type of features available can sometimes be frustrating for the player.

It should be noted that today dedicated gaming devices have global options for accessibility. This is the same with computer Operating Systems (OS) that implement features as part of the OS settings. Though these do reply on the video game making use of them of these global settings and not overriding them when the game itself launches.

7.3 Closing the Gap

There are areas of focus that could help to close the gap [i.24]. Universally accessible design perhaps cannot be perfectly applied to every game, but game developers can apply thoughtfulness toward accessibility in the game creation process. Also, the need greater awareness of design approaches that are inclusive, such as for enhanced accessibility. This may lead to improved games for the widest possible game-playing audience. Further communication between developers and players with disabilities by including them, and their concerns, into the game design process. Rather than seeing people with disabilities as separate individuals, designers should consider how to see them as partners who can collaborate to build the experience. There have been games that found success by doing this. It should be noted that mass-marketed, wide-release games, which often spend years in development, should include persons with disabilities as consultants and co-creators, especially since their input would most likely improve the experience for all players. Advocacy for sharing best practices and standards if they so choose game studios should publicly announce how they adhere to current best practices for universal design and accessibility. In addition, they should continue to further the field and participate alongside other studios across the industry in developing and sharing guidelines and design patterns that can help all organizations. These documents should come with suggestions on how to adapt the guidelines to different types of game experiences so that game companies can adjust how they approach accessibility depending on the nature of each game. Organizations mentioned previously like AbleGamers Foundation are already sharing best practices and design patterns. All players benefit from greater accessibility as changes in design can better support people with disabilities, these changes will also help all people. Throughout a person's lifetime they experience changes which may affect their ability to enjoy and play videos games therefore thinking about apply accessibility to help one group of people is the wrong approach. Adequately understanding how talking about accessibility in gaming carries with it the potential to practically improve lives. Designing for accessibility makes games more accessible for everyone.

It is important to note that there will be a need to balance of implementation of these accessibility and useability measures in the area of entertainment use when compared to the use of games in a work, teaching, or medical environment where they are used as tools to specific functions and where certain accessibility measures may conflict with those functions. For example, in a video game tool for teaching safety and awareness, reflecting the real-world failing may be part of the learning experience so any accessible measures should not conflict with those goals.

8 Real world use cases

8.1 Introduction

This clause describes real-world use cases of accessibility and useability measures that have been implemented in video games. This will make use of meet the requirements stated in EN 301 549 [i.11] how different videos meet have those requirements. The chosen examples are not an endorsement of them as products but for their implementation of the measures they use for improving accessibly and useability.

8.2 Hearing

Forza Horizon 5 [i.27]

Forza Horizon 5 is a 2021 racing video game developed by Playground Games and published by Xbox Game Studios. It is set in an open world environment based in a fictional representation of Mexico.

- Accessibility features.

NOTE 1: Subtitles:

  - turn subtitles on or off;
  - adjust the font size;
  - adjust the background opacity;
  - ability to highlight key words.

NOTE 2: Customize the menu and gameplay font size.

NOTE 3: Screen reader narrator that reads text, buttons, and other elements aloud.

NOTE 4: Text-to-speech and speech-to-text options for players that want to participate in Voice Chat and either need to send synthesized voice or receive voice chat as synthesized text.

NOTE 5: Support for American Sign Language (ASL) and British Sign Language (BSL) for cinematics in Forza Horizon 5. This feature will include a picture-in picture display near the bottom of the screen of an ASL/BSL interpreter during the cinematics in the game.

8.3 Vision

Life is Strange: True Colors [i.28]

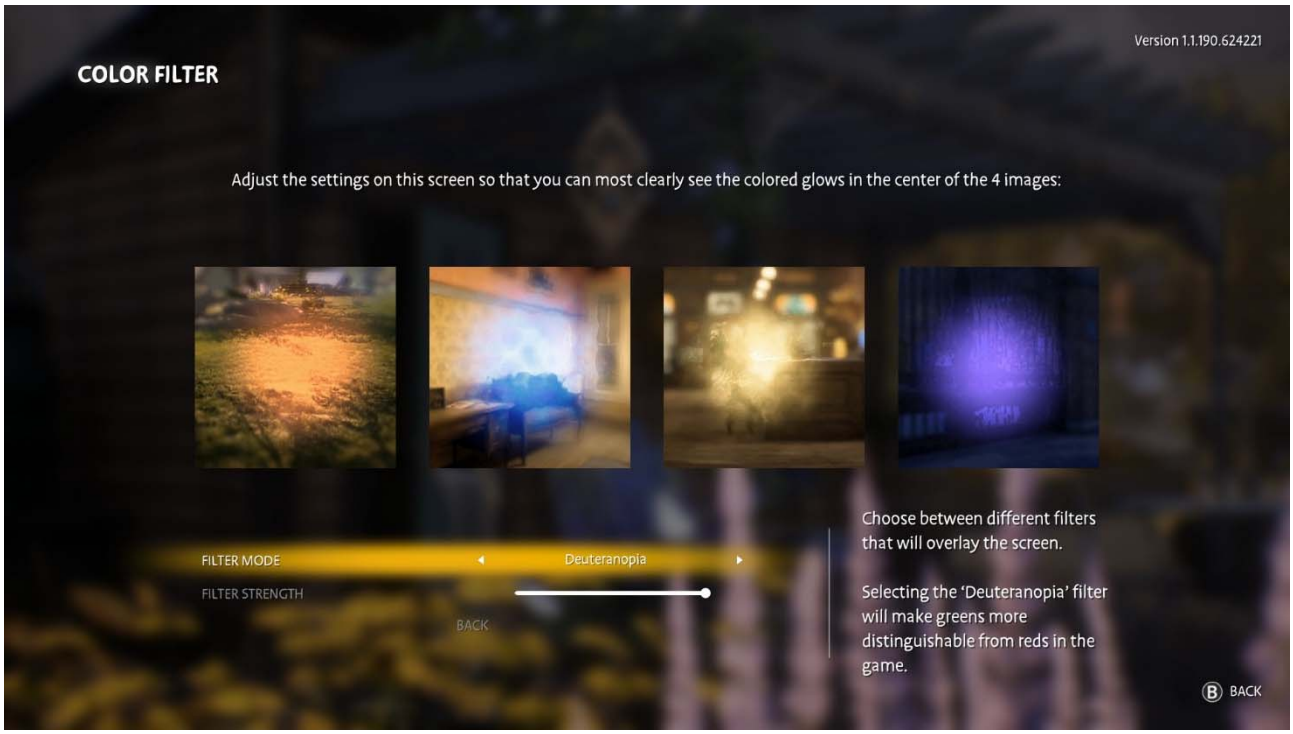
Life Is Strange: True Colors is a graphic adventure, played from a third-person view, video game developed by Deck Nine and published by Square Enix.

- Accessibility options.

NOTE: Adjust the font style, which affects all subtitles and game text.

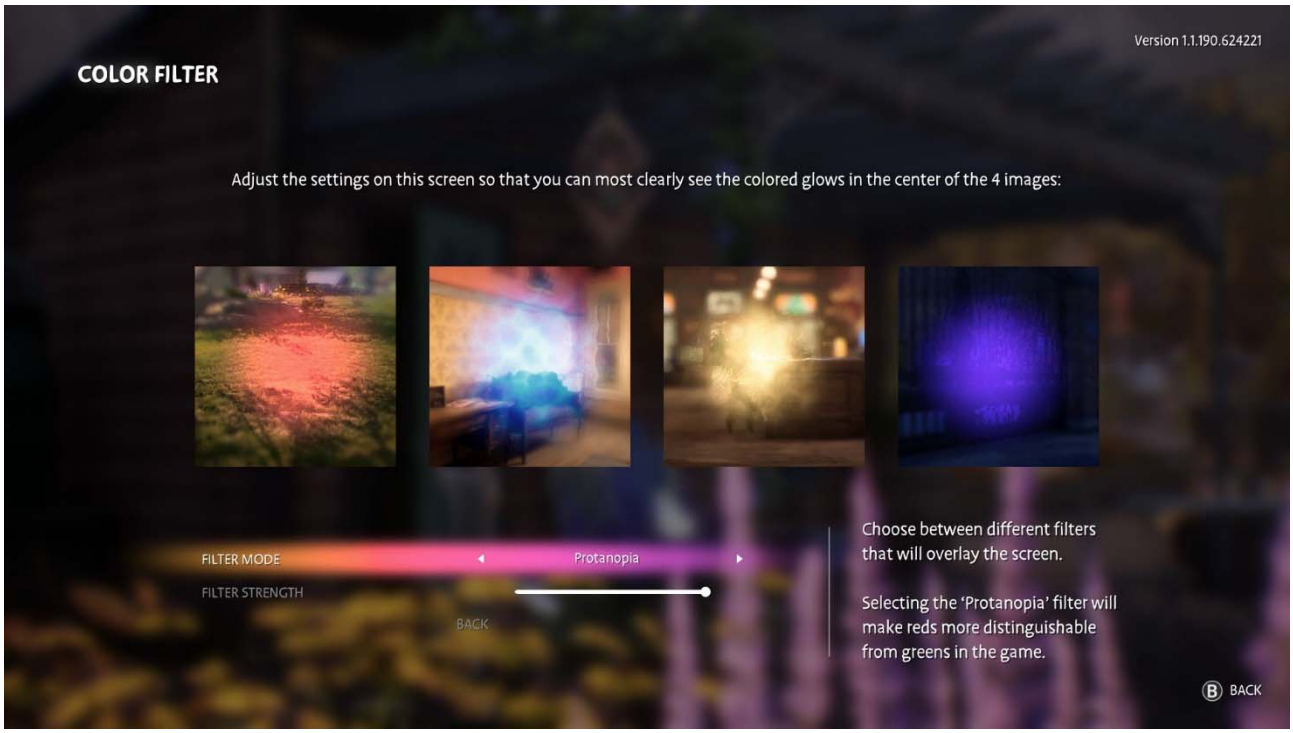
- Colour Spectrum.

Alex Chen, the protagonist, can see, hear, and experience the strong emotions of others as if they are her own - a psychic supernatural power. This power manifests in coloured auras around Non-Player Characters (NPCs), being able to judge a character's emotional state before diving in deeper to reveal their innermost secrets. The game's four emotional auras - blue for sadness, red for anger, purple for fear, and gold for joy. The game has a suite of three specific, adjustable filters to support players with Colour Vision Deficiency (CVD).



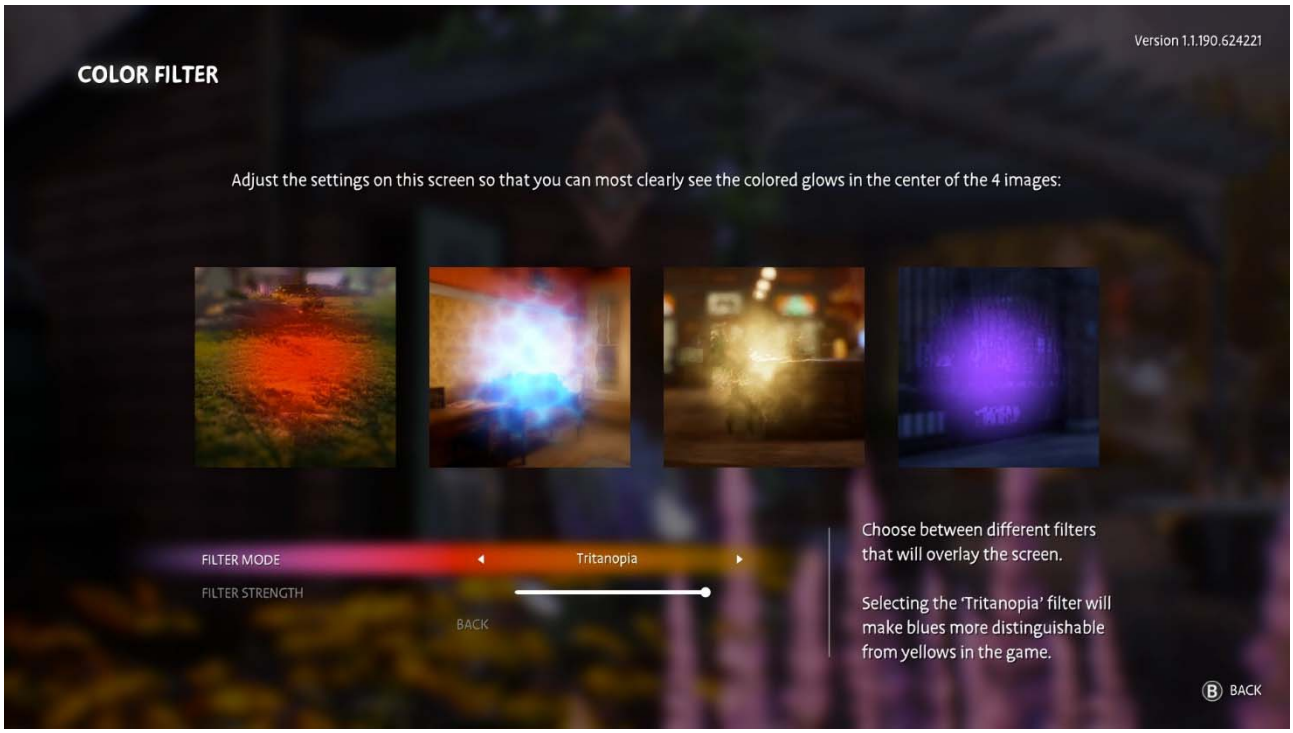
NOTE: A filter to make greens more distinguishable from reds.

Figure 2: Deuteranopia



NOTE: A filter to make reds more distinguishable from greens.

Figure 3: Protanopia



NOTE: A filter to make blues more distinguishable from yellows.

Figure 4: Tritanopia

8.4 Cognitive

The Last of Us Part II [i.29]

The Last of Us Part II is a 2020 action-adventure game developed by Naughty Dog and published by Sony Interactive Entertainment for the PlayStation 4.

Combat Accessibility (see table 1).

Players, have a number of options that can significantly alter the gameplay experience. For instance, the Invisible While Prone feature allows them to experience stealth gameplay that might otherwise be inaccessible. If they have difficulty aiming, they can give themself more time by enabling Slow Motion while aiming. The goal is to provide the player with all the tools they need to make the combat experience enjoyable and challenging.

Table 1: Combat Accessibility

Setting	Options	Description
Enable Combat Accessibility	On or Off	Enables the combat accessibility settings. These settings are designed to make combat accessible for all players. As such, they can significantly alter the gameplay experience.
Hostages Don't Escape	On or Off	Enemies grabbed by the player will not break free while struggling.
Allies Don't Get Grabbed	On or Off	Allies will automatically escape when grabbed by enemies. This setting will not apply during certain combat encounters.
Enemies Don't Flank	On or Off	Enemies will not intentionally try to get behind the player position.
Reduced Enemy Perception	On or Off	Reduce enemy perception in stealth. This setting is relative to the chosen difficulty.
Reduced Enemy Accuracy	On or Off	Reduce enemy accuracy when shooting. This setting is relative to the chosen difficulty.
Enhanced Dodge	On or Off	Dodge with |L1| is better at evading enemy attacks.
Invisible While Prone	Off, Limited, Unlimited	Players are invisible to enemies while prone and not aiming. This setting is disabled during certain encounters where stealth is not an option. If set to **LIMITED**, the time limit will be based on the stealth difficulty settings.
Weapon Sway	On or Off	Enables camera sway while aiming weapons.
Slow Motion	Off, While Aiming, Toggle	Reduces game speed when enabled. When set to **TOGGLE** use |touchpad-swipe-right| to toggle slow motion.

Heads Up Display (HUD) (see table 2)

If a player is deaf, hard-of-hearing, or need to play at low or no volume, they may not be able to access gameplay information that is only represented through audio. To address this discrepancy, by providing several options to display this information visually instead. Awareness Indicators allow the player to determine when they are being spotted in stealth; they also can be set to persist during combat, pointing in the direction of high-threat enemies.

Table 2: HUD

Setting	Options	Description
Damage Indicators	On or Off	Enables HUD spikes in the direction damage was taken.
Awareness Indicators	Off, Stealth, Always	Enables HUD element warning you when enemies are about to spot you and from which direction. **STEALTH**: Awareness indicators display until you are spotted. **ALWAYS**: Awareness indicators persist during combat. This setting is recommended for players who are deaf or hard of hearing. (Available with Patch 1.01*)
Hints	Off, Sometimes, Frequent	Enables gameplay hints that appear when you're lost in an area for some time. Hints are activated by pressing |L3|.
Pick-Up Notifications	On or Off	Displays a HUD notification when you pick up ammo, crafting ingredients, or other resources
Dodge Prompts	Off, Sometimes, Frequent	Adjust the frequency of the |L1| dodge tutorial prompt that appears when enemies begin a melee attack.

- Game Difficulty (see table 3).

The player can customize specific aspects of difficulty to their needs or desired experience. They can individually tweak difficulty settings related to incoming damage, enemy and ally effectiveness, stealth, and resources.

Table 3: Game Difficulty

Setting	Options	Description
Challenge	Very Light, Light, Moderate, Hard, Survivor, Custom	Adjust the overall difficulty of the game
Player	Very Light, Light, Moderate, Hard, Survivor	Adjusts difficulty settings related to:• Amount of damage the player takes from enemies• Frequency of mid-encounter dynamic checkpoints
Enemies	Very Light, Light, Moderate, Hard, Survivor	Adjusts difficulty settings related to:• Accuracy of enemy gunfire and frequency of projectiles• Aggression of enemies advancing and flanking• Complexity of enemy melee combos• Movement speed of certain high-threat enemies• Custom tuning to specific combat encounters
Allies	Very Light, Light, Moderate, Hard, Survivor	Adjusts difficulty settings related to:• Aggressiveness of allies in combat• Frequency at which allies kill enemies
Stealth	Very Light, Light, Moderate, Hard, Survivor	Adjusts difficulty settings related to:• Enemy's perception through vision, hearing, and smell• Length of grace period before enemies will alert others• Conditions for grabbing enemies from stealth
Resources	Very Light, Light, Moderate, Hard, Survivor	Adjusts difficulty settings related to:• Quantity of ammunition and supplies found in the world• Durability of melee weapons dropped by enemies• Yield of certain crafting recipes

8.5 Motor Control/Physical

Hellblade: Senua's Sacrifice [i.30]

Hellblade: Senua's Sacrifice is a 2017 action-adventure game developed and published by the British video game development studio Ninja Theory.

Gameplay

NOTE 1: Accessibility options available on launch within the first-boot options menu.

NOTE 2: Adjustable combat difficulty between dynamically adjusted 'Auto' mode, or manually selected 'Easy', 'Medium', or 'Hard' modes.

NOTE 3: Game can be paused both during gameplay and cinematics.

- Input

NOTE 4: Player Controlled Input.

- Adjustable input sensitivity for controller joystick and mouse axes, and ability to invert camera axis.
- Input remapping for keyboard keys and controller buttons (camera control and menu navigation keys excluded).
- Full keyboard support allowing the game to be entirely played with a keyboard (arrow keys replace mouse/right stick movement).
- Controller vibration can be set to On or Off.
- Running modifier can be set to be activated on key/button Toggle or Hold.

9 Conclusion and Recommendations

9.1 Recommendations

The recommendation of the present document is that for now there is no need for an SDO, such as ETSI, to produce a standard (EN) in the area of accessibility and useability of video games. Though there is near future potential for some limited work if wanted. Firstly, an update or the next revisions to EN 301 549 [i.11] 'Accessibility requirements for ICT products and services' to add examples that include video games and additional to text that states these requirements can be applied to video games. Secondly if there is support with an SDO, such as ETSI, they could produce an informative guide based off the EN 301 549 [i.11] for example that can be applied directly to video games without mandating requirements. Also, it is worth noting there is no mandate for standardization of accessibility and usability within video games. This does not mean though that industry as whole is not taking steps and measures itself to improve accessibility and usability with video games.

The video game industry is itself taking steps and actions to improve accessibly and useability in video games. Advocacy groups, such as 'AbleGamers', 'Game accessibility guidelines', 'International Game Developers Association (IGDA)', 'the ablegamers charity' and 'Can I Play That', continue to provide support, guidance, and critiques to improve accessibility in video games. There is also a video game developer and industry trend to partner or consult with these advocacy groups to implement and improve the accessibility methods within their video game production. The industry body that represents video game developers and publishers the 'Entertainment Software Association' (ESA) has moved to start up an effort to create a taxonomy of game accessibility settings and needs. Though it could take a year or two before this is widely adapted. Overall, the situation of improving accessibility and usability within videos games is already in a positive trend therefore unless this changes the motivation or necessity for a mandated standard is low.

9.2 Conclusion

As stated at the beginning of the present document while there are no existing common standards for the design and implementation for accessibility and usability in video games at the moment with no push for mandated harmonized standards there is no reason for an SDO, such as ETSI, to get involved in this area currently but this may change in the future. Though already positive steps and actions are being taken by advocacy groups to produce guidance on accessibility and useability within video games. The video game industry itself are improving though with varying levels of implantation within each individual video game itself are already addressing the challenges in ensuring accessibility and useability within video games.

Annex A:
Change History

Date	Version	Information about changes
01/2022	0.0.0.1	First draft. Proposed content, layout and some included text.
03/2022	0.0.0.2	Second draft. Incorporated comments and new text/content. Change of title.
05/2022	0.0.0.3	Third draft. Incorporated comments from the USER group. Content added to clause 5.
06/2022	0.0.0.4	Fourth draft. Additional comment from the USER group incorporated. Minor additional text and content added under hearing.
06/2022	0.0.0.5	Comment from the HF group incorporated.
07/2022	0.0.0.6	Content added to clause 7 'gap analysis'. Additional editorial changes and text throughout the document.
07/2022	0.0.0.7	Comments from ETSI TC HF resolved.
08/2022	0.0.0.8	Text for Gap analysis and Use cases added.
10/2022	0.0.0.9	Editorial changes to tidy up text and content added to clauses 9.1 & 9.2.
04/2023	1.1.1	First published version.

History

Document history		
V1.1.1	April 2023	Publication